1. **Explain Software with its characteristics**

Ans: Software is a collection of programs, data, and documentation that perform specific tasks on a computer system. It enables users to interact with hardware and perform desired functions. Computer software is the product that software professionals build and then support over the long term. It also includes a set of documents, such as the software manual, meant for users to understand the software system. Today's software comprises the source code, Executable, Design Documents, Operations and System Manuals and installation and Implementation Manuals.

Characteristics of Software:

1. Software is Developed or Engineered, Software is not manufactured:

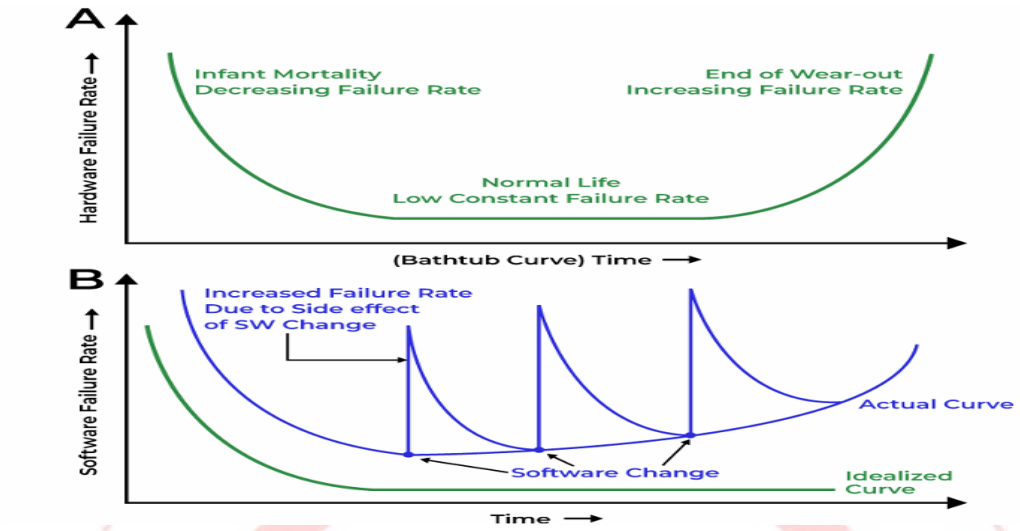
It is developed through design and coding. The two activities (software development and hardware manufacturing) are fundamentally different. In both activities, high quality is achieved through good design, but the manufacturing phase for hardware can introduce quality problems.

2. Software doesn't "wear out" like hardware and it is not degradable over a period.

The following figure depicts failure rate as a function of time for hardware. The relationship often called the "bathtub curve", indicates that hardware exhibits relatively high failure rates early in its life. The failure rate curve for software should take the form of an "idealized curve" as shown in the above figure. Undiscovered defects will cause high failure rates early in the life of a program. However, these are corrected and the curve flattens as shown. Hence the software doesn't wear out, but it does deteriorate.

3. Most of the Software are Custom-built or generic rather than assembled from existing components:

Software can be tailored or commercially available. Although the industry is moving toward component – based construction, most software continues to be custom built. A software component should be designed and implemented so that it can be reused in many different programs

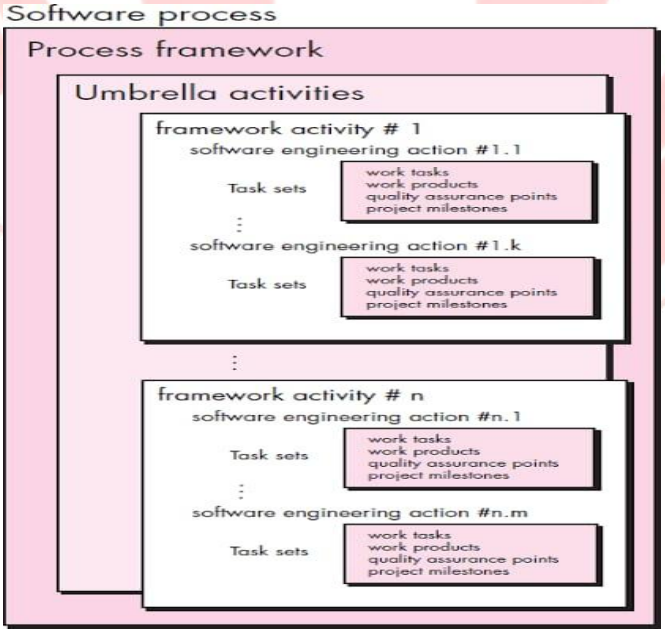


Other Characteristics are:

4. Complex: Often contains millions of lines of code.
5. Easy to modify: Can be updated with new features or bug fixes.
6. Intangible

2. Describe Generic Process Framework activities and Umbrella activities.

Ans: These are the core activities that are part of almost every software development process, regardless of the development model (Waterfall, Agile, Spiral, etc.).



Communication

● Involves interacting with stakeholders to understand the requirements.

● Includes activities like requirement gathering, meetings, and interviews.

Planning

● Defines a roadmap for the project.

● Includes estimating time, cost, resources, and setting milestones.

Modeling

● Focuses on designing the architecture and system structure.

● Includes data modeling, process modeling, interface design, etc.

Construction

● Involves actual coding and testing of the software.

● Focuses on writing source code, unit testing, integration testing, etc.

Deployment

● Involves delivering the final product to the end-user.

● May include installation, user training, and feedback collection.

● Updates and patches are handled during post-deployment maintenance.

Umbrella Activities

Umbrella Activities in Software Engineering Umbrella activities are supportive tasks that occur throughout the software development life cycle (SDLC). They ensure that the core development activities are well-managed and high in quality.

✓1. Software Project Tracking and Control

● Monitors project progress to ensure it's on time and within budget.

● Helps take corrective actions if deviations occur.

✓2. Risk Management

● Identifies, analyzes, and prepares for potential risks that could impact the project.

● Plans strategies to reduce or avoid risks.

✓3. Software Quality Assurance (SQA)

● Ensures the software meets the defined quality standards.

● Includes activities like audits, reviews, and testing.

✓4. Formal Technical Reviews (FTRs)

● Structured reviews of software artifacts (design, code, documents)

Helps in early error detection and correction.

✓5. Measurement and Metrics

● Collects quantitative data to assess process and product quality.

● Used for improvement, estimation, and evaluation.

✓6. Software Configuration Management (SCM)

● Manages changes in software versions and components.

● Maintains integrity and traceability of project artifacts.

✓7. Reusability Management

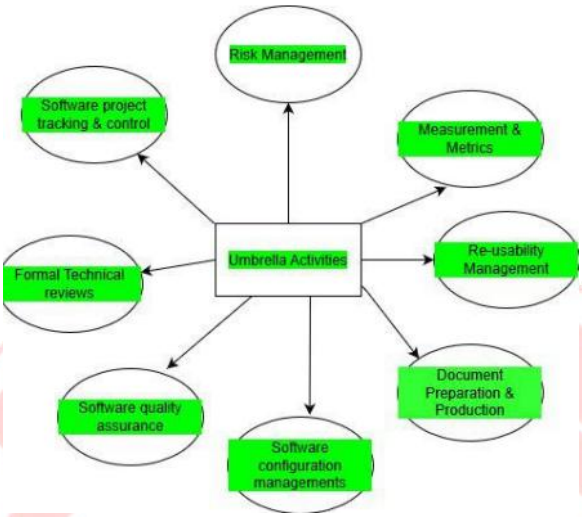
● Identifies and promotes reuse of existing software components.

● Saves time and improves reliability.

✓8. Documentation

● Ensures proper recording of all development activities, plans, and decisions

● Helps in maintenance, training, and future development.



3. **Describe the types and categories of software.**

Ans: 1. System Software: It is a collection of programs written to service other programs. Some system software (e.g., compilers, editors, and file management utilities) processes complex, but determinate, information structures. Other systems applications (e.g., operating system components, drivers, networking software, telecommunications processors) process largely indeterminate data.

2. Application Software: Stand-alone programs that solve a specific business need. Applications in this area process business or technical data in a way that facilitates business operations or management/technical decision making

3. Programming Software: Used by developers to write code. Examples: Compilers, editors, debuggers.

4. Embedded Software: Embedded software can perform limited functions (e.g., key pad control for a microwave oven) or provide significant function and control capability (e.g., digital functions in an automobile such as fuel control, dashboard displays, and braking systems). Used in embedded systems (non-PC devices). Examples: Software in washing machines, traffic lights.

5. Web-based Software: In their simplest form, WebApps can be little more than a set of linked hypertext files that present information using text and limited graphics. Runs on web browsers and accessed via the internet. Examples: Gmail, Google Docs.

6. AI Software: Designed to simulate intelligence. Examples: Chatbots, recommendation systems.

7. Engineering/scientific software: Applications range from astronomy to volcanology, from automotive stress analysis to space shuttle orbital dynamics, and from molecular biology to automated manufacturing Example: CAD software

8. Product-line software: Designed to provide a specific capability for use by many different customers. Product-line software can focus on a limited marketplace (e.g., inventory control products) or address mass consumer markets (e.g., word processing, spreadsheets, database management).

4. Explain Software Engineering as a layered approach.

Ans: Software Engineering as a Layered Approach

1. Quality Focus (Base Layer)

This is the foundation of all software engineering activities.

- It ensures the final product meets customer requirements and performs reliably.
- Quality is maintained through activities like quality assurance (QA), reviews, and testing.
- Without this layer, all other efforts may lead to unreliable or unsatisfactory software.
- Total quality management, six sigma and similar philosophies foster a continuous process improvement culture.
- The bedrock that supports software engineering is a quality focus. 2 Process Layer
- This layer defines the framework for managing and controlling the software development process.
- It provides a structured approach using Software Development Life Cycle (SDLC) models like Waterfall, Agile, Spiral, etc.
- Ensures planning, monitoring, and evaluation of all phases in software development.
- The software process forms the basis for management of software projects.

3 Methods Layer

This layer includes the technical methods used to build software.

- Covers requirement analysis, system design, coding, testing, and maintenance.
- Methods guide how software is developed technically to ensure correctness and efficiency.

4 Tools Layer

This is the topmost layer, consisting of automated tools that support the methods and processes.

- Tools improve productivity, accuracy, and efficiency.
- Examples include IDEs (like VS Code), testing tools (like Selenium), version control systems (like Git).

5. Explain the Core Principles of Software Engineering.

Ans: These principles are fundamental guidelines to help engineers build software that is reliable, efficient, maintainable, and user-focused

- ❖ The Reason It All Exists
  - Always focus on adding value to the customer or end-user.
  - Software is created to solve a problem or meet a specific need.
- ❖ KISS (Keep It Simple, Stupid) .
  - Simple solutions are often better and easier to maintain.
  - Avoid unnecessary features and complexity
- ❖ Maintain the Vision
  - Keep a clear goal throughout development.
  - Ensure every team member understands the core purpose of the product.
- ❖ What You Produce, Others Will Consume
  - Write clear code and documentation that others (like future developers or testers) can understand and use.
- ❖ Be Open to the Future
  - Design software to be scalable and adaptable, so it can evolve over time without major rewrites
- ❖ Plan Ahead for Reuse

- Create modular, well-documented components that can be reused in other projects or systems.

❖ Think!

- Always think before you code. Analyze the problem, assess solutions, and anticipate challenges

6. Explain Software Engineering practices.

Ans: Involves the continuous exchange of accurate and complete information between stakeholders (clients, users, developers, testers).

i) Communication Principle

1. Listen: Try to focus on the speaker's words. Ask for clarification if something is unclear, but avoid constant interruptions.
2. Prepare before you communicate: Speed the time to understand the problem before you meet with others. If necessary, do some research to understand business domain jargon.
3. Someone should facilitate the activity: Every communication meeting should have a leader to keep the conversation moving in a productive direction.
4. Face-to-Face communication is best: It usually works better when some other representation of the relevant information is present. For eg. A participant may create a document that serves as a focus for discussion.
5. Take notes and document decisions: Someone participating in the communication should serve as a “recorder” and write down all important points and decisions.
6. Strive for collaboration: Each small collaboration serves to build trust among team members and creates a common goal for the team.
7. Stay focused; modularize your discussion: The facilitator should keep the conversation modular; leaving one topic only after it has been resolved.
8. If something is unclear, draw a picture: A sketch or drawing can often provide clarity when words fail to do the job.
9. A) Once you agree to something, move on. B) If you can’t agree to something, move on C) If a feature or function is unclear and cannot be clarified at the moment, move on.
10. Negotiation is not a contest or a game. It works best when both parties win.

ii) Planning Principle

1. Understand the scope of the project: It's impossible to use a road map if you don't know where you are going. Scope provides the software team with a destination.
2. Involve stakeholders in the planning activity: Stakeholders define priorities and establish project constraints.
3. Recognize that the planning is iterative: When the project work begins it's likely that few things may change. To accommodate these changes the plan must be adjusted, as a consequence.
4. Estimate based on what you know: The purpose of estimation is to provide an indication of the efforts, cost, and task duration. If the information is vague or unreliable, estimates will be equally unreliable.
5. Consider the risk as you define the plan: The team should define the risks of high impact and high probability. It should also provide a contingency plan.
6. Be realistic: The realistic plan helps in completing the project on time including the inefficiencies and change.
7. Adjust granularity as you define the plan: Granularity refers to the level of details that is introduced as a project plan is developed.
8. Define how you intend to ensure quality: The plan should identify how the software team intends to ensure quality.
9. Describe how you intend to accommodate change: Even the best planning can be obviated by uncontrolled change.
10. Track and monitor the plan frequently and make adjustments if required: Software projects fall behind schedule one day at a time.

iii) Modeling Principle

Analysis Modelling Principles:

1. The information domain of a problem must be represented and understood.
2. The functions that the software performs must be defined.
3. The behavior of the software (as a consequence of external events) must be represented.
4. The models that depict information function and behavior must be partitioned in a manner that uncovers detail in a layered fashion.

5. The analysis task should move from essential information toward implementation detail.

iv) Construction Principle

Preparation Principles:

1. Understand of the problem you're trying to solve.
2. Understand basic design principles and concepts.
3. Pick a programming language that meets the needs of the software to be built and the environment in which it will operate.
4. Select a programming environment that provides tools that will make your work easier.
5. Create a set of unit tests that will be applied once the component you code is completed.

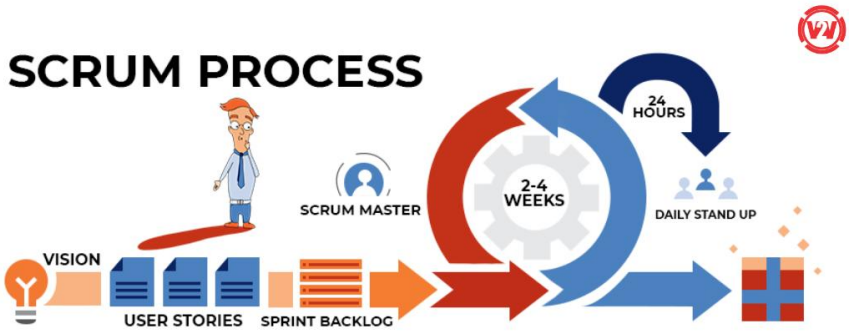
v) Deployment Principle

1. Customer expectations for the software must be managed.
2. A complete delivery package should be assembled and tested.
3. A support regime must be established before the software is delivered.
4. Appropriate instructional materials must be provided to end users.
5. Buggy software should be fixed first, delivered later.

8.Explain Scrum, XP (Extreme Programming), Agile Model, and Spiral Model , DSDM , ASD , AUP

Ans:

i)Scrum



Scrum is an Agile framework that organizes development in short iterations (called sprints), typically lasting 1–4 weeks. The team works collaboratively to complete selected features during each sprint.

☑ Key Roles in Scrum:

- Product Owner: Represents the customer, defines product backlog
- Scrum Master: Facilitates the process, removes blockers
- Development Team: Self-organizing team that delivers the product

☑ Key Elements

- Product Backlog: List of features or requirements
- Sprint Backlog: Tasks to be completed in a sprint
- Sprint Planning: Decide what to deliver in the sprint
- Daily Stand-up (Daily Scrum) : 15-minute daily progress meeting
- Sprint Review & Retrospective: Evaluate work and process after each sprint

☑ Advantages of Scrum:

- Faster and incremental delivery of features.
- Encourages continuous feedback and improvement.
- Quick identification and resolution of problems through daily stand-ups.
- Promotes transparency and accountability within the team.

✖ Disadvantages of Scrum:

- Not suitable for uncooperative teams
- Scope creep can occur if backlog is not managed well
- Requires experienced team for best results

Applications:

- Web and mobile app development
- Product-based companies with regular releases
- Projects requiring frequent updates or customer involvement

ii)Extreme Programming(XP)

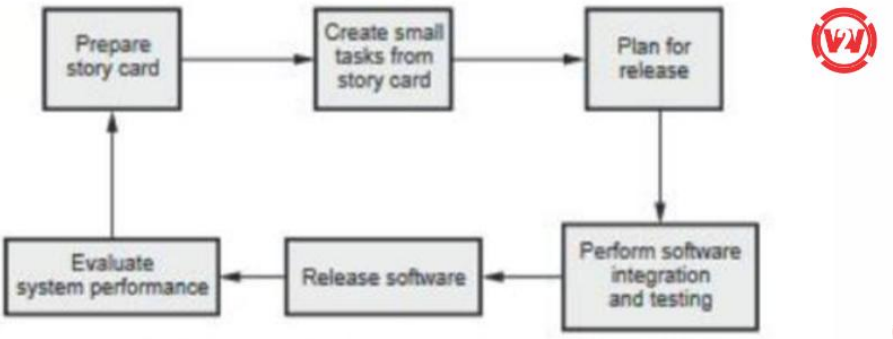


Fig. 1.8.1 Extreme programming release cycle

Definition: XP is an Agile method focused on improving software quality and responsiveness to customer requirements using frequent releases and technical practices. Prioritizes code simplicity, communication, and continuous improvement.

Practices include Test-Driven Development (TDD), Pair Programming, Continuous Integration, and Refactoring.

☑ Core Practices of XP:

- Pair Programming – Two developers code together on the same computer
- Test-Driven Development (TDD) – Write tests before coding
- Continuous Integration – Code is integrated and tested frequently
- Refactoring – Regular code improvement
- Small Releases – Deliver functional software often
- Simple Design – Avoid unnecessary complexity

☑ Advantages of XP:

- High-quality code due to frequent testing and continuous integration.
- Enables fast and flexible responses to changing requirements.
- Promotes strong team communication through pair programming and stand-ups.
- Frequent releases keep customers engaged and informed.

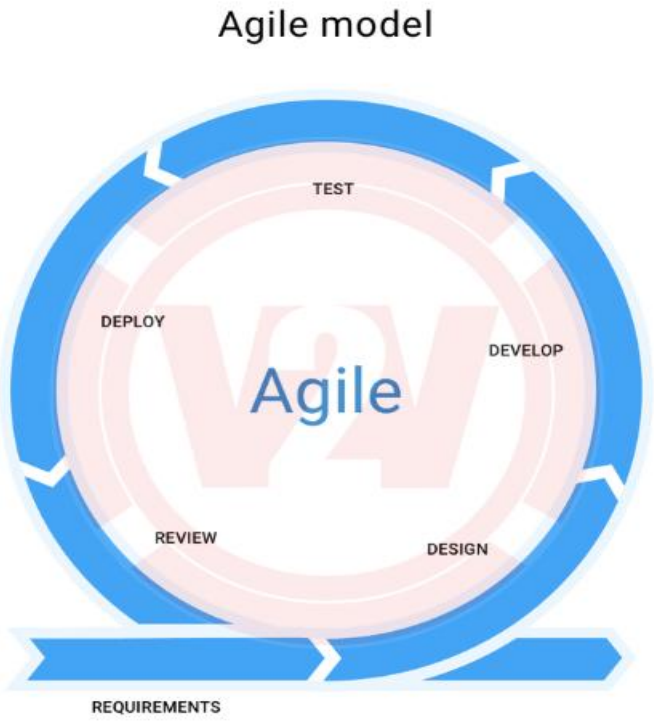
❌ Disadvantages of XP:

- Requires high discipline and skilled developers
- Continuous feedback may be overwhelming
- Not ideal for very large teams or long-term planning

Applications:

- Small to medium-sized software projects
- Real-time and evolving applications
- Startups needing quick MVP (Minimum Viable Product)

iii)Agile Model



Agile is a flexible, iterative, and collaborative software development methodology. Agile is a lightweight and iterative software development methodology focused on flexibility, customer collaboration, frequent delivery, and responding to change. Instead of a rigid plan, Agile encourages continuous improvement, short development cycles (sprints), and early delivery. Divides work into small units called iterations or sprints (typically 1–4 weeks).Continuous planning, testing, and integration.

☑ 2. Core Principles of Agile (Based on Agile Manifesto)

- Individuals and interactions over processes and tools
- Working software over comprehensive documentation
- Customer collaboration over contract negotiation
- Responding to change over following a plan

☑ 3. Importance of Agile

- Fast Delivery: Delivers usable software early and frequently.
- Customer Satisfaction: Involves customer feedback at every stage.
- Flexibility: Easily adapts to changing requirements.
- Improved Quality: Regular testing during each iteration.
- Better Team Collaboration: Promotes face-to-face communication and teamwork.
- Risk Reduction: Problems are identified early, reducing the risk of failure.

☑ 4. Agile Process – Key Activities

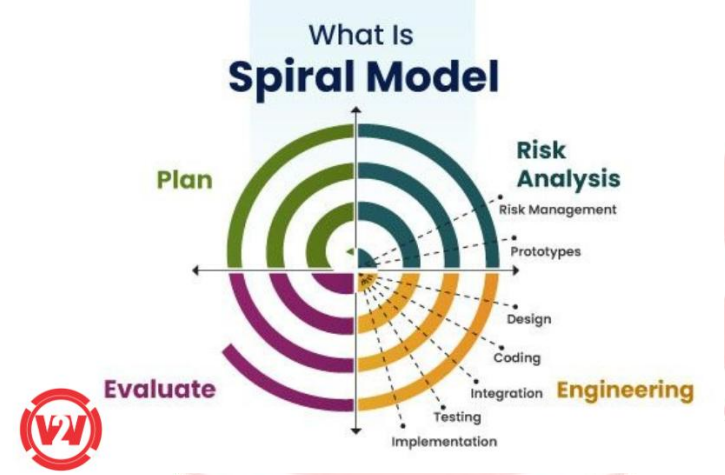
1. Requirement gathering in the form of user stories

2. Planning for short time-boxed iterations (called sprints)

3. Design and Development in cycles (each sprint produces working software)

4. Testing and Review after each sprint 5. Retrospective to reflect and improve in the next iteration

iv)Spiral Model



Definition: The Spiral Model combines features of Waterfall and Prototyping, focusing on risk analysis. It involves repeated cycles (spirals), each with planning, risk analysis, development, and evaluation. Excellent for large, complex, high-risk projects. Allows changes at any stage. More costly and complex to manage.

Advantages:

- Focuses on risk analysis and mitigation at every phase.

- Supports flexible and iterative development.
- Well-suited for large, high-risk, and complex projects.

Disadvantages:

- Allows progressive refinement of requirements.
- Complex to manage and implement
- Expensive for small projects
- Requires expertise in risk assessment

Applications:

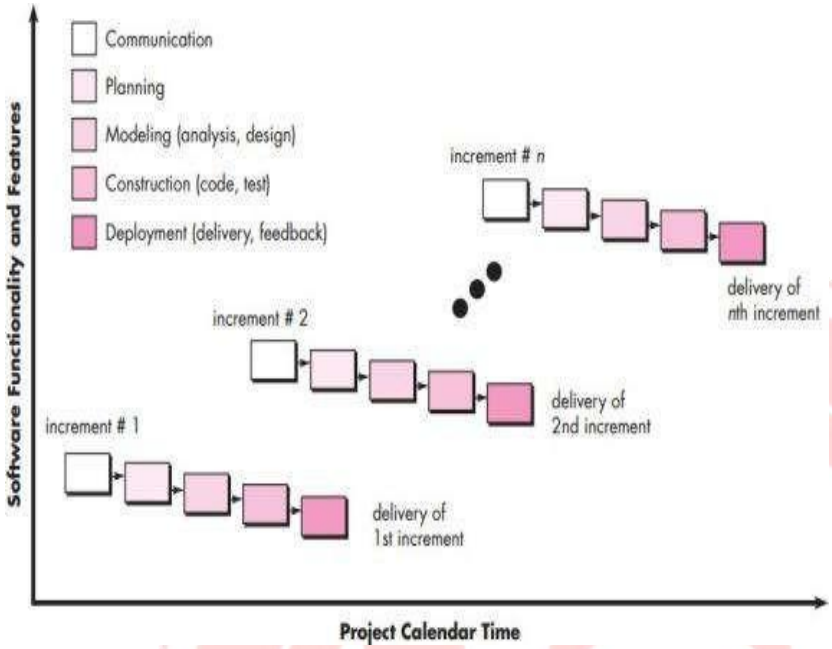
- Aerospace, military, and safety-critical software
- Long-term or high-budget systems
- R&D projects

v) Incremental Model

Definition: The Incremental Model develops software in **small, manageable parts (increments)**. Each increment adds functionality until the final product is complete.Easier to test and debug.Early delivery of partial functionality.Each increment includes design, coding, and testing.Useful when requirements are well understood, but may evolve.

Helps reduce risk by identifying issues early

.



Advantages:

- Early partial product delivery — some features are usable early in the process.
- Easier testing and debugging — smaller pieces of code are tested incrementally.
- Flexible to changes — easier to adapt based on feedback from earlier increments.
- Lower initial delivery cost — functionality is delivered

Disadvantages:

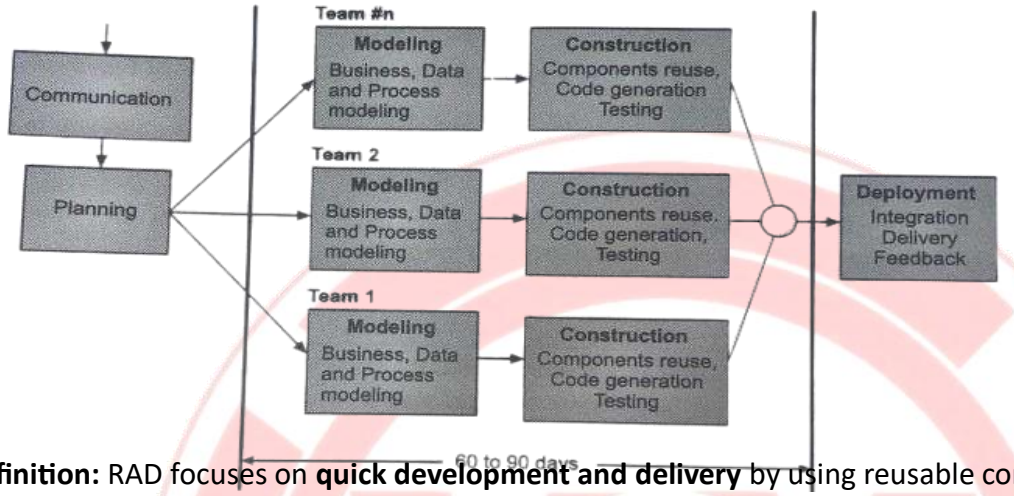
- Requires proper planning and design
- Integration can become complex

  May not be suitable for large systems with tight deadlines

Applications:

- Web applications

vi. RAD Model (Rapid Application Development)



Definition: RAD focuses on **quick development and delivery** by using reusable components, prototyping, and minimal planning. It emphasizes **rapid iterations with user feedback**.Very fast development using reusable components.Requires active user involvement.Best for small to medium-sized projects

Advantages:

- Faster development due to component reuse and parallel tasks.
- Customer involvement is high with constant feedback and review.
- Prototyping helps refine requirements early in the project.
- Highly flexible to changing requirements.

Disadvantages:

- Not suitable for large-scale or complex systems

- Requires skilled developers and designers
- Poor documentation due to rapid pace

Applications:

- Short-term projects
- Mobile apps, internal tools
- UI/UX-heavy applications needing quick changes

9. Explain the Selection Criteria for Software Process Model

Ans. Selection Criteria for Software Process Model

· **Definition:** The selection of a **software process model** depends on the **nature of the project**, **requirements**, and **organizational goals**. Choosing the right model helps ensure **efficient development**, **reduced cost**, and **timely delivery**.

· *Key Selection Criteria:*

· **1. Project Size and Complexity**

- **Small & simple projects** → Waterfall or Incremental model
- **Large & complex projects** → Spiral or Agile models

· *2. Clarity of Requirements*

- **Clearly defined and stable** → Waterfall model
- **Unclear or evolving** → Prototyping or Agil

· *3. Time to Market / Delivery Speed*

- **Short timelines / fast delivery needed** → RAD, Agile
- **More time available** → Waterfall, Spiral

· *4. Customer Involvement*

- **Continuous involvement possible** → Agile, Scrum, XP
- **Minimal involvement** → Waterfall or Incremental

· *5. Risk Management*

- **High-risk projects** → Spiral model (strong risk assessment)
- **Low risk** → Incremental or Waterfall

· *6. Team Size and Skill Level*

- **Small, skilled team** → XP, Agile
- **Large or varied skill level** → Waterfall or Incremental

· *7. Budget Constraints*

- **Tight budgets** → Incremental, Agile (faster feedback, less rework)
- **Flexible budget** → Spiral (more planning and evaluation)

· *8. Flexibility to Changes*

- **Highly dynamic requirements** → Agile, Prototyping
- **Fixed, stable requirements** → Waterfall

· *9. Need for Rapid Prototyping or UI Focus*

- If the project requires **user interface testing** or frequent feedback, use the *Prototyping model or RAD model.*

10. Define Requirement Engineering with its task

Ans: Requirement Engineering is the process of gathering, analyzing, documenting, and validating the needs and constraints of the stakeholders for a software system.

Its goal is to ensure that the software meets user expectations and business needs.

From a software process perspective, requirements engineering is a major software engineering action that begins during the communication activity and continues into the modeling activity. It must be adapted to the needs of the process, the project, the product, and the people doing the work.

Main Tasks of Requirement Engineering:

1. **Requirement Elicitation**
    - Involves gathering requirements from stakeholders, users, customers, and other sources.
    - Techniques: Interviews, questionnaires, brainstorming, observation, document analysis.
2. **Requirement Analysis**
    - Examines and refines the gathered requirements to remove conflicts, inconsistencies, and ambiguities.
    - Ensures that requirements are clear, complete, and feasible.
3. **Requirement Specification**
    - Documents the analyzed requirements in a clear and structured format (usually in a **Software Requirement Specification - SRS** document).
    - This becomes the official agreement between developers and clients.
4. **Requirement Validation**
    - Ensures that the documented requirements accurately reflect stakeholder needs.
    - Techniques: Reviews, inspections, prototypes, and test cases.

Mob No : 9326050669 / 9372072139 | Youtube : @v2vedtechllp|

5. **Requirement Management**
    - Handles changes in requirements throughout the software development lifecycle.
    - Involves tracking, version control, and impact analysis of changing requirements.

11. Describe the different types of requirements

Ans: Types of Requirements Requirements are generally classified into three main types:

A. Functional Requirements

- Define what the system should do.
- Describe system behavior under specific conditions.
- Functional requirements describe the interaction of software with its environment and specify the inputs, outputs, external interfaces and the functions that should be included in the software.
- These requirements should be complete and consistent.
- Completeness implies that all the user requirements are defined.
- Consistency implies that all requirements are specified clearly without any contradictory definition.
- Example: "The system shall allow users to log in using email and password."

B. Non-Functional Requirements

- Define how the system performs tasks (quality attributes).
- Includes performance, usability, reliability, and security.
- These requirements arise due to user requirements, budget constraints, organizational policies, and so on. These requirements are not related directly to any particular function provided by the system.

Different type of Non Functional Requirement

1. Product Requirements:

- Reliability Requirements describe the acceptable failure rate of the software.
- Usability Requirements describe the ease with which users are able to operate.
- Efficiency Requirements describe the extent to which the software makes resources, the speed with which the system executes and the memory it consumes for its operation.
- Portability Requirements describe the ease with which the software can be transferred from one platform to another

2. Organizational Requirements:

(a) Implementation Requirements describe requirements such as programming language and design method.

(b) Standards Requirements describe the process standards to be used during software development. For example, ISO and IEEE standards.

(c) Delivery Requirements specify when the software and its documentation are to be delivered to the user.

3. External Requirements:

(a) Interoperability Requirements defines the way in which different computer-based systems interact with each other in one or more organizations.

(b) Legislative Requirements ensures that the software operates within the legal jurisdiction. For example, pirated software should not be sold.

(c) Ethical Requirements specifies the rules and regulations of the software so that they are acceptable to users.

Example: "The system must handle 1000 transactions per second.

4. Domain Requirements

- Specific to the domain or industry of the software.
- Often driven by regulations, standards, or specific rules.
- Example: "A banking system must comply with RBI data security policies."

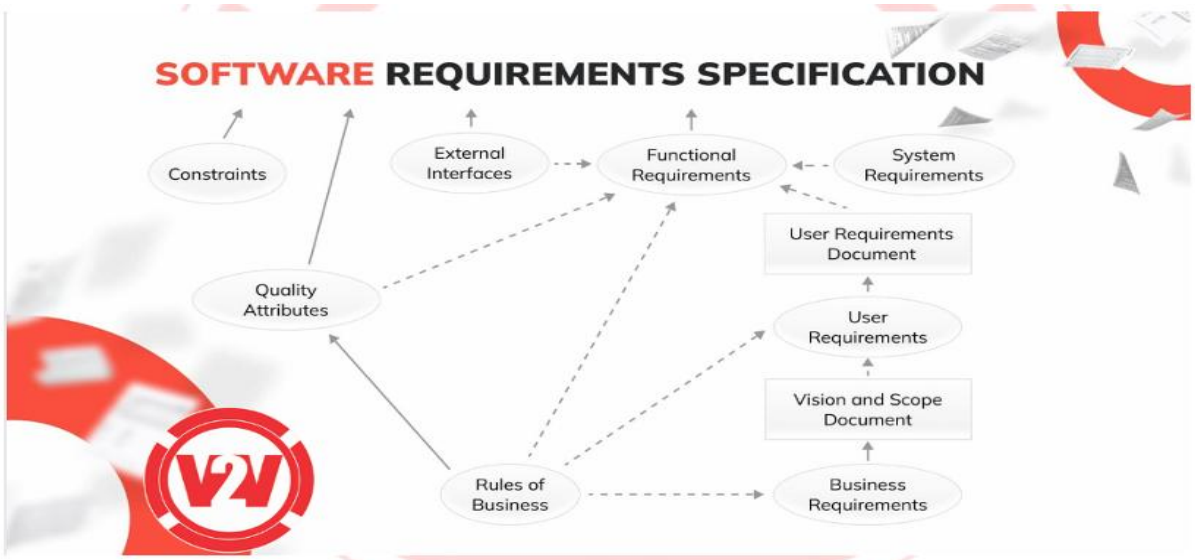
12. Explain Software Requirement Specification (SRS) with its needs and importance.

Ans: - SRS is a formal document that describes the functional and non-functional requirements of the software system to be developed. It acts as an agreement between the customer and the development team. The document completely describes what the proposed software should do without describing how the software will do it.

Need for SRS (Why SRS is Important)

- Clear Communication: It serves as a contract between stakeholders and developers.
- Requirement Clarity: It helps avoid misunderstandings and assumptions.
- Project Planning: It provides the foundation for cost, effort, and time estimation.

- Design & Development Base: It is used by designers and developers to build the system.
- Testing & Validation: Testers use it to create test cases and validate functionality.
- Maintenance Reference: It helps in future enhancements and debugging.



13. Explain format & characteristics of a good SRS.

Ans: An SRS (Software Requirement Specification) is a formal document that clearly describes what the software system should do. It defines the functional and non-functional requirements of the system and acts as a bridge between the client and the development team.

The characteristics of a good SRS are:

- Correctness: It should accurately describe the actual needs of the stakeholders.
- Completeness: It should include all significant requirements.
- Unambiguity: Each requirement should have only one interpretation.
- Consistency: It should contain no conflicting requirements or definitions.
- Verifiability: Each requirement must be testable.
- Modifiability: The document should be easy to update and modify.

- Traceability: Each requirement should be traceable to its source.
- Rank for Importance: Requirements should be prioritized.

Format / Structure of SRS

A standard SRS follows the IEEE 830:1998 format (commonly used in software engineering).

1. Introduction

Describes the basic idea and purpose of the software.
Includes:

- Purpose of the document
- Scope of the system
- Definitions, acronyms, and abbreviations
- References
- Overview of the document

---

2. Overall Description

Gives an overview of the system, its functions, and constraints.
Includes:

- Product perspective (how it fits in environment)
- Product functions (summary of major features)
- User characteristics (who will use it)
- Constraints (hardware, software, legal, etc.)
- Assumptions and dependencies

---

3. Specific Requirements

Contains detailed functional and non-functional requirements.
Includes:

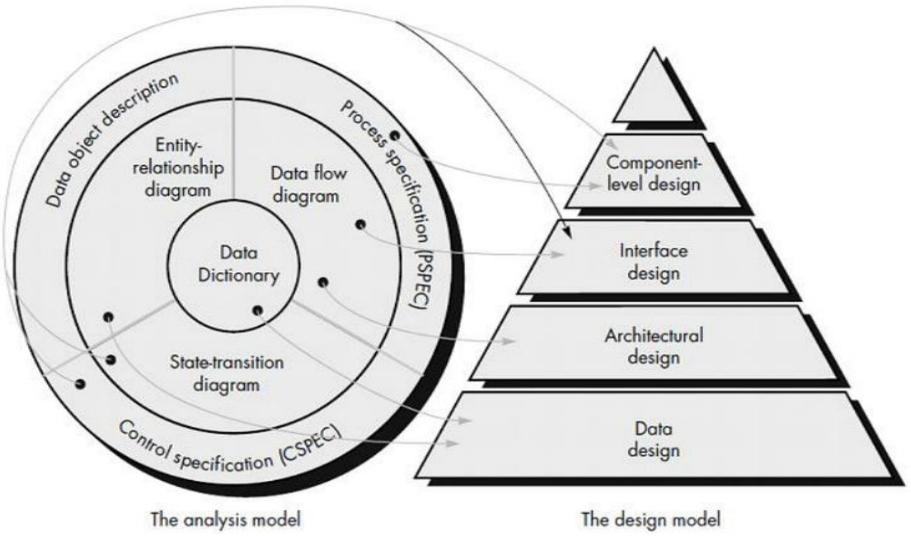
- Functional Requirements: Describe specific behaviors or functions.
  Example: "System shall allow users to log in using email and password."
- Non-functional Requirements: Describe quality attributes.
  Example: "System should respond within 2 seconds."
- Interface Requirements: Define user, hardware, and software interfaces.
- Performance Requirements: Specify speed, accuracy, capacity, etc.
- Security Requirements: Define access control, data protection, etc.

4. Appendices

- Additional information such as diagrams, tables, data dictionaries, and references.

14. Explain the process of translating a Requirement Model into a Design model

Ans: - Translating the requirement model into the design model means converting the "what" (requirements) into the "how" (design). It bridges the gap between user needs (captured in the SRS or use-case model) and the technical solution (architecture and components of the system).



☑ 2. Purpose of Translation

- To structure the software solution based on user requirements
- To ensure the system design meets all functional and non-functional equirements
- To prepare the system for implementation (coding)

☑ 3. Steps in Translating Requirement Model into Design Model

Step 1: Analyze the Requirements

- Review the SRS document, use-cases, and user stories
- Identify key system functions, interactions, and constraints

Step 2: Create the Data Design

- Define data structures and data storage needs
- Use tools like ER Diagrams, Class Diagrams, or Data Dictionaries

Step 3: Develop the Architectural Design

- Decide how the system will be structured
- Identify main components, their responsibilities, and communication
- Output: Architecture Diagram or Component Diagram

Step 4: Design Interfaces

- Design user interfaces (UI) and system interfaces
- Consider input forms, navigation, and user interaction

Step 5: Create Procedural/Component Design

- Define modules, functions, and logic flow
- Describe control flow using Activity Diagrams, Sequence Diagrams, or Flowcharts

Step 6: Verify and Validate the Design

- Ensure the design satisfies all the requirements
- Conduct reviews, walkthroughs, or prototyping

15. What is a Data Flow Diagram (DFD)? Explain DFD Level 0 and DFD Level 1 with their symbols

Ans: A Data Flow Diagram is a graphical representation of the flow of data through a system, showing processes, data stores, external entities, and data flows.

🧱 **Basic Components of DFD:**

Symbol	Element	Purpose
🟦 Rectangle	**External Entity**	Source or destination of data (e.g., user)

Symbol	Element	Purpose
🟢 Circle/Oval	**Process**	A function that transforms data
🗃️ Open rectangle	**Data Store**	Storage of data (e.g., database, file)
➡️ Arrow	**Data Flow**	Direction of data movement

📊 **Levels of DFD:**

Level	Description
Level 0	**Context Diagram** – Shows the system as a single process and all external entities
Level 1	Shows main sub-processes and data flow between them
Level 2+	Further breaks down Level 1 processes into detailed sub-processes

1. DFD Level 0 (Context Diagram)

- Also called the **Context Level DFD**.
- It is the **highest level** in a DFD (topmost view).
- Shows the **entire system as a single process** and its **interaction with external entities**.
- Gives an **overall picture** of the system's boundary and data flow.

Features:

- Only **one process** (representing the whole system).
- **External entities** connected through data flows.
- **No data stores** shown at this level.

Example:

2. DFD Level 1

- **Expands** the single process of Level 0 into **multiple subprocesses**.
- Shows **major functions or modules** within the system.
- Includes **data stores**, which represent where information is held.
- Provides **more detail** about how the system operates internally.

16. Draw DFD diagrams for the following systems:

i) Banking System

ii) Hospital Management System

iii) College Management System

iv) Railway Management

v)Library

Ans:

i) Banking System .

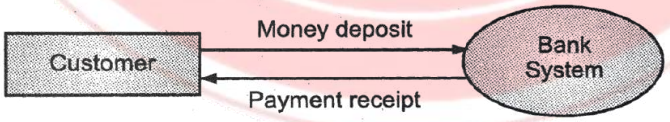


Fig. 2.16: Context Diagram of Bank System

Level 0 DFD

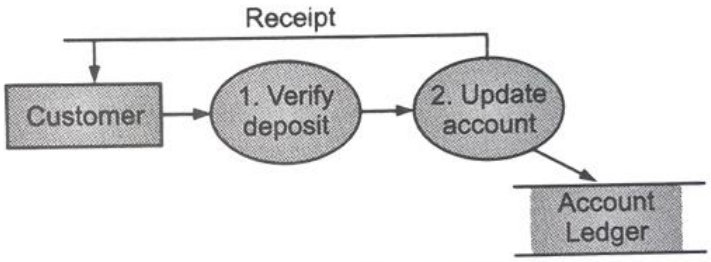
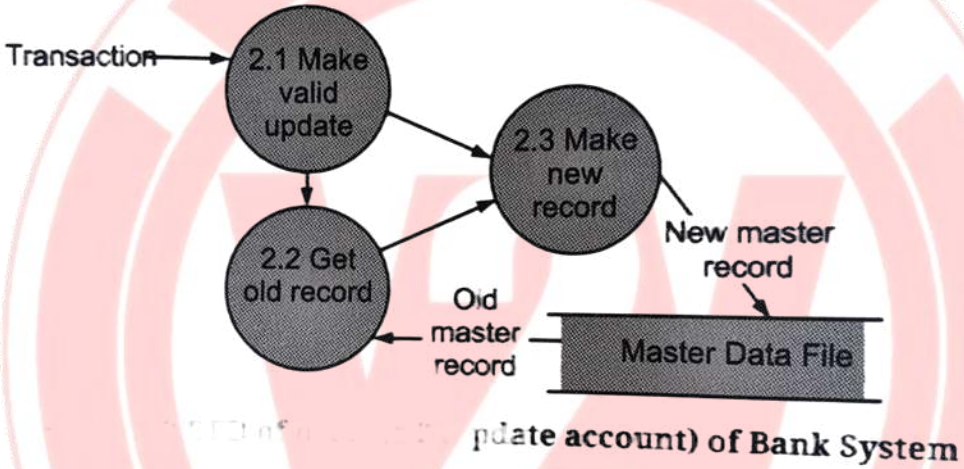


Fig. 2.17: Level 1 DFD of Bank System



pdate account) of Bank System

Level 2 DFD

ii) Hospital Management System

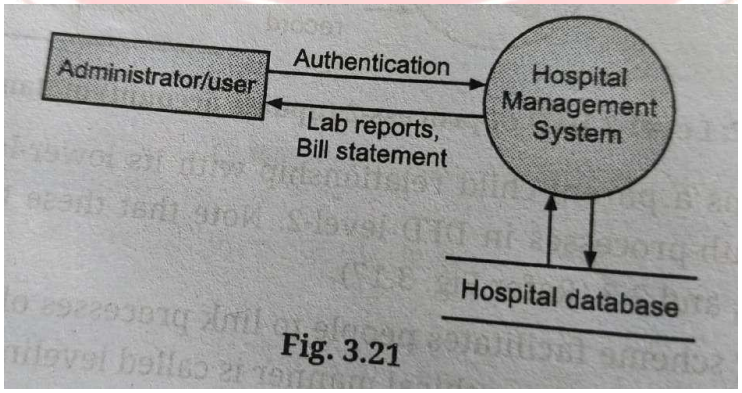


Fig. 3.21

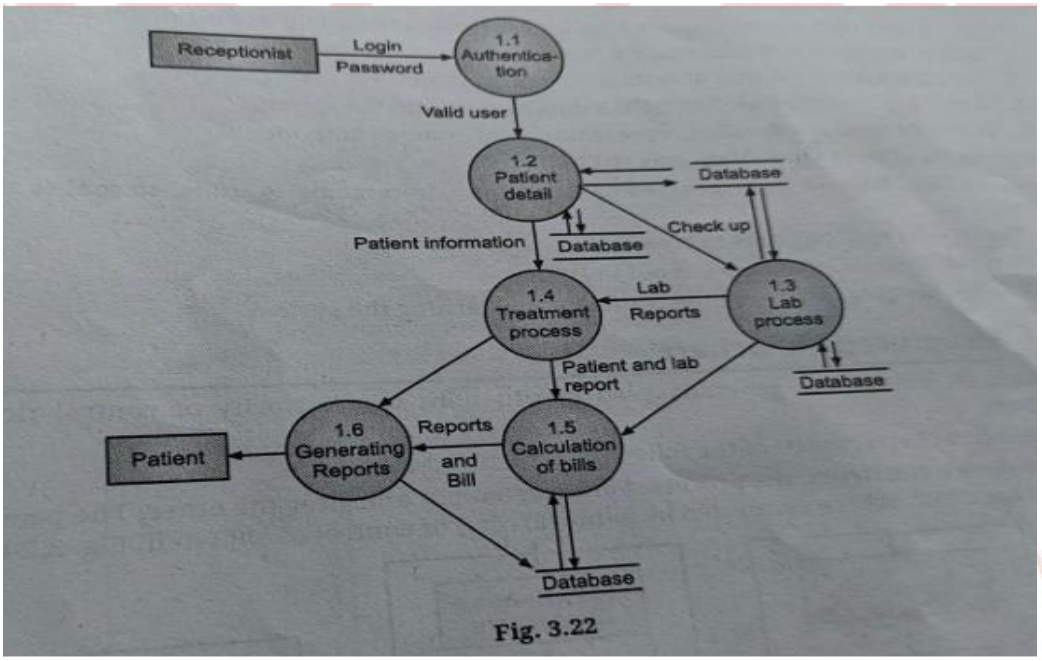


Fig. 3.22

Level 1 DFD

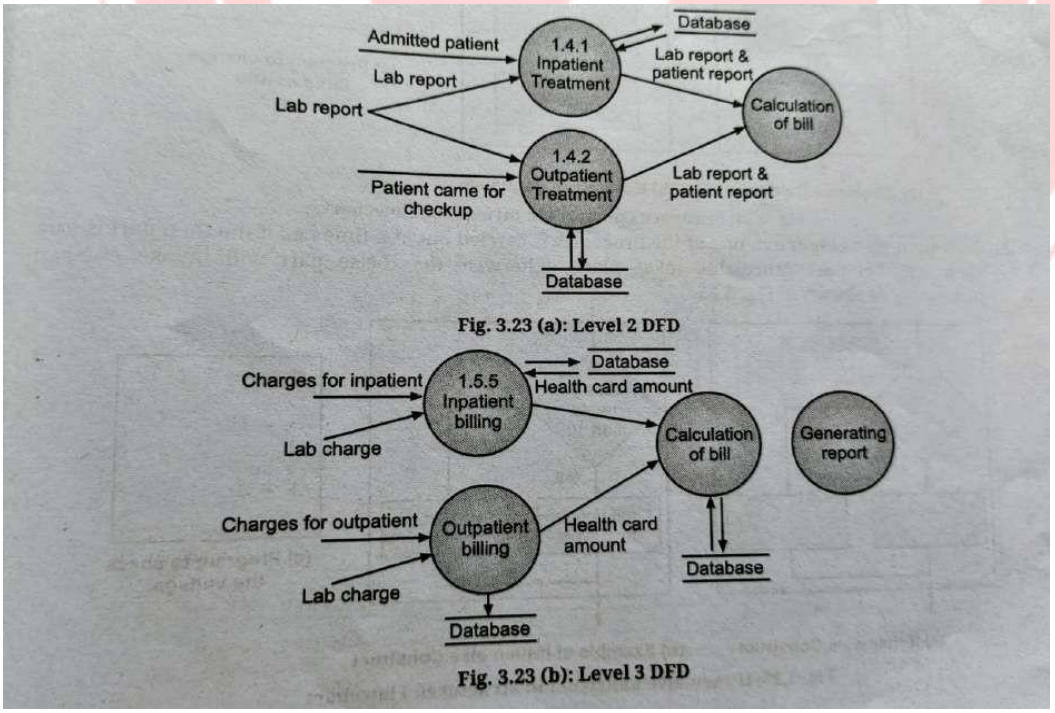
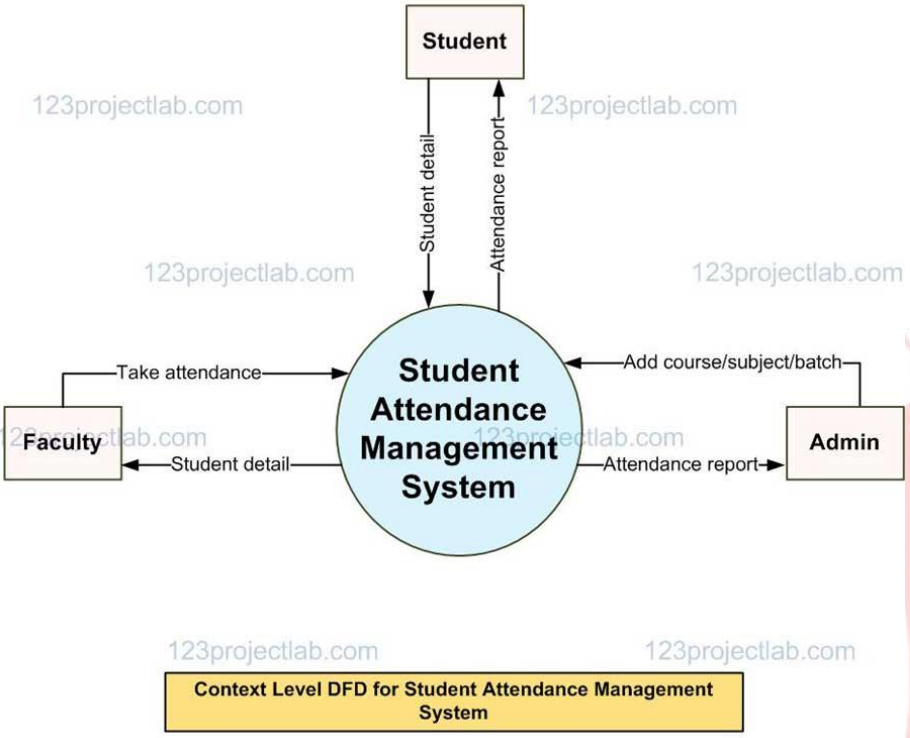


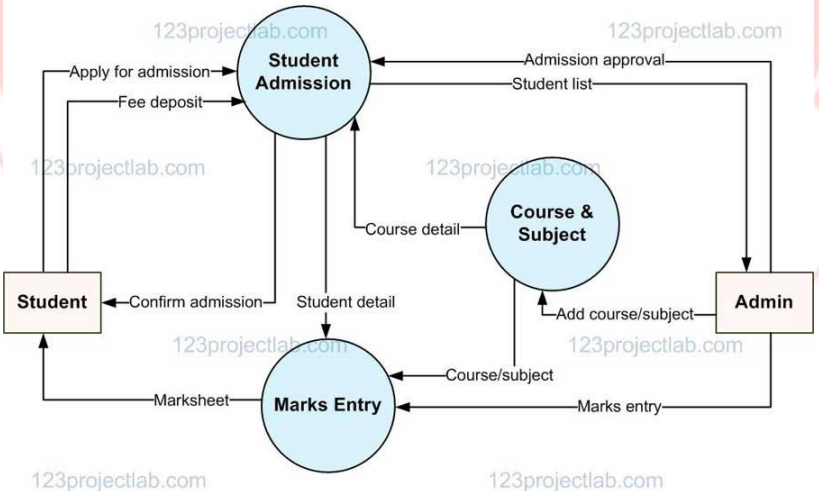
Fig. 3.23 (a): Level 2 DFD

Fig. 3.23 (b): Level 3 DFD

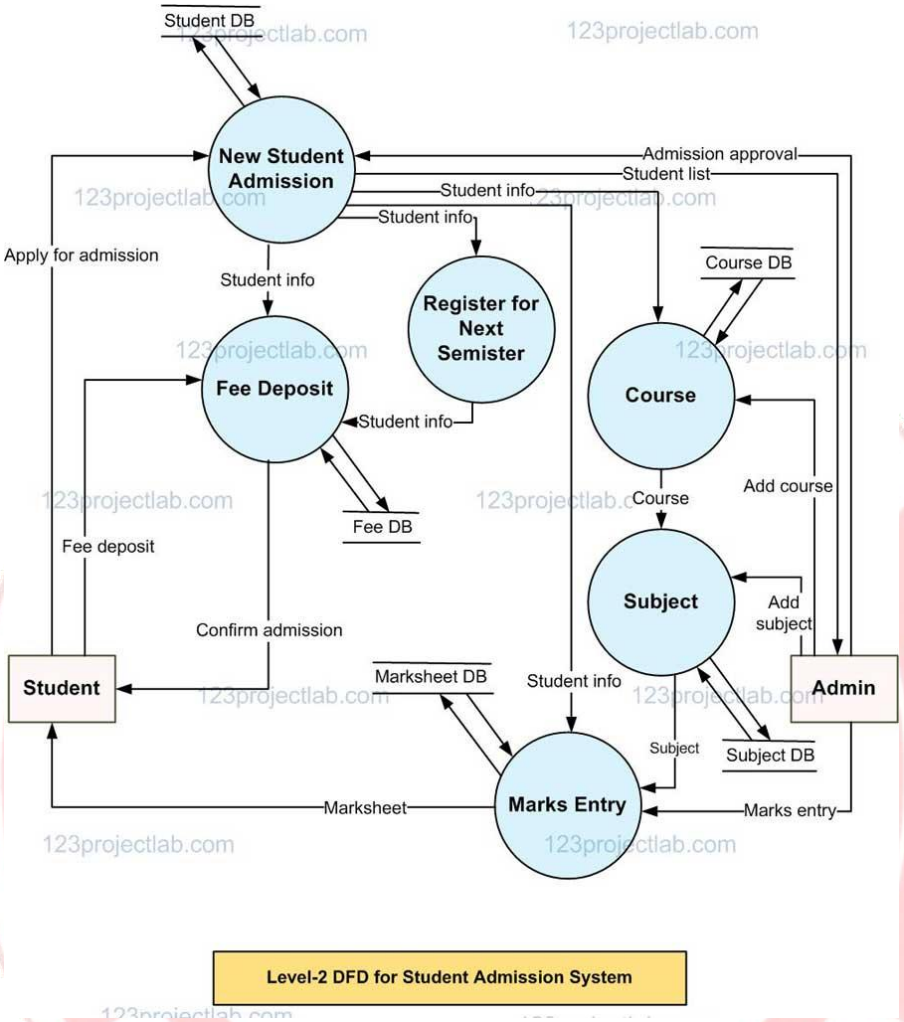
iii) College Management System



Context Level DFD for Student Attendance Management System



Level-1 DFD for Student Admission System

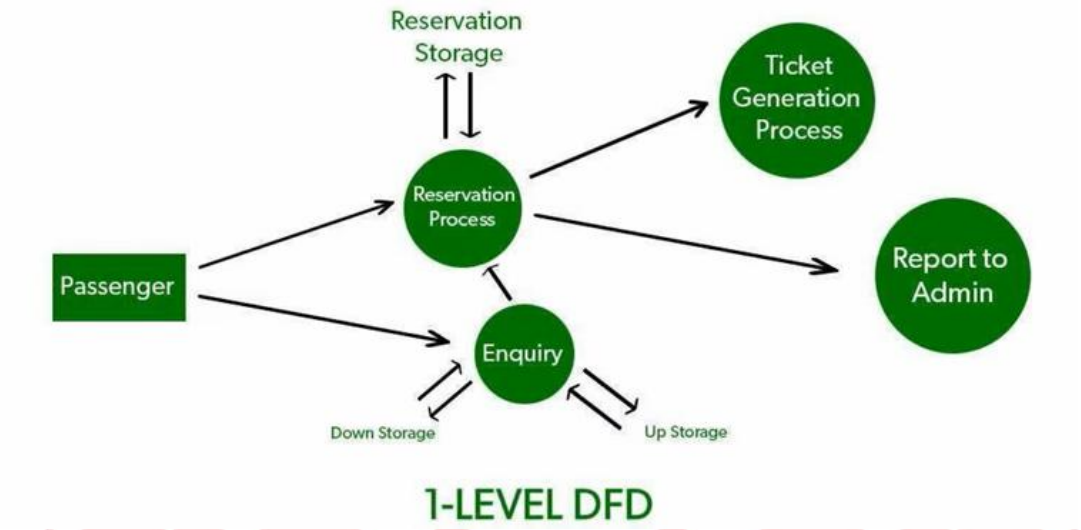


Level-2 DFD for Student Admission System

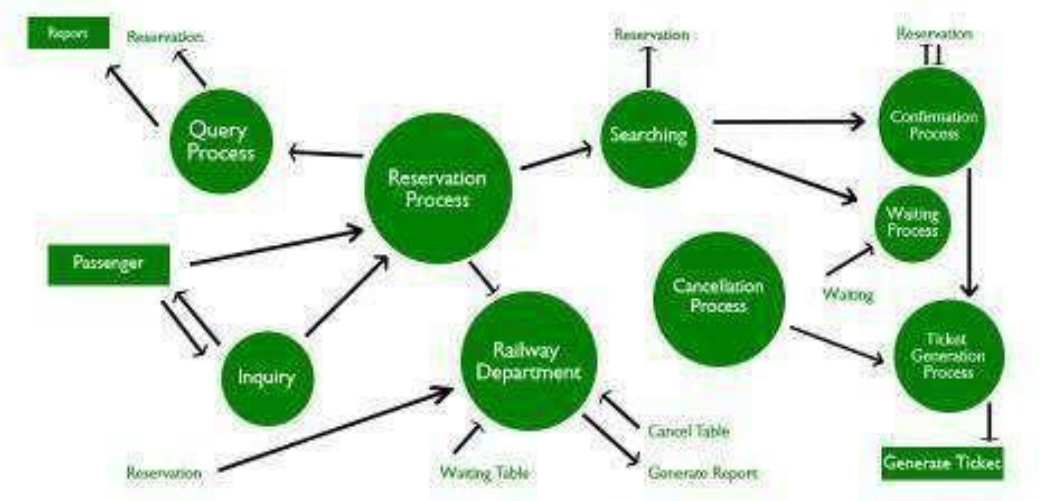
iv) Railway Management System

0-LEVEL DFD

🔵 **Level 1 DFD**

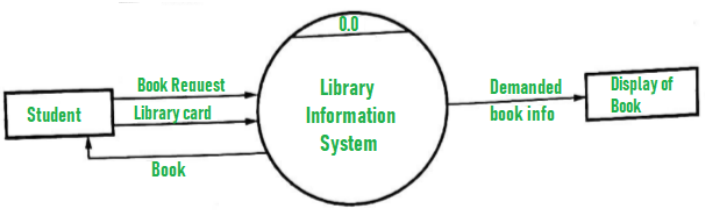


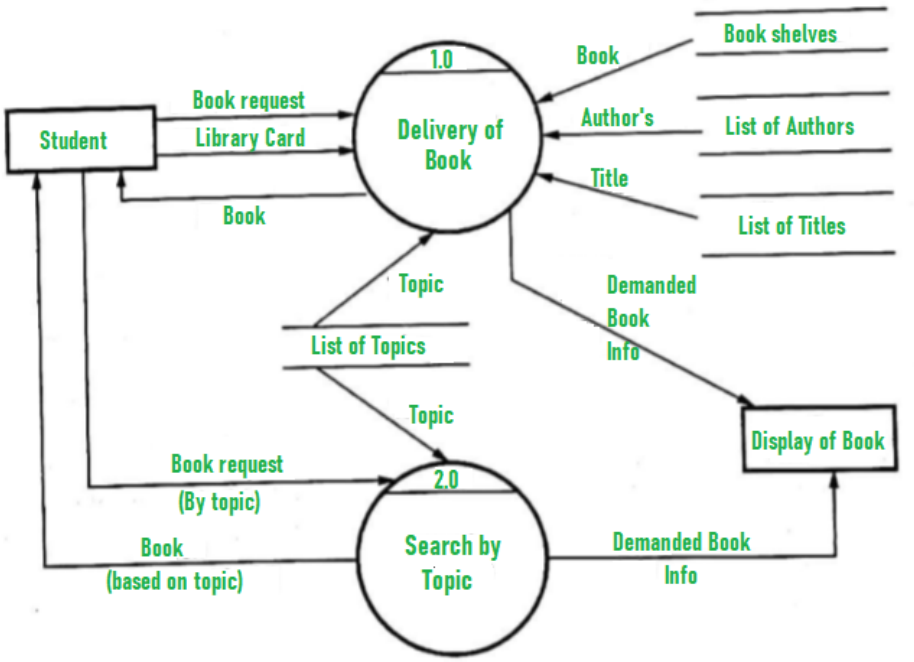
1-LEVEL DFD



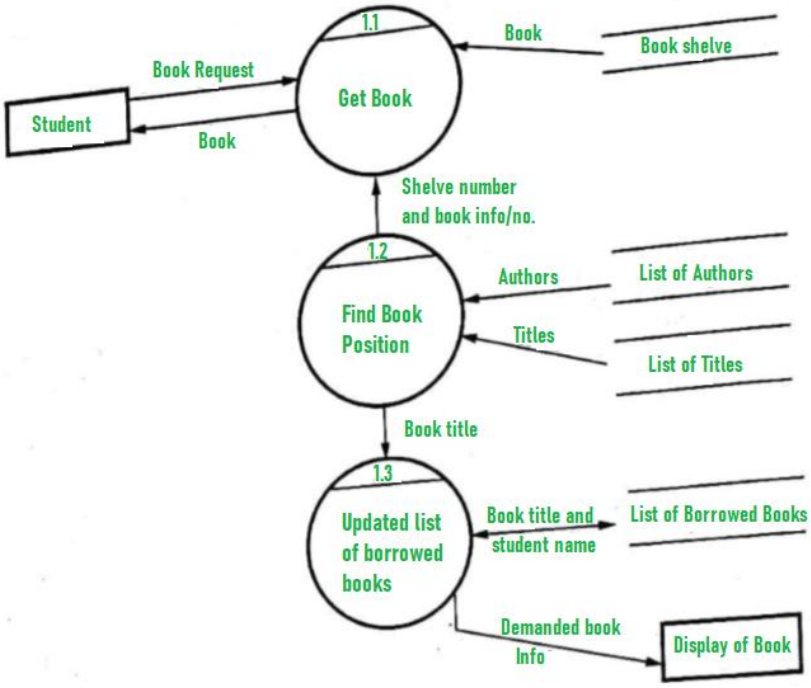
2-LEVEL DFD

v) Library





Level 1 DFD



Level 2 DFD

17. Explain Structured flowchart and its elements.

Ans: A structured flowchart is a diagram that shows the step-by-step logic or flow of a program or process using standard symbols.

Basic Symbols Used:

Symbol	Meaning	Purpose
Oval	**Terminator**	Start/End of the process
■ Rectangle	**Process / Task**	A specific operation or instruction
△ Diamond	**Decision / Condition**	Yes/No or true/false decisions
➔ Arrow	**Flowline**	Shows the direction of control or process flow
□ Parallelogram	**Input/Output**	Data input or output operation

A flowchart is a graphical representation of an algorithm or process that shows the sequence of steps needed to solve a problem or perform a task.
It uses symbols and arrows to represent different operations and the flow of control in a program or system.

Purpose of a Flowchart

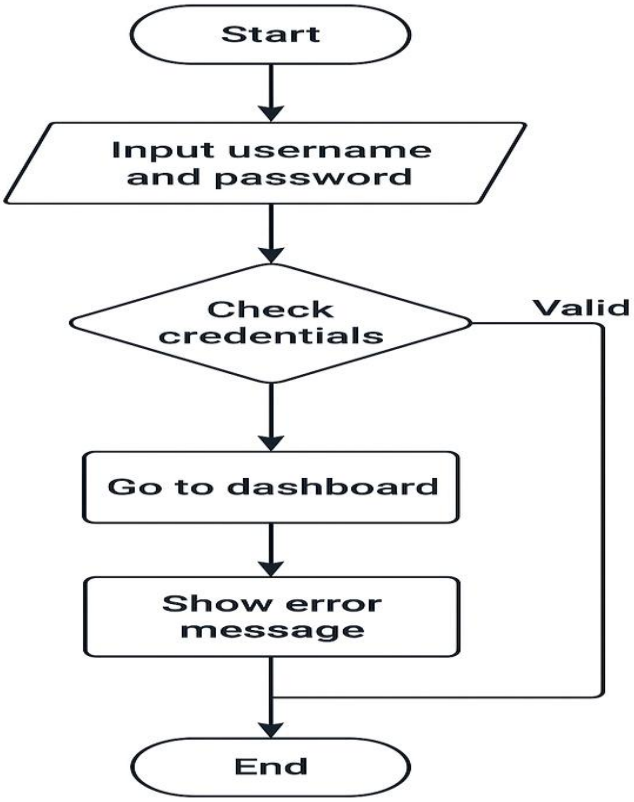
- To illustrate logic clearly and simply.
- To analyze, design, and document a process or algorithm.
- To detect errors or inefficiencies in logic before coding.
- To communicate processes easily among team members.

Advantages of Flowcharts:

- Clearly shows the logic of a process
- Helps in debugging and testing
- Improves communication between developers and clients
- Visual Clarity
- Effective Problem-Solving: By visualizing the entire process, flowcharts help identify bottlenecks, inefficiencies, and unnecessary steps
- Efficiency in Analysis: They enable teams to analyze workflows systematically, identify flaws logic or execution, and optimize the process

Example: Login System Flowchart

1. Start
2. Input username and password
3. Check credentials
4. If valid → Go to dashboard
5. If invalid → Show error message
6. End



18. Explain how to execute Test Cases and prepare a Test Summary Report

Ans. **1. Executing Test Cases**

Definition:

Test Case Execution is the process of running a set of predefined test cases on the software application to verify whether it meets the specified requirements.

Steps in Test Case Execution:

1. **Select test cases** from the test plan.
2. **Set up the test environment** (hardware, software, data).
3. *Execute test cases manually or via automation tools.*
4. **Log results**: Pass, Fail, Blocked, or Skipped.
5. **Record actual results** and compare them with expected results.
6. **Raise defects/bugs** for any failed test cases.

📌 *Best Practices:*

- Maintain traceability between requirements and test cases.
- Log test execution results clearly.
- Update test cases if changes occur in requirements.
- Automate where feasible for regression tests.

❓ **Example:**

Test Case ID	Description	Expected Result	Actual Result	Status
TC_01	Login with valid input	Dashboard opens	Dashboard opens	Pass

Test Case ID	Description	Expected Result	Actual Result	Status
TC_02	Login with invalid pwd	Error message shown	No message shown	Fail

2. Preparing Test Summary Report

Definition: A **Test Summary Report** (TSR) is a high-level document that summarizes the overall testing activities, results, defect statistics, and evaluation of the testing process.

Contents of a Test Summary Report:

Section	Description
Report Identifier	Project Name, Date, Report Version
Objective	Purpose and scope of testing
Test Items	Modules/features tested
Environment	Hardware, OS, test tools used
Test Results	No. of test cases passed/failed/skipped
Defects	Summary of raised and resolved defects
Risks	Outstanding risks or concerns
Recommendations	Next steps (e.g., ready for release?)

Example Summary (Table):

Metric	Value
Total Test Cases Executed	100
Passed	85

Metric	Value
Failed	10
Blocked/Not Run	5
Total Defects Raised	12
Critical Defects Resolved	10
Pending Critical Defects	2

✅ **Benefits of Test Reporting:**

- Gives stakeholders a **clear view of testing progress**
- Helps in **release decisions**
- Ensures **accountability** and traceability

- Documents **quality metrics** for future audits

⚠️ *Drawbacks / Challenges:*

- Time-consuming to prepare without proper tooling
- May miss key insights if not formatted correctly
- Requires detailed **data logging during execution**

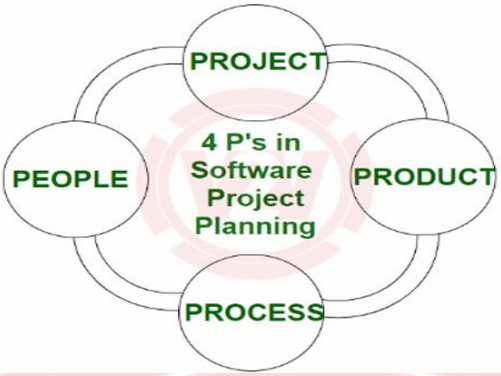
🛠️ *Tools for Test Execution & Reporting:*

- **TestRail, HP ALM, JIRA + Zephyr, qTest**
- **Automation tools**: Selenium, TestNG (with reports)

Diagramatical representation of Test Case Execution

19. Explain Management Spectrum or 4P's

Ans: In software engineering, the Management Spectrum refers to the four essential elements that influence the success or failure of a software project. It focuses on the 4P's. People, Product, Process and Project. These are known as the 4 P's



1.People

People are the most important resource in any software project. This includes project managers, developers, testers, customers, users, and other stakeholders. Effective communication, collaboration, motivation, and leadership play a vital role in managing people.

Organizations that achieve high levels of maturity in the people management area have a higher likelihood of implementing effective software engineering practices.

People connected directly or indirectly are the dynamic and live factor in project management. Project management has to deal and interact with different levels of people within and outside the organization.

People from within the organization are developers, analysts, designers, technology specialists, HR, managers and senior management.

2.Product

The product is the software system to be developed. It includes all functional and non-functional requirements specified by the customer. The product in the context of software is the scope of the software that is proposed to solve the requirement of the user.

To develop successfully, product objectives and scope should be established, alternative solutions should be considered, and technical and management constraints should be identified.

Without this information, it is impossible to define reasonable (and accurate) estimates of the cost.

Understanding the product clearly is essential for correct estimation of resources, time, and cost.

The software and its scope are a product that is defined and described by following four factors:

1.Objective : Objective is beneficial to users to solve business problems.

2.Performance: This stipulates non-functional requirements of speed, quality and features such as ease of use, adaptability, interoperability.

3.Context: The scenario or situation in business which has problems and which need solutions within the given domain.

4.Functions: Software system processes and functions it provides.

3. Process

A process is the set of activities and tasks used to develop the software. Process refers to methodologies to be followed for developing the software. It is the framework for establishment of a comprehensive plan and strategies for software development. Choosing an appropriate process model (e.g., Waterfall, Agile, Spiral) ensures that the project is well-managed, efficient, and structured.

The process specifies the policies, procedures, tools and techniques to be used for software development.

4. Project

The project includes the overall management and execution of work. It involves planning, monitoring, scheduling, resource allocation, and risk management to ensure timely and successful delivery.

A project is defined as an activity that has a definite start and a definite end require multiple resources and is full uncertainties on a number of counts.

Project management is "the application of knowledge, skills, tools and techniques to manage resources to deliver customer needs within agreed terms of cost time, and scope of delivery".

20. Explain size estimation techniques and their types (VIMP).

Ans: Size estimation is an important part of project management. It helps estimate effort, cost, and duration of the software project. Estimating the size of the software to be developed is the very first step to make an effective estimation of the project. A customer's requirements and system specification forms a baseline for Estimation of the size of software. It helps to determine or estimate the size of a software application of a component. Two widely used size metrics are:

Project	LOC	Effort	$(000)	Pp doc	Errors	Defects	People
alpha	12,100	24	168	365	134	29	3
beta	27,200	62	440	1224	321	86	5
gamma	20,200	43	314	1050	256	64	6

Fig. Size-Oriented Metrics

❖ **Line of Code (LoC)**

Definition: Line of Code (LoC) is a metric that measures the number of lines of source code in a software program. It does not include blank lines and comments.

Counting the number of lines of code in computer programs is the most traditional and widely used software metric. It is also the most controversial. Lines Of Code (LOC) is one of the widely used methods for size estimation.

Lines of code written for assembly language are more than lines of code written in C++ From LOC.

Advantages:

- Simple and easy to measure after coding is done
- Useful for measuring programmer productivity
- Helps estimate effort using historical data

Disadvantages:

- Language-dependent (LoC varies by programming language)
- Doesn't measure functionality or logic
- May encourage writing more lines instead of efficient code

Example: A module with 500 LoC can be used to estimate time and cost using past productivity data.

❖ **Function Points (FP)**

Definition: Function Point is a functionality-based size metric that estimates the size of software by evaluating user-visible features, not lines of code.

Key Components Considered:

- External Inputs (EI)
- External Outputs (EO)

- External Inquiries (EQ)
- Internal Logical Files (ILF)
- External Interface Files (EIF)

Each component is assigned a weight based on complexity (Low, Medium, High), and then total function points are calculated.

Advantages:

- Language-independent
- Can be estimated early in development
- Focuses on business functionality, not implementation

Disadvantages:

- Estimation may vary based on evaluator's judgment
- Requires proper training to calculate accurately

Example: If a system has 5 inputs, 3 outputs, and 2 files, function points can be calculated using a weighted formula.

Difference Between LoC and FP

Aspect	Lines of Code (LoC)	Function Points (FP)
1. Basis	Counts physical lines of code	Measures functionality delivered to the user
2. Language Dependence	Yes, depends on the programming language	No, independent of programming language
3. Timing of Use	Useful **after** coding starts	Useful in the **early stages** of project (before coding)
4. Accuracy	Can be misleading (same logic may use more or fewer lines in different languages)	More consistent and standardized
5. Measurement	Easy to count using tools	Requires functional analysis and understanding of scope
6. Usability	Good for **maintenance projects**	Better for **new project estimation and planning**

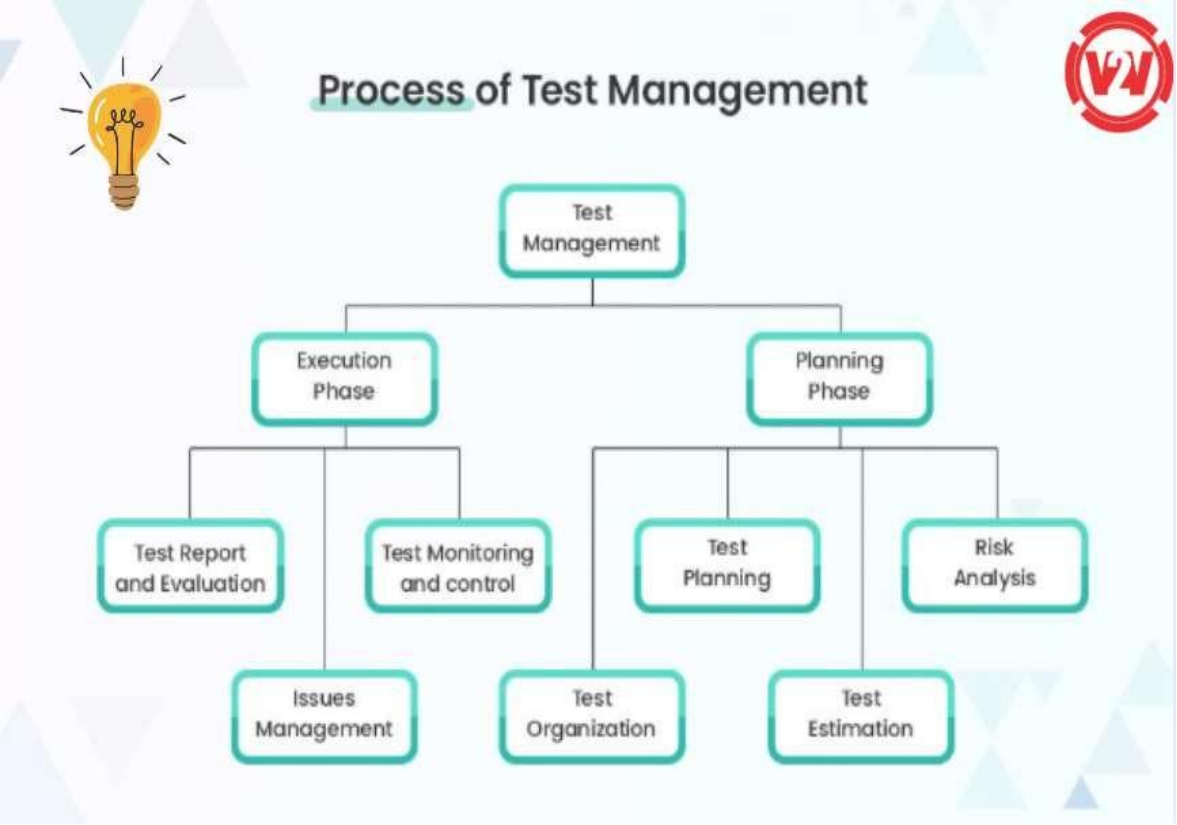
21. Explain Test Infrastructure Management

Ans. *Test Management: Test Infrastructure Management*

✅ **Definition:**

Test Infrastructure Management refers to the setup, maintenance, and management of the hardware, software, tools, environments, networks, and data required to perform effective software testing.

It ensures that the **testing environment replicates the production environment** as closely as possible for accurate results.



🛠 Key Elements of Test Infrastructure:

Component	Description
Test Environment	Physical or virtual systems where testing is executed (OS, servers, networks)
Test Tools	Tools used for automation, defect tracking, performance testing, etc.
Test Data	Dummy or mock data prepared to execute test cases
Version Control	Tools like Git to manage code and configuration versions
Build Management	CI/CD tools (e.g., Jenkins) to manage test builds
Network Configuration	Mimicking production network environments (firewalls, bandwidth, etc.)

⚙ **Responsibilities of Test Infrastructure Management:**

1. **Set up test environments** according to system requirements
2. **Install and configure tools** needed for testing (like Selenium, JIRA, TestNG)
3. **Provide secure and stable environments** for testers and developers
4. **Manage test data** preparation, refresh, and masking
5. **Monitor performance** of infrastructure to avoid bottlenecks
6. **Maintain test environments** in sync with production environments
7. **Control access** and permissions for users in different roles

Benefits:

- *Enables consistent, reliable, and repeatable testing*
- Reduces **environment-related failures**
- Helps in early **defect identification**
- Improves **efficiency of automation** and continuous testing
- Ensures **scalability** and flexibility for different testing types (unit, load, integration)

⚠ *Challenges / Drawbacks:*

- **High cost** of maintaining multiple environments
- **Time-consuming setup** if automation isn't used
- Risk of **configuration mismatches** between environments
- **Dependency issues** between hardware, software, and networks

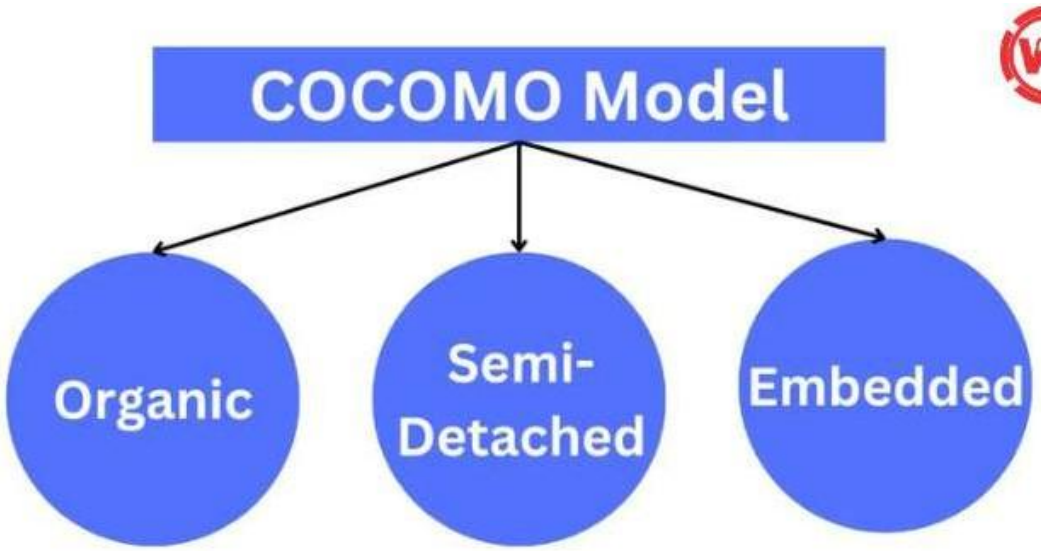
22. Explain COCOMO I & COCOMO II or sums on COCOMO I or II.

Ans:

COCOMO I

COCOMO (Constructive Cost Model) is a **cost estimation model** used in software engineering to estimate the **effort, cost, and time** required to develop a software project.

Developed by **Barry Boehm** in **1981**, COCOMO is based on historical project data and uses mathematical formulas.



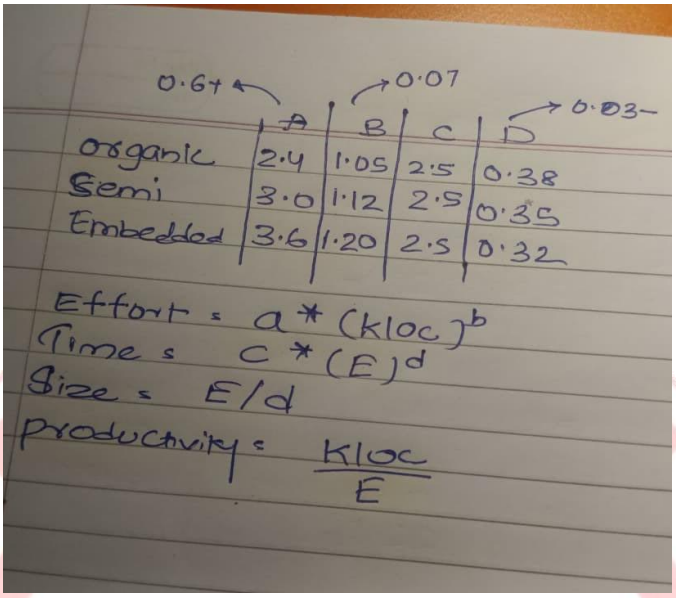
Types of Projects (Modes):

Mode	Description
Organic	Small projects, experienced teams, well-defined requirements
Semi-Detached	Medium-size projects, mixed experience, moderately flexible
Embedded	Large, complex projects, strict constraints and tight coupling

Purpose:

To estimate:

- **Effort** (in person-months)
- **Development Time** (in months)
- **Cost** (in labor units)



Note: - For Embedded, B value 1.12 + 0.07 = 1.19, But actual value is 1.20, please make a note of this

Problem Statement: Estimate the Effort and Development Time for a software project of 50 KLoC using:

- (a) Organic Mode
- (b) Semi-Detached Mode
- (c) Embedded Mode

◇ (a) Organic Mode

Formulas: Effort = 2.4 × (KLoC)^1.05

Time = 2.5 × (Effort)^0.38

Step 1: Effort

$$\text{Effort} = 2.4 \times (50)^{1.05}$$

$$50^{1.05} \approx 60.80$$

$$\text{Effort} \approx 2.4 \times 60.80 = \boxed{145.92 \text{ Person - months}}$$

Step 2: Time

$$\text{Time} = 2.5 \times (145.92)^{0.38}$$

$$(145.92)^{0.38} = 6.64$$

$$\text{Time} \approx 2.5 \times 6.64 = \boxed{16.6 \text{ Months}}$$

(b) Semi-Detached Mode

Formulas: Effort = 3.0 × (KLoC)^1.12

Time = 2.5 × (Effort)^0.35

Step 1: Effort

$$\text{Effort} = 3.0 \times (50)^{1.12}$$

$$50^{1.12} \approx 79.95$$

$$\text{Effort} \approx 3.0 \times 79.95 = \boxed{239.85 \text{ Person - months}}$$

Step 2: Time

$$\text{Time} = 2.5 \times (200.1)^{0.35}$$

$$200.1^{0.35} \approx 6.38$$

$$\text{Time} \approx 2.5 \times 6.38 = \boxed{15.95 \text{ Months}}$$

(c) Embedded Mode

Formulas: Effort = 3.6 × (KLoC)^1.20

Time = 2.5 × (Effort)^0.32

Step 1: Effort

$$\text{Effort} = 3.6 \times (50)^{1.20}$$

$$50^{1.20} \approx 102.33$$

$$\text{Effort} \approx 3.6 \times 102.33 = \boxed{368.38 \text{ Person - months}}$$

Step 2: Time

$$\text{Time} = 2.5 \times (368.38)^{0.32}$$

$$(368.38)^{0.32} = 6.62$$

$$\text{Time} \approx 2.5 \times 6.62 = \boxed{16.55 \text{ Months}}$$

COCOMO II

Definition: The **Post-Architecture Model** is the **most detailed** and widely used model inthe **COCOMO II suite**. It is used after the project's **architecture and major requirements have been finalized**.

It helps estimate:

- **Effort** (in person-months)
- *Schedule (time)*
- **Cost**

It supports modern software practices like:

- **Component-based development**
- **Agile and iterative models**
- **Reuse and Object-Oriented Design**

When is it used?

After:

- Requirements are stable
- High-level architecture is defined
- Key project decisions are made (language, platform, team, etc.)

Estimate the effort for a project with:

- Size = 50 KSLOC
- Σ(Scale Factors) = 18
- EAF = 1.15
- A = 2.94

Step 1: Calculate Exponent B

$$B = 0.91 + 0.01 \times 18 = 0.91 + 0.18 = \boxed{1.09}$$

Step 2: Calculate Effort

$$\text{Effort} = 2.94 \times (50)^{1.09} \times 1.15$$

$$(50)^{1.09} \approx 71.10$$

$$\text{Effort} = 2.94 \times 71.10 \text{ x } 1.15 = \boxed{240.39 \text{ Person Months}}$$

Step 3: (Optional) Development Time

Assume S = 0.33:

$$\text{Time} = 3.67 \times (240.39)^{0.33} = 3.67 \text{ x } 6.10 = \boxed{22.38 \text{ Months}}$$

23. Define risk & explain risk management process.

Ans: A risk is a potential problem or uncertain event that may negatively affect the success of a software project. It could cause delays, increased costs, reduced quality, or project failure.

Principles of Risk Management

Here are the main principles that guide effective risk management in software engineering:

1. Risk Identification

- The first and most crucial step.
- Identify all possible risks that could affect the project.
- Risks can be technical, managerial, financial, or external.

Examples:

- Unrealistic deadlines
- Lack of skilled developers
- Technology change
- Requirement changes

2. Risk Analysis

- Analyze each identified risk to understand its probability (likelihood) and impact (severity).
- Classify risks as low, medium, or high priority.

3. Risk Prioritization

- Rank the risks according to their severity and impact on the project.
- Use a risk matrix to determine which risks need immediate attention.

Example:

Probability	Impact	Priority
High	High	Critical
Medium	High	Major
Low	Low	Minor

4. Risk Planning (Response Planning)

- Prepare strategies to handle each risk.
- There are four main response strategies:

Strategy	Meaning	Example
Avoidance	Eliminate the cause of risk	Use stable technology instead of a new one
Reduction/Mitigation	Reduce the likelihood or impact	Provide training to reduce human error
Transfer	Shift the risk to another party	Take insurance or outsource risky components
Acceptance	Accept and monitor the risk	Acknowledge minor risks with low impact

5. Risk Monitoring and Control

- Continuously track and review identified risks.
- Detect new risks and update the risk management plan regularly.
- Compare actual results with expected outcomes.

6. Communication and Documentation

- Keep all stakeholders informed about risks and mitigation plans.
- Maintain a Risk Register that records:
    - Risk ID
    - Description
    - Probability
    - Impact
    - Response strategy
    - Responsible person

24. Explain types of risk (VIMP).

Ans: Risks in software projects are generally divided into the following major categories:

1. Project Risks

These are risks that **affect the project schedule, resources, or management**.

Examples:

- Unrealistic project deadlines
- Budget overruns
- Inadequate planning or poor project estimation
- Lack of skilled manpower
- Miscommunication among team members

Impact:
May cause **delays**, **increased cost**, or **failure to meet deadlines**.

2. Technical Risks

These are risks related to the **technology**, **tools**, or **technical performance** of the software system.

Examples:

- Use of **new or untested technology**
- Integration issues between software modules
- Performance problems (slow response time)
- Technical failure or design errors
- Incompatibility with hardware or software platforms

Impact:
Can lead to **system failure**, **rework**, or **poor software quality**.

3. Business (Organizational) Risks

These are risks that affect the **organization or business goals** of the project.

Examples:

- Change in **business priorities or strategies**
- **Budget cuts** or **funding withdrawal**
- **Client dissatisfaction** or change in requirements
- **Market competition** or **regulatory issues**

Impact:
May cause **project cancellation**, **reduced profits**, or **loss of reputation**.

4. Operational Risks

These are risks related to **daily operational activities** and **process management**.

Examples:

- Lack of proper process documentation
- Poor communication between teams
- Misuse or loss of critical data
- Hardware or network failures

Impact:
Can affect **team efficiency**, **data integrity**, or **system reliability**.

5. External Risks

These are risks that come from **outside the organization's control**.

Examples:

- Natural disasters (floods, earthquakes)
- Political instability
- Changes in government regulations or taxation
- Vendor or supplier failures
- Economic downturns

Impact:
May **delay** or **suspend** the project unexpectedly.

6. Security Risks

These are risks that affect the **confidentiality, integrity, and availability** of software data and systems.

Examples:

- Data breaches or cyberattacks

- Unauthorized access to confidential data
- Weak authentication or encryption mechanisms
- Malware or virus attacks

Impact:

7. Requirement Risks

These arise when the **requirements are unclear, incomplete, or frequently changing**.

Examples:

7. Ambiguous or misunderstood requirements
8. Frequent requirement changes by clients
9. Poor requirement documentation

Impact:
Can lead to **rework**, **scope creep**, or **customer dissatisfaction**.

25. Explain RMMM (Risk Mitigation, Monitoring, and Management).

Ans:

RMMM stands for:

Risk Mitigation, Risk Monitoring, and Risk Management

It is a structured risk-handling approach used in software engineering to identify, reduce, track, and respond to potential risks in a project.

Goal of RMMM Strategy

The main goal of the RMMM strategy is:

“To identify risks early in the software process, minimize their impact through planning, monitor them continuously, and handle them effectively when they occur.”

It ensures:

- Project continuity
- Reduced cost and schedule impact
- Higher quality and reliability

Components of RMMM Strategy

1. Risk Mitigation

- Goal: Prevent the risk or reduce its probability or impact
- Involves creating preventive plans

Examples:

o Use experienced developers for complex modules

o Backup plans for third-party tools

o Allocate extra time in schedule for high-risk tasks

2. Risk Monitoring

● Goal: Track the risk and observe warning signs

● Ongoing activity throughout the project

● Includes regular status reports, risk checklists, and review meetings

3. Risk Management

- Goal: Take proper action when the risk actually occurs
- Execute contingency plans

Examples:

o Reassign tasks if a developer leaves

o Use alternative tool if preferred tool fails

o Adjust schedule/resources when delays happen

26. Explain project scheduling with its principles.

Ans: Project Scheduling is the process of planning tasks, allocating resources, and setting timelines to ensure a software project is completed on time and within budget.

Basic Principles of Project Scheduling

1. Compartmentalization – Divide the project into smaller manageable tasks or modules.

2. Interdependency – Determine relationships between tasks (what depends on what).

3. Time Allocation – Estimate the time required for each task.

4. Effort Validation – Ensure enough resources are available for each task.

5. Defined Responsibilities – Assign responsibilities to team members.

6. Milestones and Deadlines – Mark key dates and review points.

7. Monitoring – Track progress and update the schedule regularly.

27. Explain PERT and CPM techniques.

Ans: PERT is used to handle uncertainty in project scheduling by using probabilistic time estimates

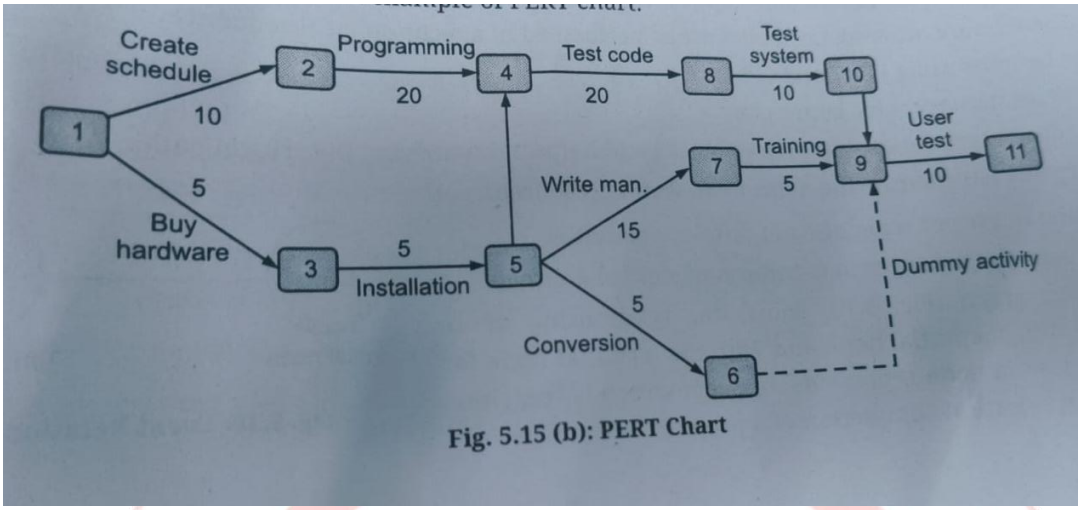


Fig. 5.15 (b): PERT Chart

Key Concepts:

● Each task has three time estimates:

o Optimistic time (O) – best-case

o Most likely time (M) – expected case

o Pessimistic time (P) – worst-case

PERT Steps:

1. List all activities and estimate O, M, P times

2. Calculate Expected Time (TE) for each activity

3. Build the network diagram

4. Find the critical path based on TE values

Advantages:

- Useful for complex or uncertain projects
- Better time estimation using probabilities
- Helps in risk analysis

Disadvantages:

- Requires accurate estimates for O, M, P
- More complex than CPM

CPM is a technique used to find the longest sequence of dependent tasks (called the critical path) that determines the minimum project duration.

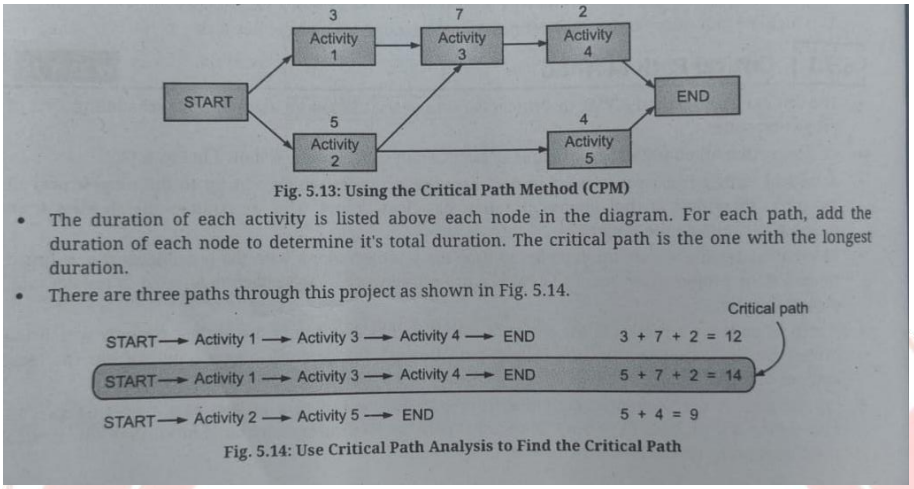


Fig. 5.13: Using the Critical Path Method (CPM)

- The duration of each activity is listed above each node in the diagram. For each path, add the duration of each node to determine it's total duration. The critical path is the one with the longest duration.
- There are three paths through this project as shown in Fig. 5.14.

Critical path

START → Activity 1 → Activity 3 → Activity 4 → END 3 + 7 + 2 = 12

START → Activity 1 → Activity 3 → Activity 4 → END 5 + 7 + 2 = 14

START → Activity 2 → Activity 5 → END 5 + 4 = 9

Fig. 5.14: Use Critical Path Analysis to Find the Critical Path

Key Concepts:

- Tasks are represented as nodes or activities
- Each task has a fixed duration
- No uncertainty in task time estimates

CPM Steps:

1. List all tasks and their durations
2. Identify dependencies between tasks
3. Draw a network diagram
4. Calculate the critical path
5. Highlight tasks with zero slack (delays in these will delay the project)

Advantages:

- Helps identify most important (critical) tasks
- Easy to use for well-defined projects
- Optimizes time and resource allocation

Disadvantages:

- Assumes fixed time estimates
- Less effective for uncertain or risky projects

28. Define project tracking and explain timeline & Gantt chart

Ans: Project tracking is the process of monitoring and controlling the software project's progress to ensure it stays on schedule, within budget, and meets quality expectations.

It involves:

- Tracking task completion
- Identifying delays
- Updating progress regularly
- Making adjustments if needed

Purpose of Project Tracking:

- Compare planned vs actual progress
- Identify and fix bottlenecks
- Ensure resource efficiency
- Keep the team and stakeholders informed

1. Timeline Chart

Definition: A Timeline Chart shows the sequence of events or tasks in a software project over time. It is a simple horizontal bar representation of the schedule.

Characteristics:

● Time is shown on the horizontal axis

● Tasks/milestones are placed in sequence

● Good for showing major events and deadlines

☑ Advantages:

● Easy to understand

● Great for high-level planning

● Visualizes the order of tasks

❌ Disadvantages:

- Does not show task dependencies
- Not suitable for complex projects

☑ 1. Timeline Chart –

Example Scenario:

You are developing a student management system.

Milestone	Planned Date
Requirements Gathering	Day 1
Design Completion	Day 4
Coding Start	Day 6
Testing Start	Day 10
Deployment	Day 14

📊 Timeline Chart (Text Representation)

```
Day →      1     4     6     10    14
           ↓     ↓     ↓     ↓     ↓
Event →  [Req] [Design] [Code] [Test] [Deploy]
```

Gantt Chart

Definition: A Gantt Chart is a detailed bar chart that shows:

- Start and end dates of tasks
- Duration of each task
- Dependencies between tasks
- Progress tracking (completion percentage) It is the most widely used tool for project tracking.

2. Components of Gantt Chart:

- Vertical axis: Tasks/Activities
- Horizontal axis: Time scale (days/weeks/months)
- Bars: Represent the duration of each task
- Arrows/Lines: Show dependencies between tasks
- Progress shading: Shows % of task completed

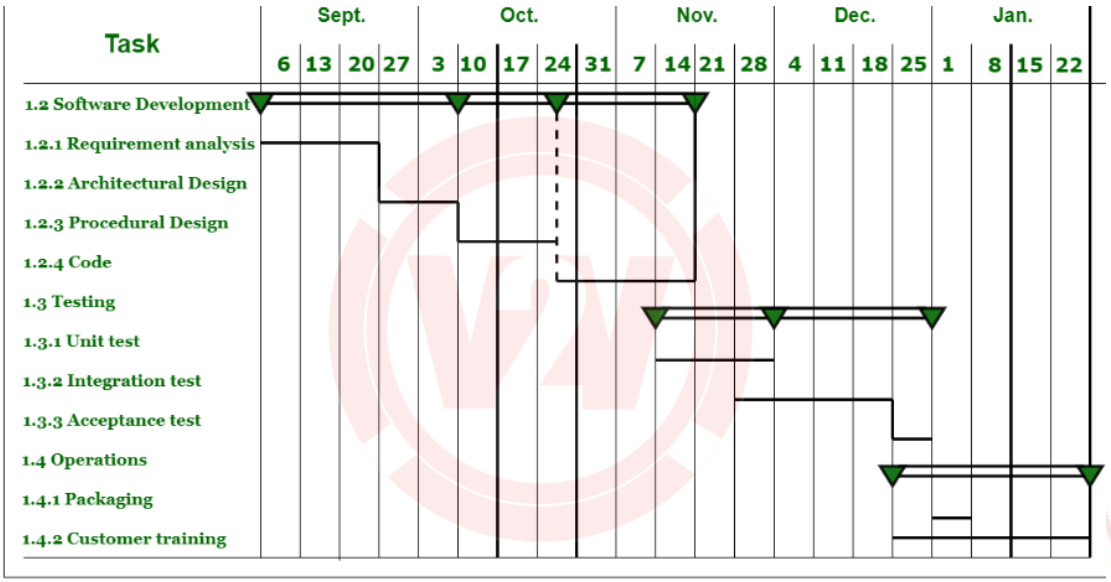
☑ Advantages:

- Clearly shows project schedule and status
- Tracks progress visually
- Helps with resource and time management

❌ Disadvantages:

- Can become complex for large projects
- Needs to be updated regularly

Gantt Chart (Example)



Gantt Chart

29. Explain black-box testing and white-box testing.

Ans: Software testing is the process of **evaluating a system or its components** to determine whether it meets the **specified requirements** and works correctly.

There are **two main approaches** to software testing:

Black-Box Testing

White-Box Testing

These two methods differ in **what the tester knows about the internal structure** of the software.

1. Black-Box Testing

Black-Box Testing is a testing technique in which the **functionality of the software is tested without knowing its internal structure, code, or logic**.

The tester only checks **what the software does**, not **how it does it**.

Focus:

- Based on **input and output** behavior.

- The system is treated as a **"black box"**, where the internal workings are hidden.

Objective:

- To check whether the software **meets user requirements**.
- To find errors in **functions, performance, and user interface**.

Techniques Used:

1. **Equivalence Partitioning** – Dividing input data into valid and invalid classes.
2. **Boundary Value Analysis** – Testing at boundary limits of input ranges.
3. **Decision Table Testing** – Using rules and conditions to test various input combinations.
4. **State Transition Testing** – Testing changes between different system states.

Example:

Suppose you have a **login form** with:

- Username
- Password

Test Cases:

Input	Expected Output
Correct username & password	Successful login
Incorrect username	Error message
Empty password field	Prompt to enter password

The tester does **not** look at the code — only checks the system's **behavior**.

Advantages:

- Tester **doesn't need programming knowledge**.
- Tests are done from the **user's perspective**.
- Helps in finding **missing functionalities**.

Disadvantages:

- Cannot find **hidden code errors**.
- **Redundant tests** may occur.

- Limited **code coverage**.

2. White-Box Testing

Definition:

White-Box Testing (also called **Glass Box** or **Structural Testing**) is a technique in which the **internal structure, design, and code** of the software are **fully visible** to the tester.

The tester checks **how the software works internally**.

Focus:

- Based on **internal code logic and structure**.
- Tests include **control flow, data flow, loops, and conditions**.

Objective:

- To ensure that all **paths, branches, and conditions** in the code work correctly.
- To check the **logic correctness** and **code efficiency**.

Techniques Used:

1. **Statement Coverage** – Every statement in the code is executed at least once.
2. **Branch Coverage** – Every decision (if/else) is tested for both true and false outcomes.
3. **Path Coverage** – All possible paths through the code are tested.
4. **Condition Coverage** – Each condition in decision statements is tested.

Example:

```
if (age > 18):
   print("Eligible to vote")
else:
   print("Not eligible")
```

Test Cases:

Input	Expected Output
age = 20	Eligible to vote

age = 15	Not eligible

Advantages:

- Provides **thorough code coverage**.
- Helps in **optimizing code** and finding **logical errors**.
- Detects **hidden bugs** in complex conditions.

Disadvantages:

- Requires **knowledge of programming**.
- **Time-consuming** and complex for large systems.
- Cannot test **missing functionalities**.

Feature	Black-Box Testing	White-Box Testing
Knowledge of Code	Not required	Required
Focus	Functional behavior	Internal code logic
Tester Type	End-user or QA tester	Developer or programmer
Based On	Input-output validation	Code structure & flow
Techniques	Equivalence Partitioning, Boundary Value Analysis	Path Coverage, Branch Coverage
Main Goal	Check what the system does	Check how the system works
Advantages	User-oriented, simple	Deep code-level validation
Disadvantages	Limited code coverage	Requires coding skills

Comparison: Black-Box vs White-Box Testing

30. Explain static vs dynamic testing.

Ans: In Software Testing, we use different approaches to detect errors and ensure quality.
Two main testing types are:
Static Testing
Dynamic Testing

These differ in when and how the testing is performed — whether the software code is executed or not.

1. Static Testing

Static Testing is a verification process where the code, documents, and design are checked without executing the program.

It focuses on finding errors early in the development phase (before the program runs).

Focus:

- Reviews, inspections, and walkthroughs of code and documents.
- Detects errors in syntax, logic, design, and documentation.

Objective:

- To ensure the correctness and completeness of the design, code, and documentation before execution.
- To catch defects early, reducing cost and time.

Examples:

1. Code Review: Peers review the source code for errors or poor practices.
2. Walkthrough: Developer explains the code or design to the team for feedback.
3. Inspection: Formal examination of requirements or design documents.
4. Static Analysis Tools: Tools like *SonarQube* or *Lint* detect syntax or code quality issues.

Example Scenario:

A developer reviews another developer's code and finds:

if (a = b): # Error: Assignment instead of comparison

Advantages:

- Detects early defects before execution.
- Saves time and cost of fixing errors later.
- Improves code quality and documentation accuracy.
- Helps ensure standard coding practices.

Disadvantages:

- Cannot find runtime errors.

- Requires manual effort and experience.
- May not cover execution-based issues (like performance).

2. Dynamic Testing

Dynamic Testing is a validation process where the software is executed to verify that it behaves as expected.

It focuses on runtime behavior of the system.

Focus:

- Checks the functionality, performance, and output of the software by running it with different inputs.

Objective:

- To ensure that the software meets user requirements.
- To detect runtime errors, logical errors, and performance issues.

Examples:

- Unit Testing – Testing individual components.
- Integration Testing – Checking interaction between modules.
- System Testing – Testing the entire system.
- Acceptance Testing – Ensuring software meets user needs.

Example Scenario:

A tester runs a login page program with valid and invalid credentials:

Input	Expected Output
Correct username/password	Login successful
Wrong password	Error message

Advantages:

- Detects runtime and logical errors.
- Ensures software behavior meets the requirements.
- Validates performance and usability.

Disadvantages:

- Requires more time and resources.

- Can detect errors only after execution.
- Fixing late-stage errors is costlier.

Comparison: Static vs Dynamic Testing

Feature	Static Testing	Dynamic Testing
Definition	Testing without executing the code	Testing by executing the code
Phase	Verification phase	Validation phase
Goal	Find errors in documents, design, or code	Check software behavior and functionality
Performed By	Developers, reviewers, QA	Testers or QA engineers
Example Methods	Code review, walkthrough, inspection	Unit, Integration, System testing
Execution	Not required	Required
Type of Errors Found	Syntax, design, documentation errors	Logical, runtime, performance errors
Cost of Fixing Errors	Low (early stage)	High (later stage)
Tools	Lint, SonarQube	Selenium, JUnit, LoadRunner
Execution	Not executed	Executed
Purpose	Verification	Validation
When Done	Early in SDLC	After coding is complete
Error Type	Design, syntax	Logic, performance
Examples	Code reviews, walkthroughs	Unit, system, acceptance testing

31. Explain verification and validation in software testing.

Ans: In Software Engineering, both Verification and Validation are important parts of the software testing process.

They ensure that the software product is:

- Built correctly (Verification)
- Built as per user's needs (Validation)

1. Verification

Verification is the process of checking whether the software is being built correctly according to the design documents, plans, and requirements — without executing the code.

It answers the question:

“Are we building the product right?”

Purpose:

To ensure that the product follows the specifications and design standards during development.

Characteristics:

- A static process (code is not executed).
- Involves reviews, inspections, and walkthroughs.
- Conducted at each phase of development (requirement, design, coding).

Examples:

Activity	Description
Requirement Review	Checking if SRS (Software Requirement Specification) is correct and complete
Design Review	Ensuring that the design meets the requirements
Code Review	Checking for coding standards and syntax errors
Document Verification	Ensuring documentation is clear and accurate

Techniques Used:

- Inspections
- Walkthroughs
- Reviews
- Static analysis tools (e.g., SonarQube, Lint)

Example:

Before coding, developers review the SRS to confirm that all user requirements are clearly stated and no features are missing.

This ensures the system is being built correctly before actual development.

Advantages:

- Detects errors early in the development phase.

- Saves time and cost of fixing errors later.
- Ensures consistency and completeness of documentation.

2. Validation

Validation is the process of checking whether the developed software meets the user's actual needs and requirements — by executing the program.

It answers the question:

"Are we building the right product?"

Purpose:

To ensure that the final product works as intended and satisfies user expectations.

Characteristics:

- A dynamic process (code is executed).
- Focuses on the behavior and performance of the software.
- Conducted after coding is complete.

Examples:

Activity	Description
Unit Testing	Testing individual components
Integration Testing	Testing interaction between modules
System Testing	Testing the complete system
Acceptance Testing	Ensuring the system meets user needs

Example:

After developing a login system, testers run it using:

- Valid username/password → Should log in successfully
- Invalid credentials → Should show error message

Techniques Used:

- Functional testing
- System testing
- User acceptance testing (UAT)

- Performance testing

Advantages:

- Ensures software meets user requirements.
- Detects runtime and logical errors.
- Improves software reliability and user satisfaction.

Comparison: Verification vs Validation

Feature	Verification	Validation
Definition	Ensures the product is built correctly	Ensures the right product is built
Question Answered	Are we building the product right?	Are we building the right product?
Type of Process	Static (no code execution)	Dynamic (code execution)
Performed During	Development phases	After development or during testing
Main Objective	To check design, documents, and code	To check functionality and behavior
Performed By	Developers, QA, reviewers	Testers, end-users
Examples	Reviews, walkthroughs, inspections	Unit testing, system testing, UAT
Cost of Fixing Errors	Low (early detection)	High (late detection)

Simple Example

Activity	Type	Purpose
Checking if login page is designed as per SRS	Verification	Confirm design correctness
Testing login with valid/invalid credentials	Validation	Confirm system works correctly

32. Explain the Life Cycle of Defect & defect types.

Ans: Defect Life Cycle (Bug Life Cycle)

Definition:

The Defect Life Cycle is the process through which a defect passes from its initial detection to its final closure in software testing.

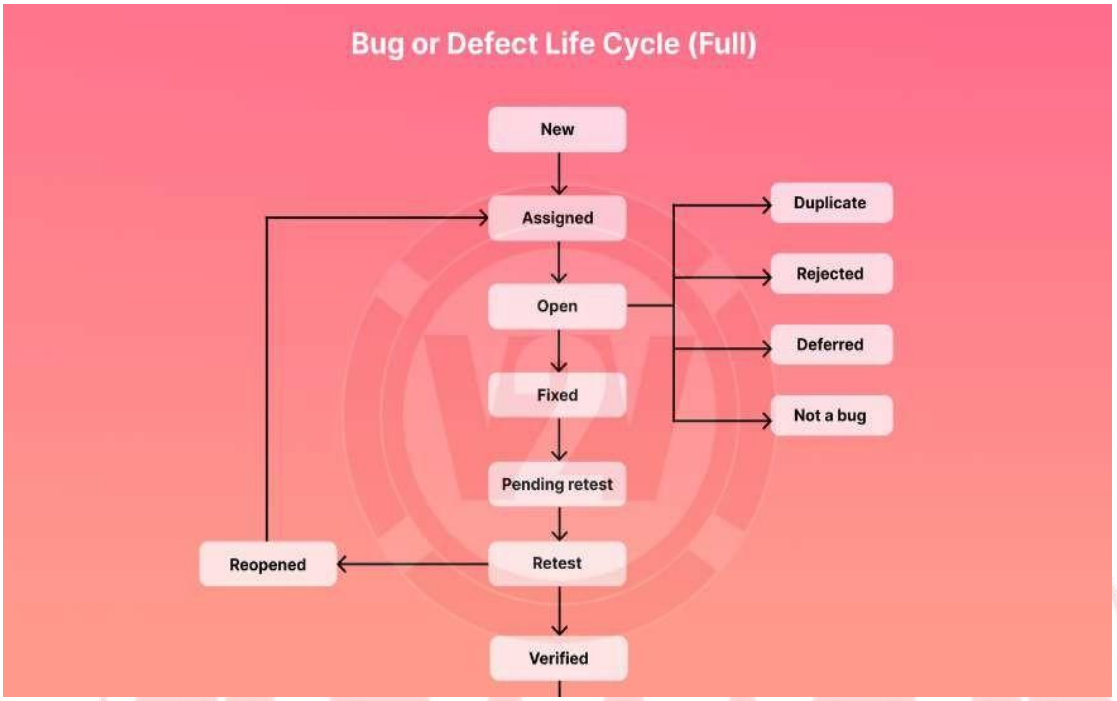
It defines the different states a defect goes through during its lifetime.

⚙ 🔁 Stages of Defect Life Cycle

Stage	Description
1. New	When a tester finds a defect, it is logged for the first time with status "New".
2. Assigned	The defect is assigned to a developer or team for analysis and fixing.
3. Open	The developer starts working on the defect and changes its status to "Open."
4. Fixed / Resolved	The developer fixes the defect and changes its status to "Fixed" or "Resolved."
5. Retest	The tester retests the application to verify if the defect has been fixed properly.
6. Verified	If the defect no longer exists after retesting, it is marked as "Verified."
7. Closed	When the fix is confirmed by the tester, the defect status becomes "Closed."
8. Reopened	If the issue still exists after the fix, the tester changes the status back to "Reopened."
9. Rejected / Deferred / Duplicate	Special statuses when a defect is not fixed immediately or is invalid.

🧠 Other Common Statuses

Status	Meaning
Rejected	Developer does not consider it a defect (e.g., works as designed).
Deferred	Defect will be fixed in a future release (low priority).
Duplicate	The same defect is already logged earlier.



Defect Types

Defects can be classified based on nature, severity, and origin.
Below are the common types:

---

1. Functional Defects

- Occur when the software does not perform a required function.
  Example: "Login button does not log in the user."

---

2. Performance Defects

- Occur when the system responds slowly or uses excessive resources.
  Example: "Website takes 10 seconds to load."

---

3. Usability Defects

- Related to user interface or user experience problems.
  🧩 *Example:* "Font too small" or "Buttons not properly aligned."

---

4. Compatibility Defects

- Occur when the software does not run properly on different devices, browsers, or OS.
  🧩 *Example:* "App crashes on Android 14 but works on Android 12."

---

5. Security Defects

- When there are vulnerabilities that can be exploited by unauthorized users.
  🧩 *Example:* "System allows login without password validation."

---

6. Logical Defects

- Errors in logic or algorithms used in code.
  🧩 *Example:* "Interest calculation formula gives wrong result."

---

7. Boundary / Data Defects

- Occur when input values at the edge of acceptable ranges are not handled properly.
  🧩 *Example:* "System crashes when entering age = 0 or 1000."

---

8. Interface Defects

Occur in data exchange between modules or systems.
🧩 *Example:* "Data not passed correctly between front-end and database."

33. Describe a Defect Template with an example.

Ans: A Defect Template (also called a Bug Report Template) is a standard format used by testers to record, track, and report defects found during software testing.

It ensures all necessary details about a defect are clearly documented so that developers can easily understand and fix it.

📝 Definition:

A Defect Template is a structured document that captures complete information about a defect, including its ID, description, severity, priority, and status.

⚙️ Common Fields in a Defect Template

Field Name	Description
Defect ID	Unique identification number assigned to each defect.
Defect Title / Summary	Short, clear title describing the defect.
Module / Component Name	The part of the application where the defect was found.
Detected By	Name of the tester who found the defect.
Detected On (Date)	Date when the defect was identified.
Build / Version	Software version or build number where the defect appeared.
Severity	Impact level of the defect (e.g., Critical, Major, Minor).
Priority	Order in which the defect should be fixed (e.g., High, Medium, Low).
Description / Steps to Reproduce	Detailed steps the tester followed to find the defect.
Expected Result	What the system should do (correct behavior).
Actual Result	What the system actually did (wrong behavior).
Status	Current state of the defect (e.g., New, Open, Fixed, Closed, Rejected).
Assigned To	Developer responsible for fixing the defect.
Attachments / Screenshots	Screenshots or logs showing the defect evidence.

🧠 Example of a Defect Template

Field	Example Entry
Defect ID	BUG_101
Defect Title	Login button not working on homepage
Module / Component	User Login Module
Detected By	Shijin George

Detected On	05-Nov-2025
Build / Version	v1.0.3
Severity	Major
Priority	High
Steps to Reproduce	1. Open the homepage 2. Enter valid username & password 3. Click “Login” button
Expected Result	User should be redirected to the dashboard page.
Actual Result	Nothing happens when clicking the Login button.
Status	Open
Assigned To	Developer: John Mathew
Attachments	Screenshot_101.png

☑ Benefits of Using a Defect Template

- Ensures clear communication between testers and developers
- Helps in tracking defect status through its lifecycle
- Maintains consistency and completeness in reporting
- Supports metrics and analysis for process improvement

34. Difference Between QC & QA.

Ans: Both QA (Quality Assurance) and QC (Quality Control) are key components of Software Quality Management, but they serve different purposes in ensuring software quality.

🧩 Definition

Aspect	Quality Assurance (QA)	Quality Control (QC)
Definition	QA is a process-oriented activity that focuses on ensuring that proper processes and methods are followed during software development to prevent defects.	QC is a product-oriented activity that focuses on detecting defects in the final product through testing and inspection.
Goal	To prevent defects by improving the development process.	To identify and fix defects in the finished product.

⚙ Key Differences

Basis	Quality Assurance (QA)	Quality Control (QC)
Nature	Preventive	Corrective
Focus	On the process used to make the product	On the actual product itself
Objective	To ensure that the process is defined, managed, and followed properly	To ensure the final product meets the required quality standards
Performed by	QA Team / Process Analysts	Testing Team / Test Engineers
Activities Involved	Process definition, audits, training, reviews	Testing, inspection, validation, verification
Timing	Done throughout the development process	Done after development (during testing phase)
Output	Process improvement reports	Defect reports, bug logs
Approach	Proactive (prevents defects)	Reactive (finds and fixes defects)

🧠 Example

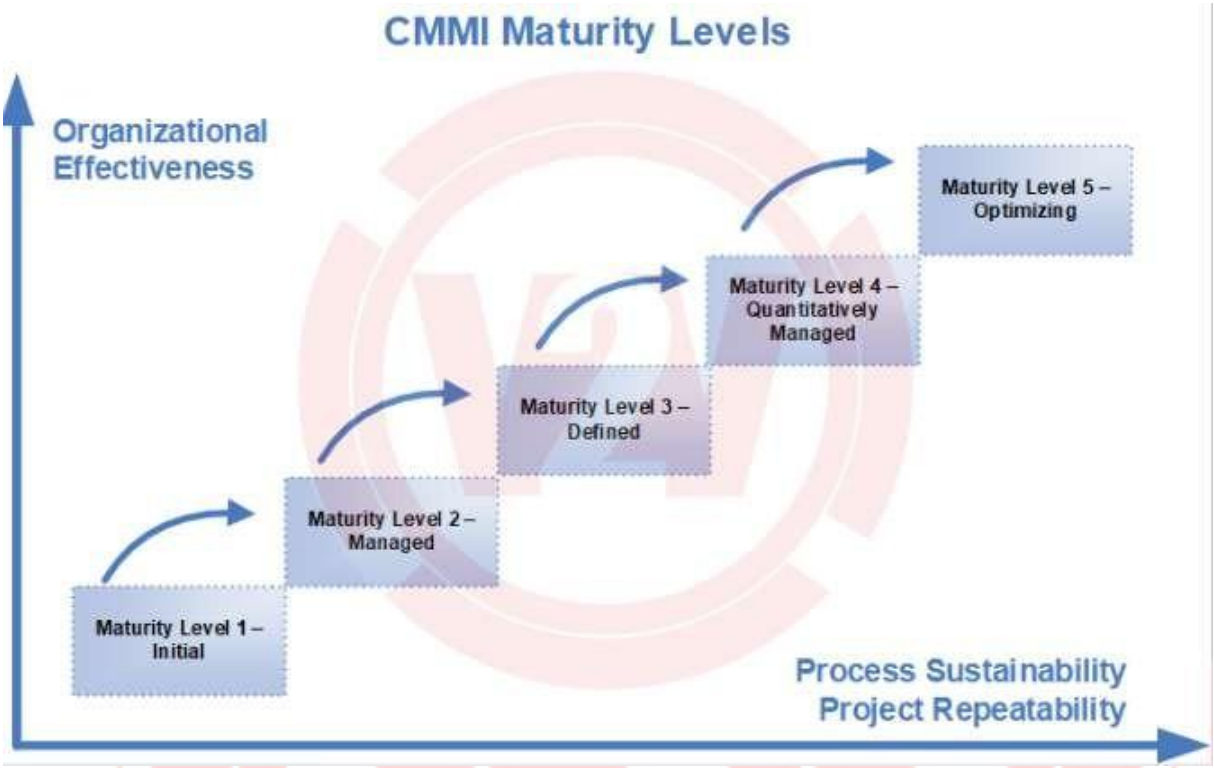
- QA Example:
  Conducting process audits, defining coding standards, or reviewing design documents to ensure proper methodology is followed.
- QC Example:
  Performing software testing, finding bugs, and verifying if the software works as expected.

35. Explain CMMI (Capability Maturity Model Integration) with its levels.

***Ans**: CMMI (Capability Maturity Model Integration)*

 Definition: CMMI is a **process-level improvement training and appraisal program**

that guides software organizations in improving their processes.



CMMI Levels:

Level	**Description**
1	**Initial** – Unpredictable process
2	**Managed – Basic project management processes exist**
3	**Defined – Processes are documented and standardized**
4	**Quantitatively Managed – Processes are measured and controlled**
5	**Optimizing – Focus on continuous improvement**

☐ **Benefits:**

- Structured and measurable process improvement
- Better risk management
- Consistent quality in projects

2. Continuous CMMI Model:

· Continuous maturity models do not classify an organization according to discrete levels. Rather they are finer-grained models that consider individuals or groups of practices.
· The maturity assessment is not, therefore, a single value but a set of values showing the organization's maturity for each process.

CMMI Levels

· The six-point scales assign a level to a process as follows:

Level 0: Not performed: One or more specific goals associated with the process area is not satisfied.

Level 1: Performed: The goals associated with the process area are satisfied and for all processes the scope of the work to be performed.

Level 2: Managed: At this level, the goals associated with the process areas are met and organizational policies are in place that define when each process should be used.

Level 3: Defined: This level focuses on organizational standardization and deployment of processes.

Level 4: Quantitatively Managed: At this level, there is an organizational responsibility to use statistical and other qualitative methods to control sub-processes.

Level 5: Optimizing: At this highest level, the organization must use the process and product measurements to drive process improvement.

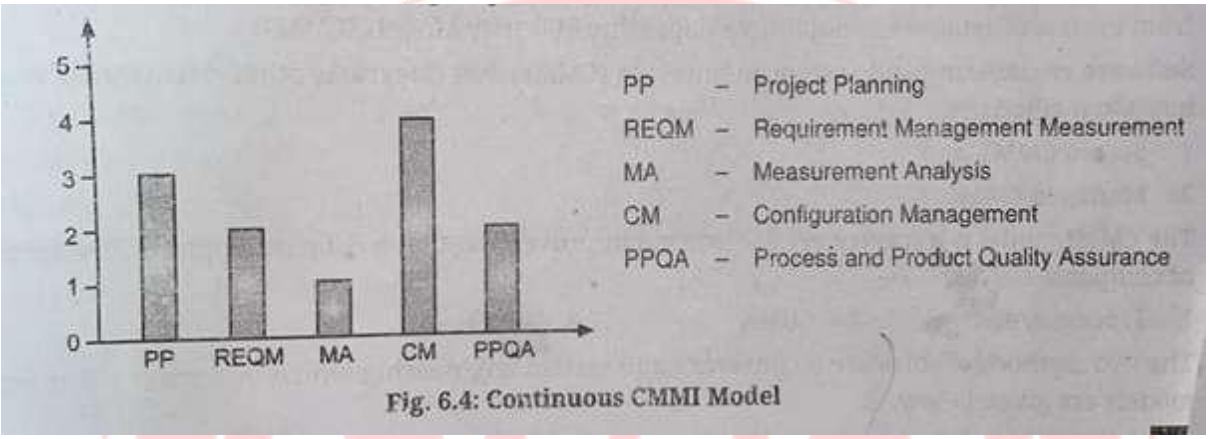


Fig. 6.4: Continuous CMMI Model

Example: A company at **CMMI Level 3** has all project processes well documented anduses defined standards for development.

36. Explain software quality assurance (SQA) processes.

Ans: Software Quality Assurance (SQA) is a systematic set of activities designed to ensure that the software development process and the final product meet the required quality standards and satisfy customer requirements.

It focuses on preventing defects in the software throughout the development lifecycle, not just detecting them during testing.

Main Objective of SQA:

- To ensure that the software development process is well-defined, effective, and follows standards.
- To produce high-quality, reliable, and maintainable software.
- To prevent errors rather than just finding them after coding.

Who Performs SQA?

- The SQA team (independent from the development team).
- Includes QA engineers, auditors, and process managers.

Software Quality Assurance Process – Overview

The SQA process is carried out throughout the Software Development Life Cycle (SDLC) and involves the following key steps

1 Establish Quality Goals and Standards

- Define quality objectives and acceptance criteria for the project.
- Select quality models and standards such as ISO 9001, CMMI, or IEEE standards.
- Decide which metrics will be used to measure quality (e.g., defect density, reliability, maintainability).

2 Develop a Quality Assurance Plan

- Create a Software Quality Assurance Plan (SQAP) that defines:
    - QA activities and responsibilities
    - Schedule and tools
    - Review and audit methods
    - Testing procedures
- The plan acts as a roadmap for ensuring quality throughout the project.

3 Define and Implement Software Development Processes

- Define standard procedures for each SDLC phase (requirements, design, coding, testing, maintenance).
- Ensure all team members follow the same process.
- Provide templates, checklists, and guidelines to maintain consistency.

4 Conduct Reviews and Audits

- Perform regular technical reviews, inspections, and walkthroughs to identify errors early.
- Conduct process audits to verify compliance with defined standards and procedures.

5 Perform Testing Activities

- Testing is part of SQA but not the only activity.
- Conduct unit testing, integration testing, system testing, and acceptance testing to verify and validate the software.

6 Measure, Monitor, and Report Quality

- Use software metrics (like defect density, code coverage, reliability) to measure process and product quality.
- Track progress using QA reports and identify areas needing improvement.

7 Control and Manage Changes

- Implement a change control process to handle modifications in requirements, design, or code.
- Ensure every change is reviewed, tested, and approved.

8 Take Corrective and Preventive Actions

- When issues are found, identify root causes and take corrective actions to fix them.
- Implement preventive measures to avoid similar defects in the future.

9 Continuous Process Improvement

- Continuously improve the quality process using feedback, audits, and lessons learned.
- Adopt models like CMMI Level 5 or PDCA (Plan–Do–Check–Act) cycle.

37. Explain SIX Sigma with DMAIC & DMADV

Ans: Six Sigma is a data-driven quality management approach that aims to reduce defects, improve processes, and ensure near-perfect quality in software or product development.

It focuses on continuous improvement by identifying and eliminating the causes of errors or variations in processes.

◇ Meaning of “Six Sigma”:

- “Sigma (σ)” is a statistical term that measures process variation (i.e., how much a process deviates from perfection).

- Six Sigma means only 3.4 defects per million opportunities (DPMO) — representing 99.99966% quality accuracy.

👉 In simple terms:
The higher the sigma level, the fewer the defects.

◇ Objectives of Six Sigma:

1. To improve software quality by minimizing defects.
2. To increase customer satisfaction through reliable and consistent performance.
3. To reduce costs by improving process efficiency.
4. To enhance productivity and decision-making using data and statistical analysis.

◇ Six Sigma Methodologies:

There are two main approaches used in Six Sigma:

1. DMAIC (for improving existing processes)

Used when a process already exists but needs improvement.

Phase	Description
D – Define	Define the problem and customer requirements.
M – Measure	Measure current performance and collect data.
A – Analyze	Analyze data to find root causes of defects.
I – Improve	Implement solutions to remove causes of defects.
C – Control	Monitor the process to maintain improvements.

---

2. DMADV (for creating new processes/products)

Used when a new process or product is being developed.

Phase	Description
D – Define	Define project goals and customer needs.
M – Measure	Measure and identify critical quality factors.
A – Analyze	Analyze different design options.
D – Design	Design the process or product.
V – Verify	Verify that the design meets customer expectations.

◇ Key Principles of Six Sigma

1. Customer Focus:
   The primary goal is to meet or exceed customer expectations.
2. Data-Driven Decision Making:
   All decisions are based on statistical data, not assumptions.
3. Process Improvement:
   Focus on improving business and software development processes.
4. Employee Involvement:
   Encourages teamwork and involvement of every employee.
5. Defect Prevention:
   Emphasizes preventing errors rather than fixing them later.
6. Continuous Improvement:
   Promotes ongoing efforts to enhance processes and performance.

38. Define Unit Testing , Integration testing , alpa testing , beta testing , acceptance testing , bang bang , performance testing , stress , Software Engineering , defect , bug, error, fault, failure.

Ans:

🧩 1. Software Engineering (Definition)

Software Engineering is the systematic, disciplined, and quantifiable approach to the development, operation, and maintenance of software.
It applies engineering principles to produce reliable and efficient software systems.

🧪 2. Unit Testing

Unit Testing is a testing technique where individual modules or components of software are tested in isolation to ensure that each part works correctly.
☑ *Example:* Testing a single function that calculates the total bill in a billing system.

🔗 3. Integration Testing

Integration Testing is the process of testing the interfaces and interactions between integrated modules to ensure they work together correctly.

Types:

- Top-Down: Testing starts from top modules to lower ones.
- Bottom-Up: Testing starts from lower modules to upper ones.
- Big Bang: All modules are combined and tested at once.
- Sandwich (Hybrid): Combines both top-down and bottom-up approaches.

🚻 4. Alpha Testing

Alpha Testing is performed by internal employees/testers at the developer's site before the product is released to users.

☑ *Goal:* Identify bugs before releasing the software to external users.

👥 5. Beta Testing

Beta Testing is performed by real users at their locations after Alpha Testing and before the final release.

☑ *Goal:* Get user feedback and detect real-world issues.

📋 6. Acceptance Testing

Acceptance Testing is done to verify whether the software meets customer requirements and is ready for delivery.

Types:

- User Acceptance Testing (UAT) – Done by end users.
- Business Acceptance Testing (BAT) – Done by business team.
- Contract Acceptance Testing (CAT) – Based on agreement terms.

☑ *Goal:* Confirm that the software satisfies the business needs.

💥 7. Big Bang Testing

Big Bang Testing is an integration testing approach in which all modules are combined at once and tested together as a complete system.

⚠ *Disadvantage:* Difficult to identify which module caused the failure if an error occurs.

🚀 8. Performance Testing

Performance Testing checks how well the software performs under expected workloads, such as speed, scalability, and stability.

☑ *Goal:* Ensure system works efficiently under normal conditions.

🔧 *Example:* Measuring response time of a website.

⚡ 9. Stress Testing

Stress Testing evaluates the system's behavior under extreme or beyond-limit conditions, such as heavy load or low memory.

☑ *Goal:* Check how the system handles overload or crashes gracefully.

🔧 *Example:* Simulating 10,000 users on an app designed for 5,000.

😵 10. Error

An Error is a mistake made by a developer or user during coding, design, or requirement interpretation.

🧩 *Example:* Typo in code, wrong formula, or incorrect logic.

🐞 11. Bug

A Bug is a defect found during testing that causes the software to behave unexpectedly.

🧩 *Example:* Login page not accepting correct credentials.

⚙ 12. Defect

A Defect is a deviation from the expected result found by a tester during testing.

☑ In simple terms, a bug reported and accepted by the developer is called a defect.

🔍 13. Fault

A Fault is the root cause of a failure, usually due to an error in design, code, or logic.

🧩 *Example:* Wrong algorithm implemented in a function.

❌ 14. Failure

A Failure occurs when the software does not perform as expected during execution.

🧩 *Example:* Application crashes when clicking "Save".

36. Explain Software Testing Life cycle.

Ans: Definition:

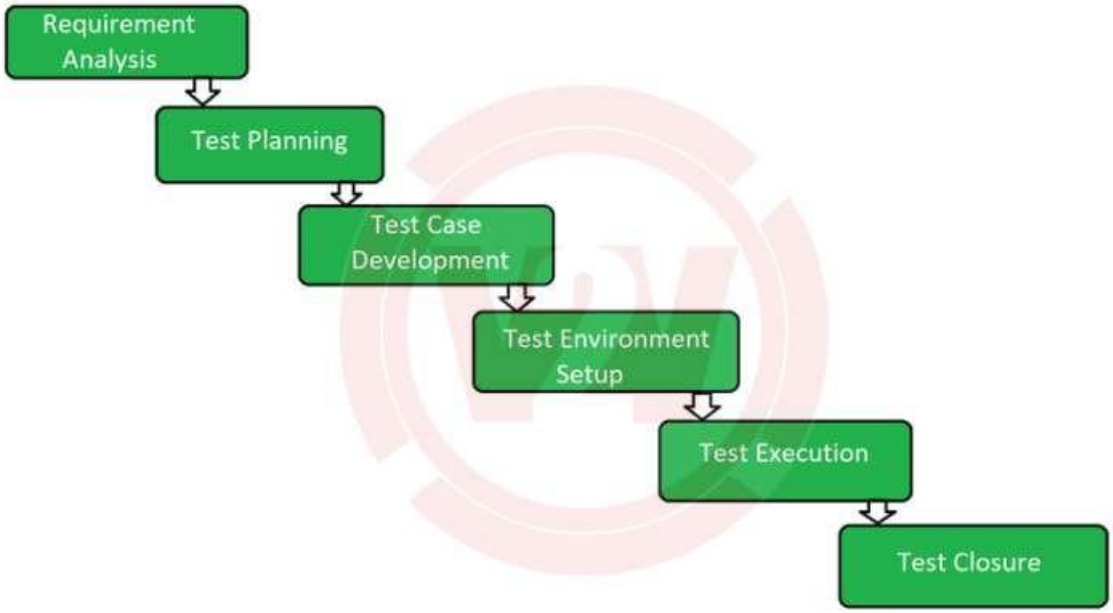
The Software Testing Life Cycle (STLC) is a sequence of specific activities performed during the testing process to ensure that software meets the required quality standards.

It defines how testing is planned, designed, executed, and completed systematically.

⚙️ Phases of STLC

Phase	Description	Key Activities / Deliverables
1. Requirement Analysis	Testers study and analyze the software requirements to identify what needs to be tested.	• Understand requirements (Functional & Non-functional) • Identify testable requirements • Prepare Requirement Traceability Matrix (RTM)
2. Test Planning	A Test Plan is created defining the scope, strategy, resources, and schedule of testing.	• Prepare Test Plan • Define roles & responsibilities • Estimate effort & resources • Identify testing tools

3. Test Case Design / Development	Testers write test cases, test scripts, and test data based on requirements.	• Design detailed test cases • Prepare test data • Review and get approval of test cases
4. Test Environment Setup	The required hardware, software, and network configuration is set up to execute tests.	• Configure test servers • Install applications and tools • Prepare test environment ready report
5. Test Execution	Testers execute test cases in the prepared environment and record results.	• Execute test cases • Compare expected vs actual results • Log defects (if any) in the defect tracking tool
6. Defect Reporting & Tracking	Defects found during execution are logged, tracked, and retested after fixing.	• Report defects with details • Retest after developer fixes • Update defect status (open, fixed, closed)
7. Test Closure	Testing team ensures all planned tests are completed and prepares a Test Summary Report.	• Evaluate test coverage • Record lessons learned • Prepare Test Closure Report



☑ Key Points:

- STLC starts after Software Development Life Cycle (SDLC) requirement phase begins.
- Each phase has entry and exit criteria to ensure quality.
- Helps in systematic, efficient, and error-free testing.

▨ Example:

For a Login Page Testing,

- Requirement Analysis → Identify username & password validation
- Test Planning → Plan manual and automation testing
- Test Case Development → Write positive & negative test cases
- Test Execution → Run test cases
- Defect Reporting → Log issue "Login fails for valid credentials"
- Test Closure → Verify all defects are fixed and report testing summary

39. Differentiate between Manual Testing and Automation Testing.

Ans: Difference Between Manual Testing and Automation Testing

Aspect	Manual Testing	Automation Testing
Definition	Testing of software manually by a human tester without using any automation tools.	Testing of software using automation tools or scripts to execute test cases.
Execution	Test cases are executed step-by-step by testers.	Test scripts are executed automatically by testing tools.
Tools Used	No tools required; uses test cases, checklists.	Uses tools like Selenium, QTP, JUnit, Appium, LoadRunner, etc.
Speed	Slower — as tests are performed by humans.	Faster — as scripts run automatically.
Accuracy	Prone to human errors.	More accurate and consistent results.
Initial Cost	Low initial cost (only human effort).	High initial cost (tool purchase + script creation).
Maintenance	Easier to modify test cases.	Test scripts need maintenance when the application changes.
Best Suited For	Exploratory, Usability, Ad-hoc testing.	Regression, Performance, Load, and Repeated tests.
Human Involvement	High — tester observes and judges the system's behavior.	Low — only requires supervision of script execution.
Reliability	Depends on tester's experience.	Highly reliable due to consistent test execution.
Time Consumption	Takes more time, especially for large projects.	Saves time in long-term testing cycles.
Programming Knowledge	Not required.	Required to write automation scripts.
Reusability	Test cases must be executed again for every cycle.	Scripts can be reused across multiple builds or releases.
Examples	Manual UI Testing, Exploratory Testing.	Selenium Testing, Load Testing, API Automation.