SOFTWARE ENGINEERING

UNIT I - INTRODUCTION

- Software Engineering paradigms – Waterfall Life cycle model – Spiral Model – Prototype Model – Fourth Generation Techniques – Planning – Software Project Scheduling, – Risk analysis and management – Requirements and Specification

UNIT II - SOFTWARE DESIGN

- Abstraction – Modularity – Software Architecture – Cohesion – Coupling – Various Design Concepts and notations – Real time and Distributed System Design – Documentation – Dataflow Oriented design – Jackson System development – Designing for reuse – Programming standards – Case Study for Design of any Application Project.

UNIT III - SOFTWARE TESTING AND MAINTENANCE

- Software Testing Fundamentals – Software testing strategies – Black Box Testing – White Box Testing – System Testing – Object Orientation Testing – State based Testing - Testing Tools – Test Case Management – Software Maintenance Organization – Maintenance Report – Types of Maintenance

UNIY IV - SOFTWARE METRICS

- Scope – Classification of metrics – Measuring Process and Product attributes – Direct and Indirect measures – Cost Estimation - Reliability – Software Quality Assurance – Standards – COCOMO model.

UNIT V - SCM

- Need for SCM – Version Control – SCM process – Software Configuration Items – Taxonomy – CASE Repository – Features – Web Engineering

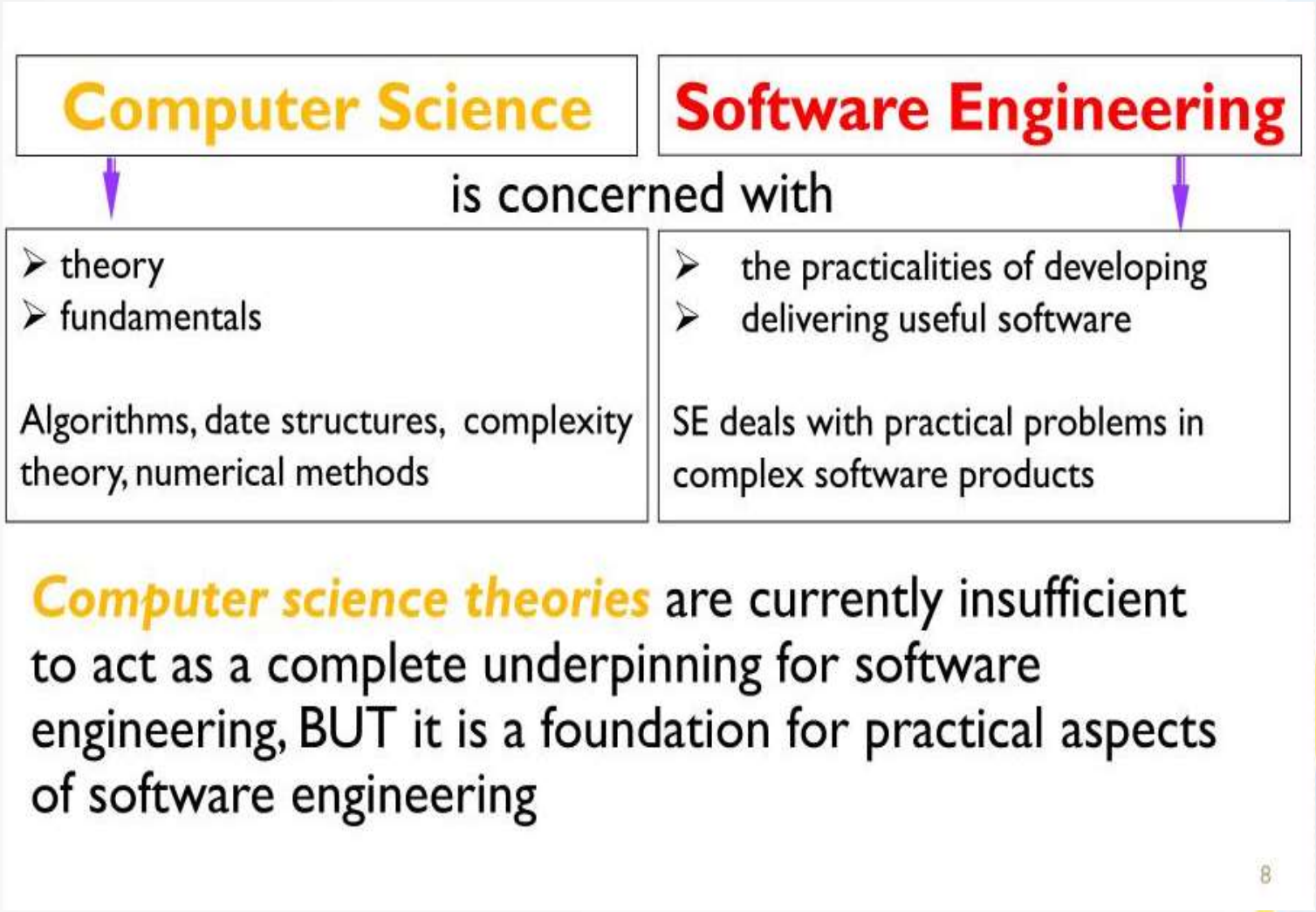
UNIT I - INTRODUCTION:

- Software is more than just a program code.
- A program is an executable code, which servers some computational purpose.
- Software is the collection of computer programs, procedures rules and associated documentation and data.
- Software is an information transformer-producing, managing, modifying, displaying or transforming information that can simple as a single bit or a complex as a multimedia application.

Software Products:

- Software products may be developed for a particular customer or may be developed for a general market.
- **Software products may be:**
  - Generic
  - Bespoke
- **What are the attributes of good software?**
  - Maintainability.
  - Dependability
  - Efficiency
  - Usability

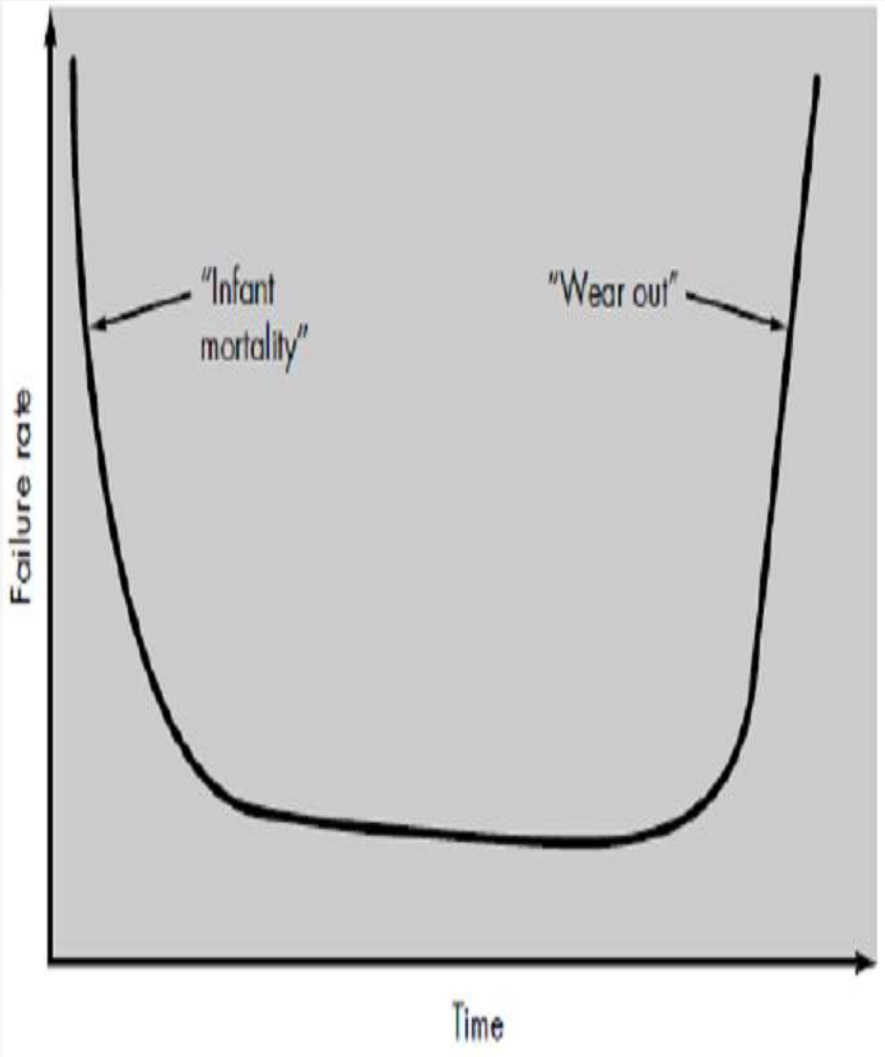
What is the difference between software engineering and computer science?

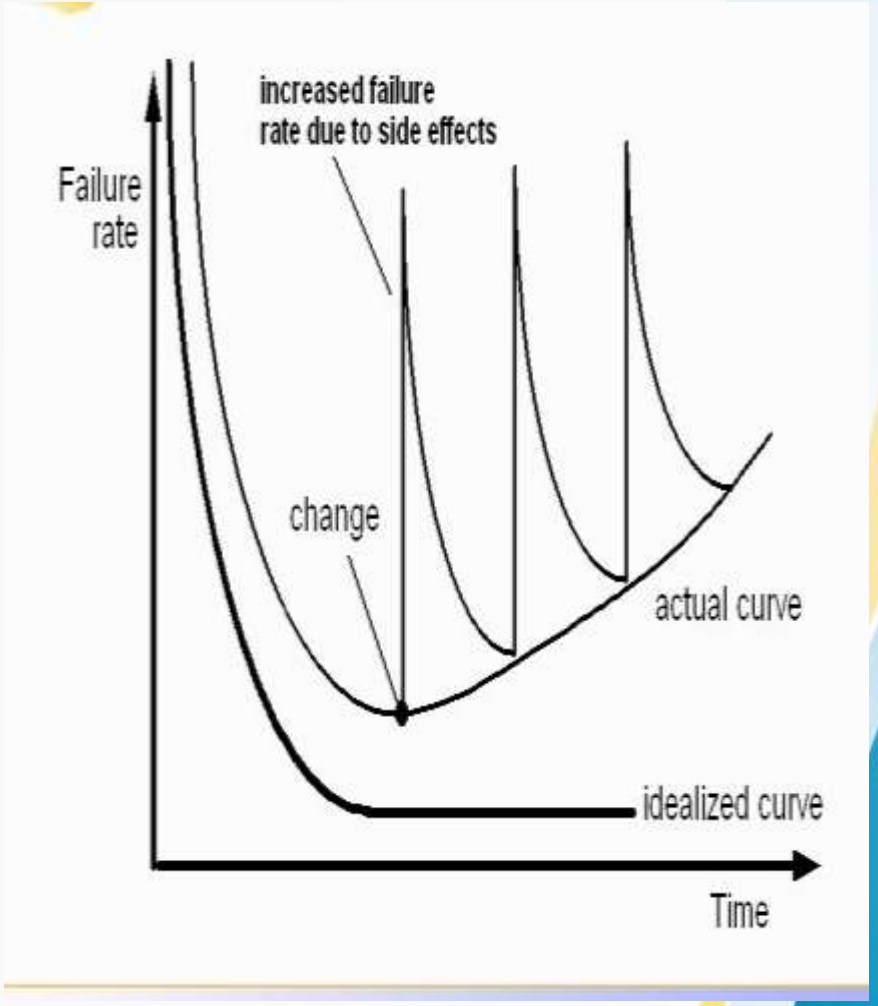


Software Engineering Paradigms:

Software Characteristics:

- Software is developed or engineered, it is not manufactured in the classical sence.
- Software doesn’t “wear out”.
- Although the industry is moving towards component based assembly, most software continues to be custom to built.


"Infant mortality"
"Wear out"
Failure rate
Time

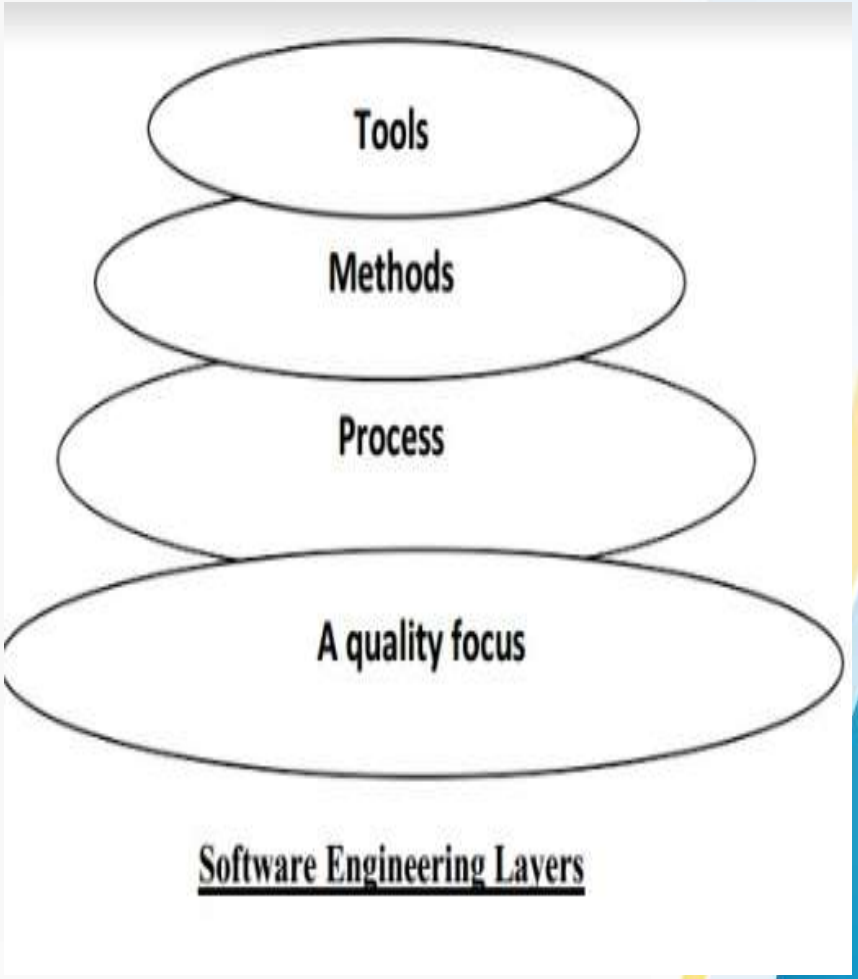

increased failure rate due to side effects
Failure rate
change
actual curve
idealized curve
Time

Software Applications Types:

- System Software.
- Real-time Software.
- Business Software.
- Engineering and Scientific Software.
- Embedded Software.
- Personal Computer Software.
- Web-based Software.
- Artifical Intelligence Software.

Software Engineering -A layered Technology:

- Application of a systematic, disciplined, quantifiable approach to the development, operation and maintenance of software that is, the application of engineering software.



What are the five generic process framework activities?

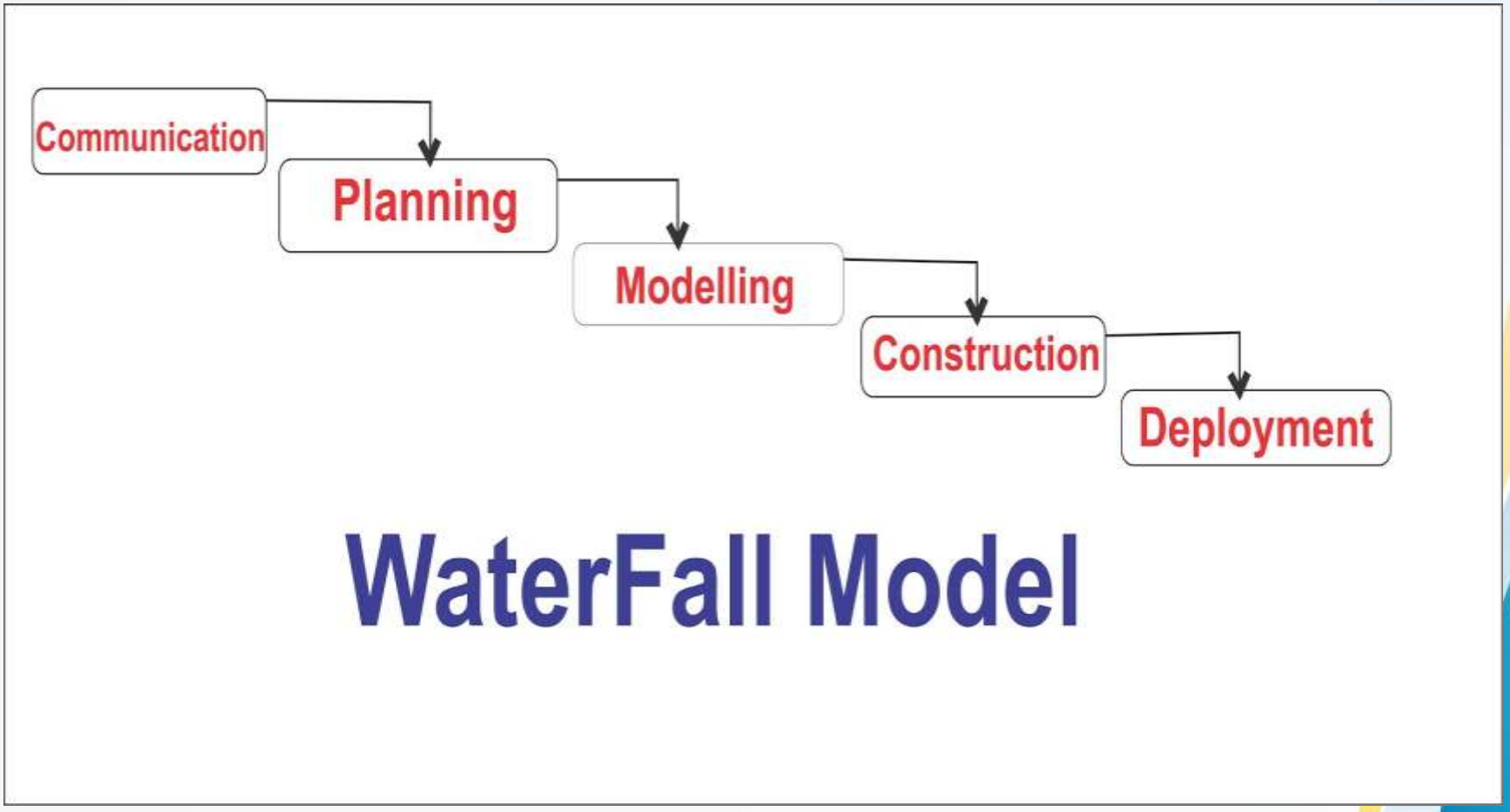
- The following generic process framework is applicable to the majority of software projects.
  - Communication.
  - Planning.
  - Modeling.
  - Construction.
  - Deployment.

Process Models:

- Every software engineering organization should describe a unique set of framework activities for the software process it adopts.
  - Waterfall Life Cycle Model.
  - Iterative Waterfall Life Cycle Model.
  - Prototyping Model.
  - Incremental Model.
  - Sprial Model.
  - RAD Model.
  - Sprial Model.

Waterfall Life Cycle Model.

- It is called classic life cycle or Linear model.
- Requirements are well defined and stable.
- It suggests a systematic, sequential approach to software development.
- It begins with customer specification of requirements and progresses.
    - Planning.
    - Modeling.
    - Construction and
    - Deployment.


Communication
Planning
Modelling
Construction
Deployment
WaterFall Model

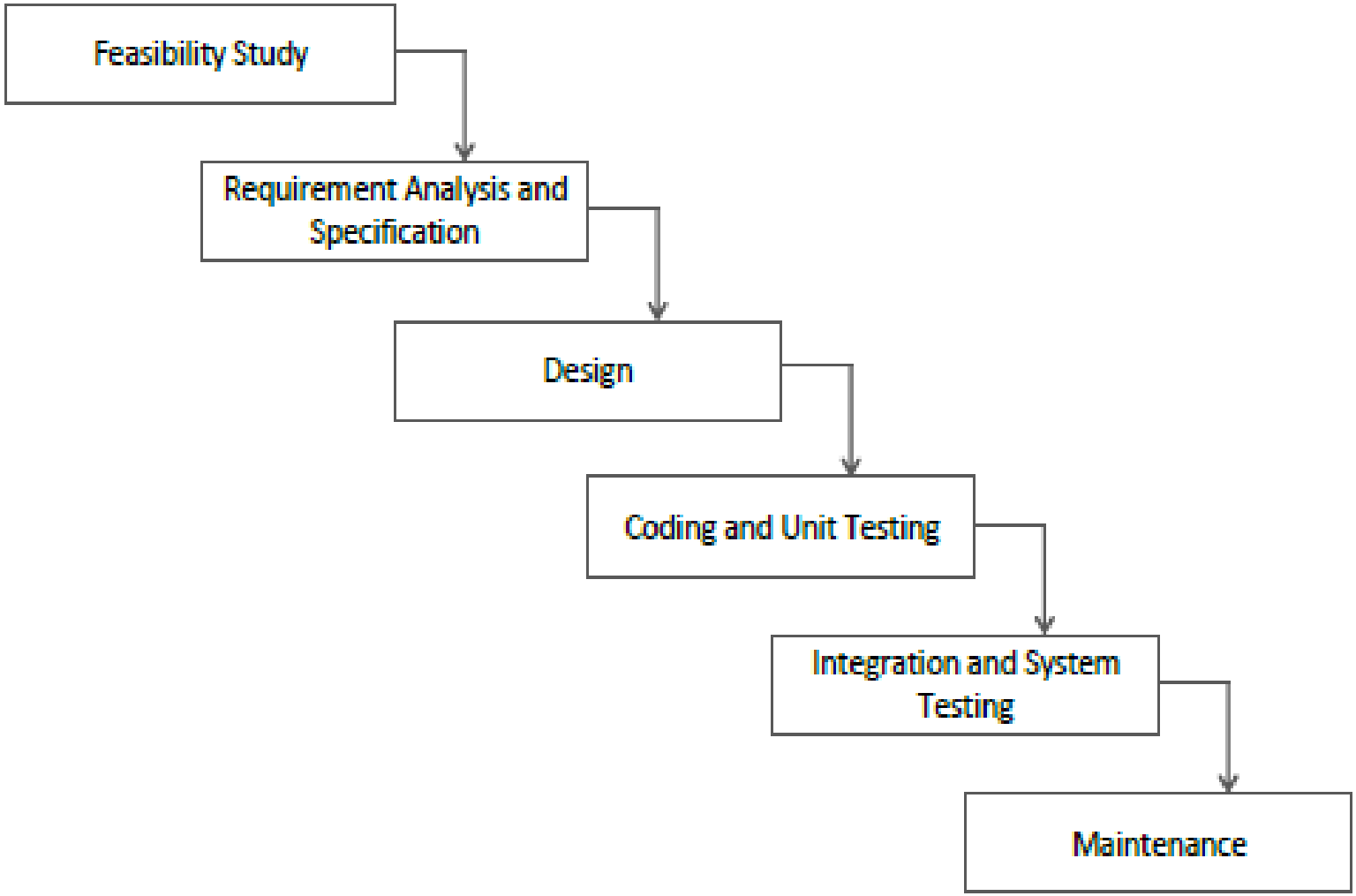
Advantages:

- Easy to understand.
- Each phase has well defined input and output.
- Helps project manger in proper planning of project.
- Provides a templates into which methods of analysis, design, code and support can be placed.

Disadvantages:

- One way street.
- It lack overlapping and interactions among phases.
- Model doesn’t support delivery of system in pieces.

Phases of the Classical Waterfall Model:



Feasibility Study:

- It involves analysis of the problem and collection of allrelevant information relating to the product.
- The collected data are analysed.
  - Requriments of the Customer.
  - Formulations of the different strategies for solving the problem.
  - Evaluation of different solution strategies.

Requriments Analysis and Specification:

- It is understand the exact requriments of the customer and to document them properly.
  - Requirements gathering and analysis.
  - Requirements specification.

Design:

- The deign phase is to transform the requirements specified in the document into a structure that is suitable for implementation in some programming languaage.
    - Traditional Design Approach.
    - Object-Oriented Design Approach.

Coding and Unit Testing:

- The purpose mof the coding and unit testing phase of software development is to translate the software design into source code.

Integration and System Testing:

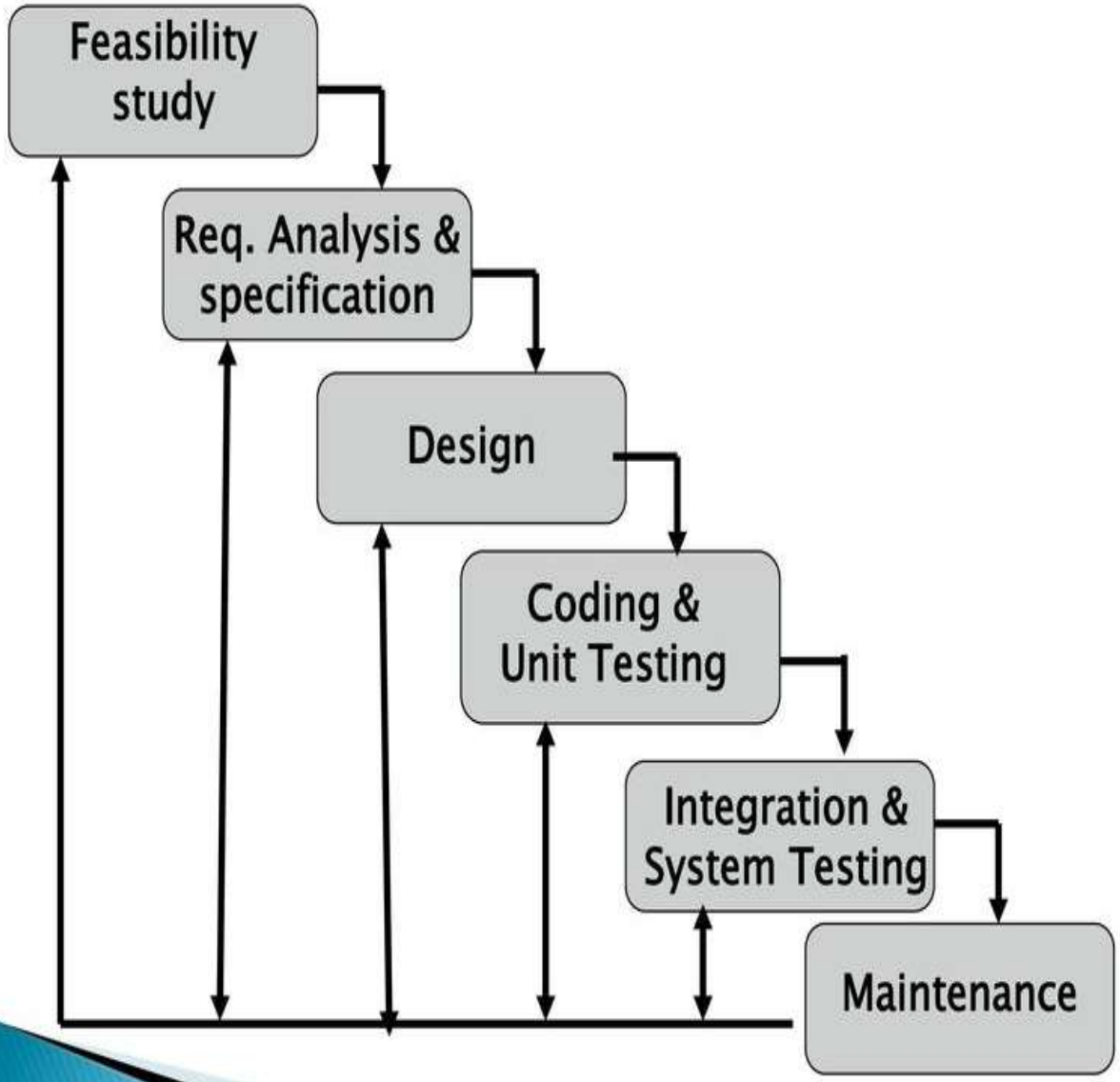
- ‘Integration of different modules is coded and unit tested.
    - $\alpha - Testing$
    - $\beta - Testing$
    - Accsptance Testing.

Maintenance:

- Maintenance of a typical software products requires much more than the effort necessary to develope the product itself.

Iterative Waterfall life cycle model:

- The main changes is done by providing feedback paths from every phase to its preceding phase.


Feasibility study
Req. Analysis & specification
Design
Coding & Unit Testing
Integration & System Testing
Maintenance

Prototype Model:

- Prototyping Model is a software development model in which prototype is built, tested, and reworked until an acceptable prototype is achieved.

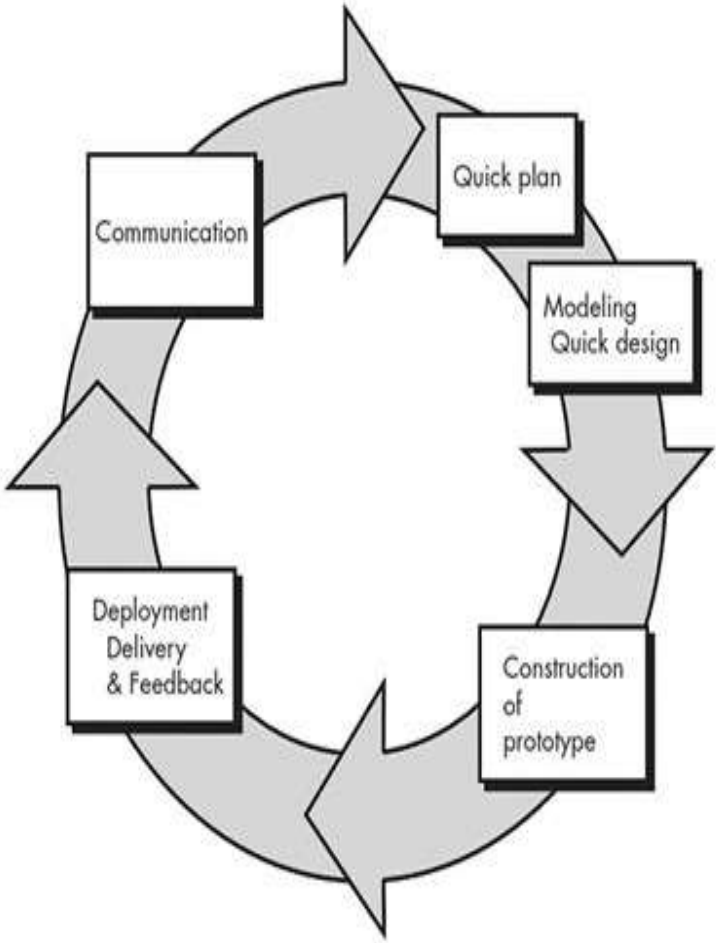


Figure: Prototype Model

Advantages:

- Clarity.
- Risk Identification.
- Good Environment.
- Take less time to complete.

Disadvantages:

- High cost.
- Slow process.
- Too many changes.

RAD Model:

- Rapid Application Development(RAD) is an incremental software model that a short development cycle.
- The RAD model is a “high-speed” of the waterfall model.
- The RAD process enables a development team to create a fully functional system within a very short time period.

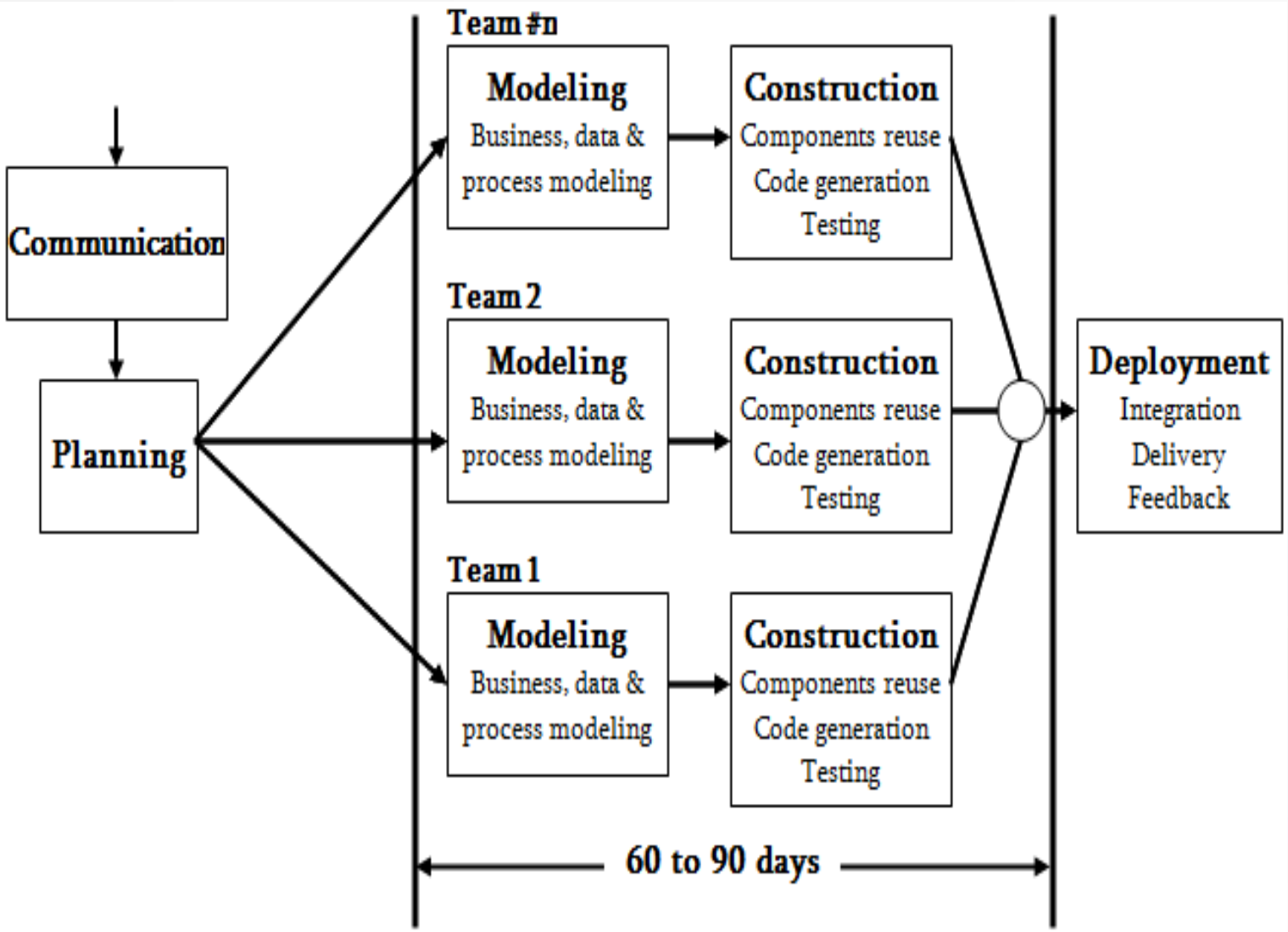


Figure : Flowchart of RAD model

Contents of RAD Pakages:

- Graphical user development environment.
- Reusable Components.
- Code generator.
- Programming Language.

Advantages:

- Fast products.
- Efficient Documentation.
- Interaction with user.

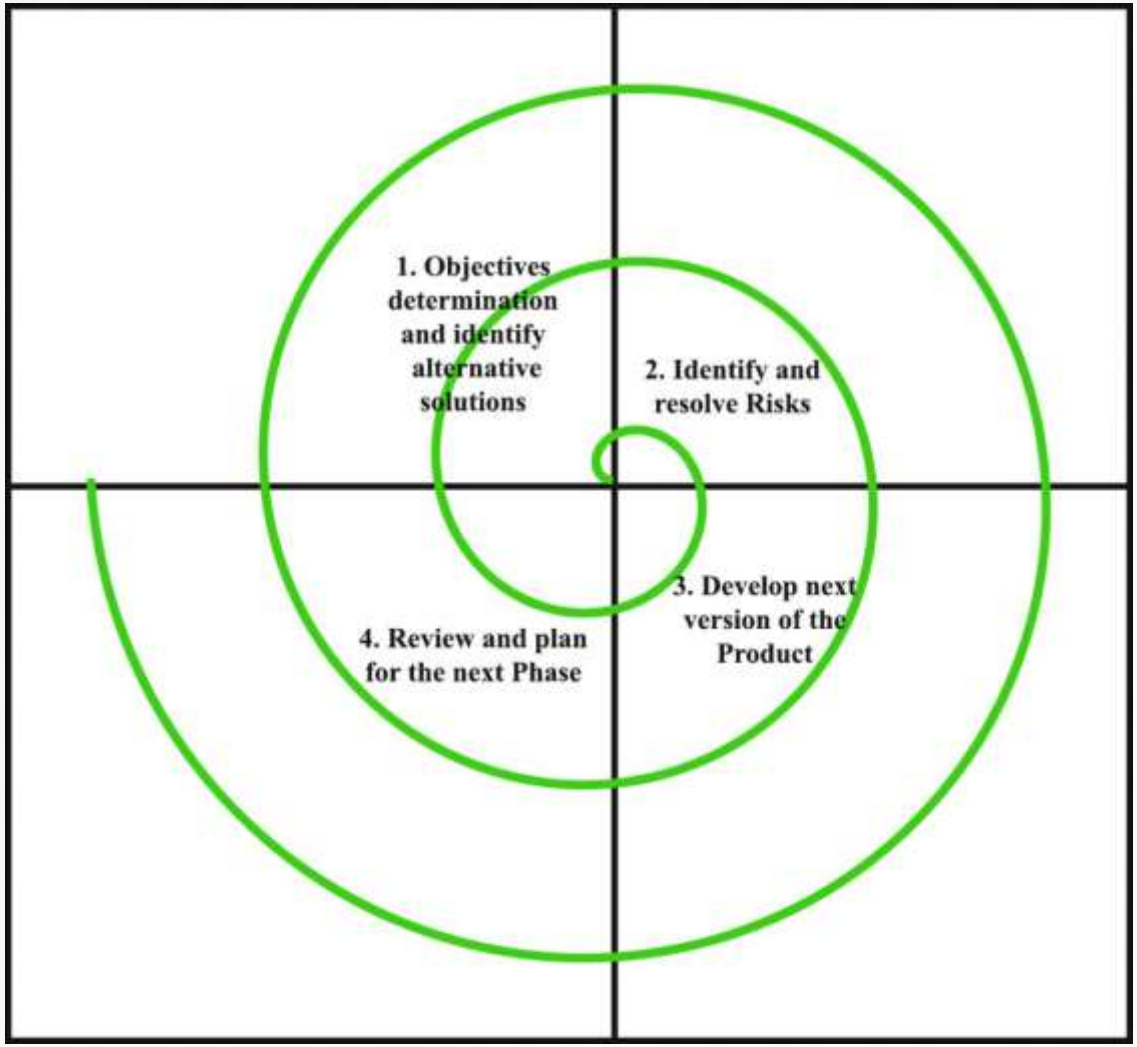
Disadvantages:

- User may not like fast activities.
- Not suitable for technical risks.

Sprial Model :

- This Spiral model is a combination of iterative development process model and sequential linear development model i.e. the waterfall model with a very high emphasis on risk analysis.
- The spiral model has four phases: Planning, Design, Construct and Evaluation.

Quadrants in sprial model :



Advantages :

- Risk Identification at early stage.
- Suitable for high rk projects.
- Flexibility for adding functionaility.

Disadvantages:

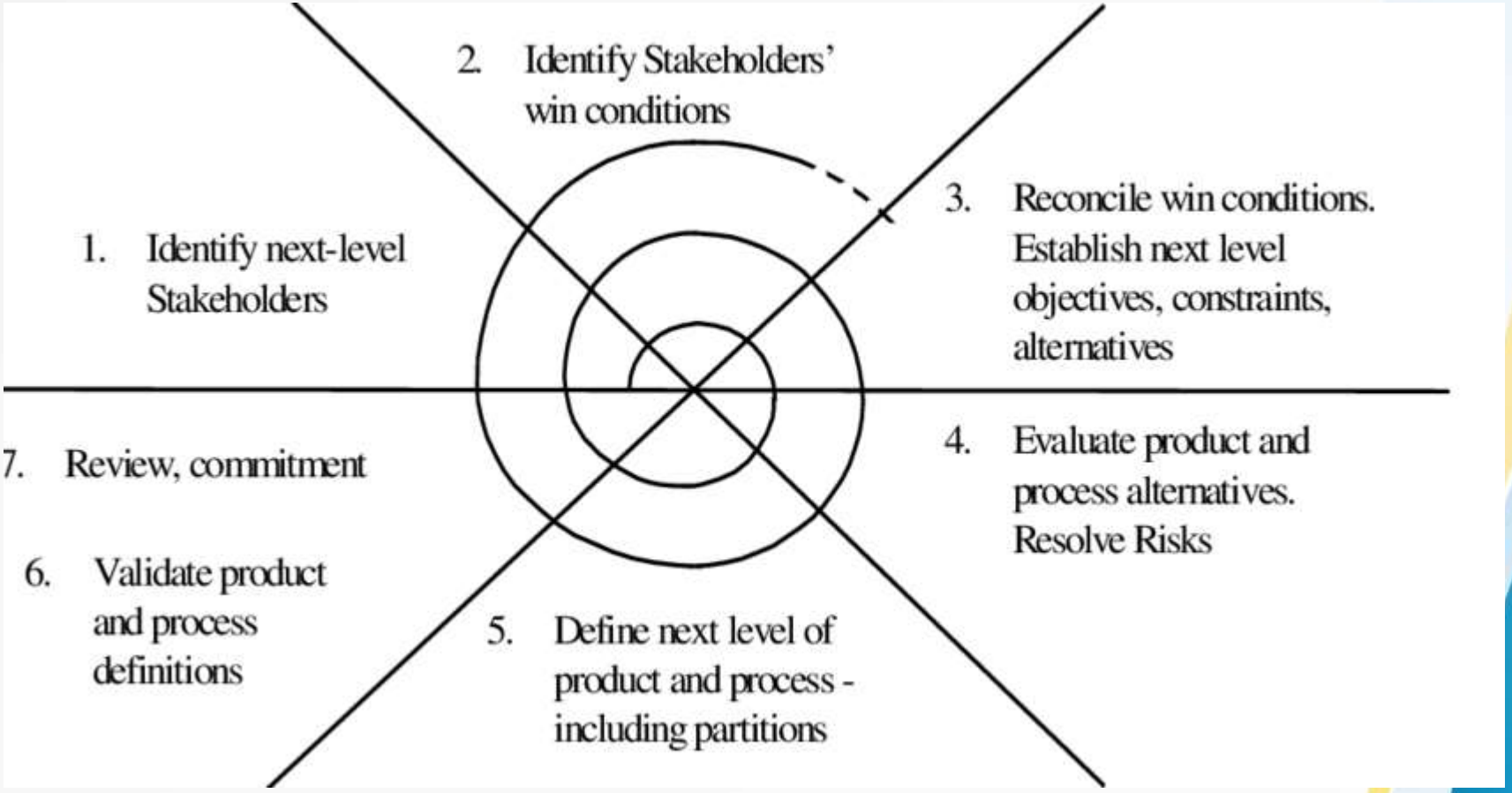
- Costly.
- Risk dependent.
- Not suitable for smaller projects.
- Difficult to meeting budget.

Win-Win Sprial Model:

- The customer wins by getting the system satisfying most of thier requirements and developers winsby working on achievable budgets and deadlines.
- **Advantages:**
- Lieghtweight methods suit small-medium size project.
- Produces good team.
- Test based approach to requirements and quality assurance

Diadvantages:

- Programming pairs is costly.
- Difficult to scale up to large projects where documentation.


2. Identify Stakeholders' win conditions
3. Reconcile win conditions. Establish next level objectives, constraints, alternatives
1. Identify next-level Stakeholders
4. Evaluate product and process alternatives. Resolve Risks
7. Review, commitment
6. Validate product and process definitions
5. Define next level of product and process - including partitions

Fourth Generation Techniques:

- Introduction:
- The tools in automatically generate ource code based on the developers specification.

Software development environment that supports the 4GT paradigm includes some or all of the following tools:

- 1) Non-procedural languages for database query
- 2) Report generation
- 3) Data manipulation
- 4) Screen interaction and definition
- 5) Code generation and High-level graphics capability
- 6) Spreadsheet capability
- 7) Automated generation of HTML and similar languages used for Web-site creation using advanced software tools.

Advantages:

- Reduction in software development.
- Improved productivity of software engineers.
- 4GT helped by CASE tools and code generators.

Disadvantages:

- Some 4GT are not at all easier than programming languages.
- Generated source code are sometimes inefficient.
- Time is reduced for only small and medium projects.

Planning:

- Software planning process include steps to estimate the size of the software work products and the resources needed produces a schedule identify and access software risks.
- **During planning a project is split into several activities :**
- How much efforts is required to complete each activities?
- How much calender time is needed?
- How much will the completed activity cost?

Planning Objectives:

- Understand the scope of the problem.
- Make use of past historical data.
- Estimate effort or function or size.
- Define a project schedule.

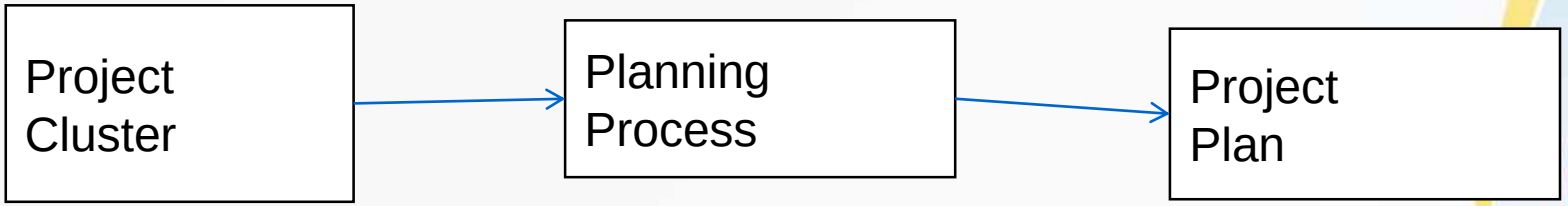
Characteristics of software project planning:

- Scope.
- Resource.
- Time.
- Quality.
- Risk.


Risk
Risk
Time
Scope
Risk
Risk
Resource
Quality
Risk
Risk
Copyright Coley Consulting 2001-2006

Project Plan:

- The biggest single problem that afflicts software developing is that of underestimating resources required for a project.
- According to the project management body of knowledge.
- According to PRINCE(PRojects IN Controlled Environments).



Types of Project Plan:

- Software development plan.
- Quality Assurance Plan.
- Validation Plan.
- Configuration Management Plan.
- Maintenance Plan.
- Staff development plan.

Structure of a software project management plan:

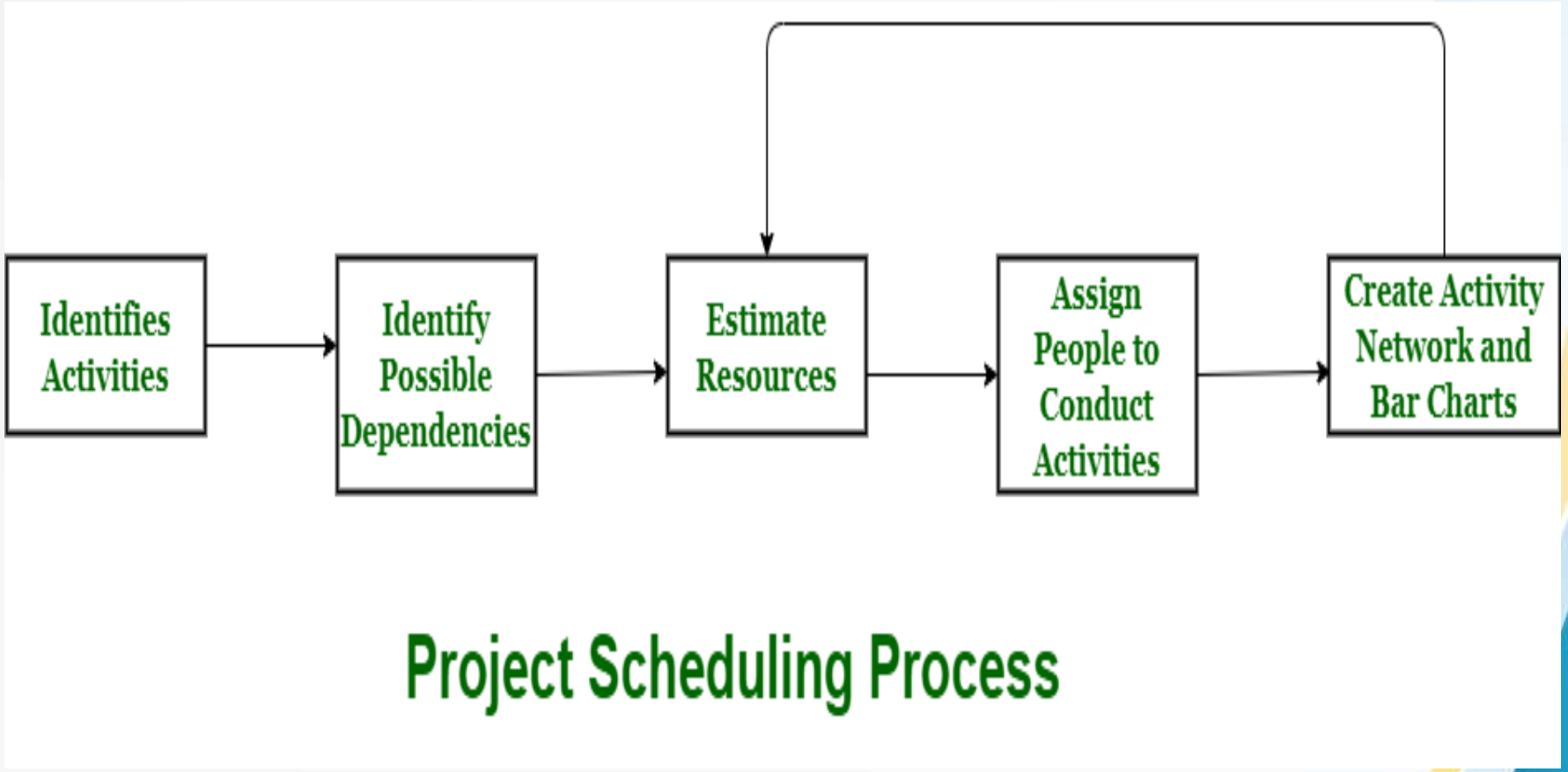
Project summary.
Project planning.

Major issues in planning a software project:

- Software requiremments are frequently incorrect and incomplete.
- Planning schedule and cost are not updated and are based on marketing needs, not system requirements.
- Cost and schedule are not re-estimated when requirements or development environment change.

Software Project Scheduling:

- **Introduction:**
- Software project scheduling is an distributes estimated effort across the planned project.
- Project schedulinginvolves seperating the total work involved in a project in seperate activities and judging the time required to complete the activities.



Project Scheduling Process

Basic principles of software project scheduling:

- Compartmentalization.
- Interdependency.
- Time Allocation.
- Effort Validation.
- Defined Responsibilities.
- Defined outcomes.
- Defined Milestones.

Relationship between people and effort:

- The PNR curve provides an indication of the relationship between effort applied and delivery time for a software project.

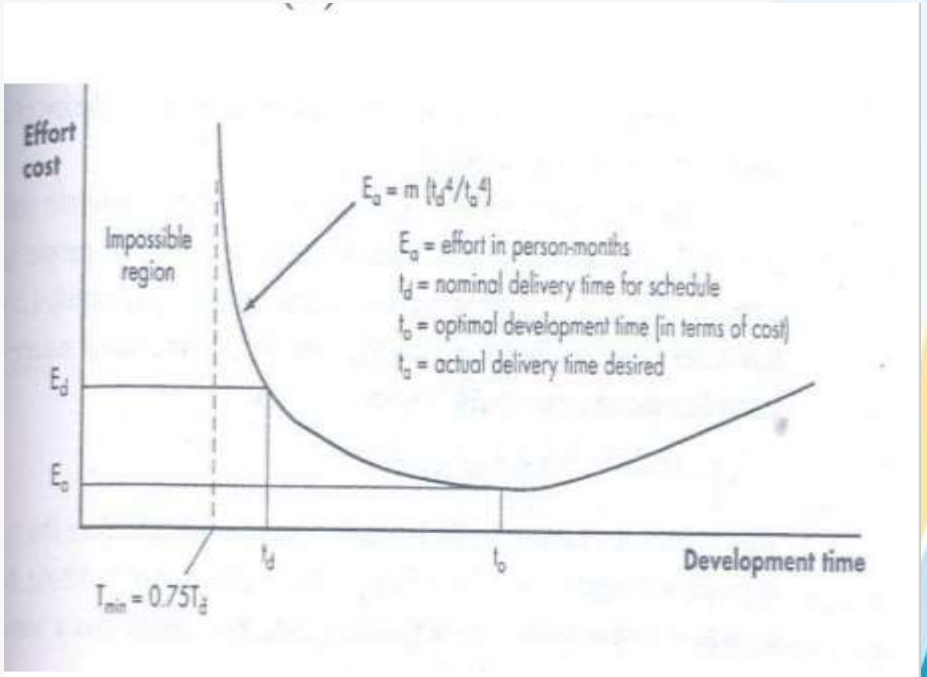


Figure 24.1: Putnam-Norden-Rayleigh (PNR) Curve

Effort Distribution:

- A recommended distribution of effort the software process is often referred to as the 40-20-40 rule.

Defining a task set for the software project:

- A task set is a collection of software engineering work tasks, milestones, and work products that must be acomplished to complete a particular project.
  - Concept Development projects.
  - New application development projects.
  - Application enhancement projects.
  - Application maintenance projects.
  - Re-Engineering projects.

Example of a task set:

- **Concept Scoping:** It determines the overall scope of the project.
- **Preliminary concept planning:** It establishes the organization ability to undertake the work implied by the project scope.
- **Technology Risk Assessment:** It evaluates the risk associated with the technology to be implemented as part of project scope.
- **Concept Implementation:** It implement the concept representation in a manner that can be reviewed by a customer and is used marketing purposes.

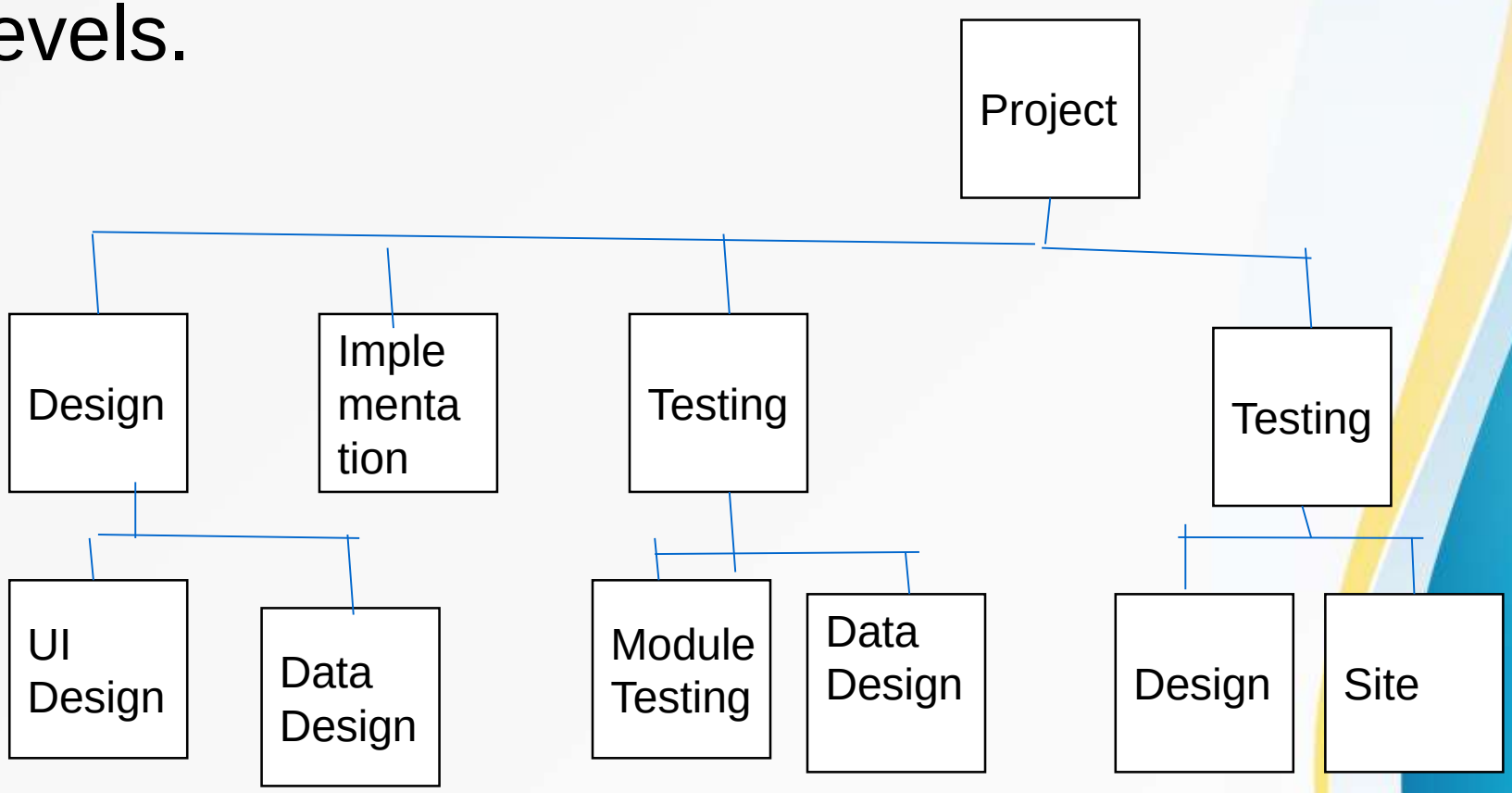
- **Customer Reaction:** Customer reaction to the concept feedback on a new technology concept and target specific customer applications.

Scheduling Techniques:

- Scheduling of a software project does not differ greatly from scheduling of any multitask engineering effort.
    - Work Breakdown Structure(WBS).
    - Activity Charts.
    - Project Evaluation Review Techniques(PERT).
    - Grant Charts.
    - Critical Path Method(CPM).

Work Breakdown Structure(WBS):

- A Work Breakdown Structure is a hierarcical decomposition or breakdown of a project or major activity into successive levels.

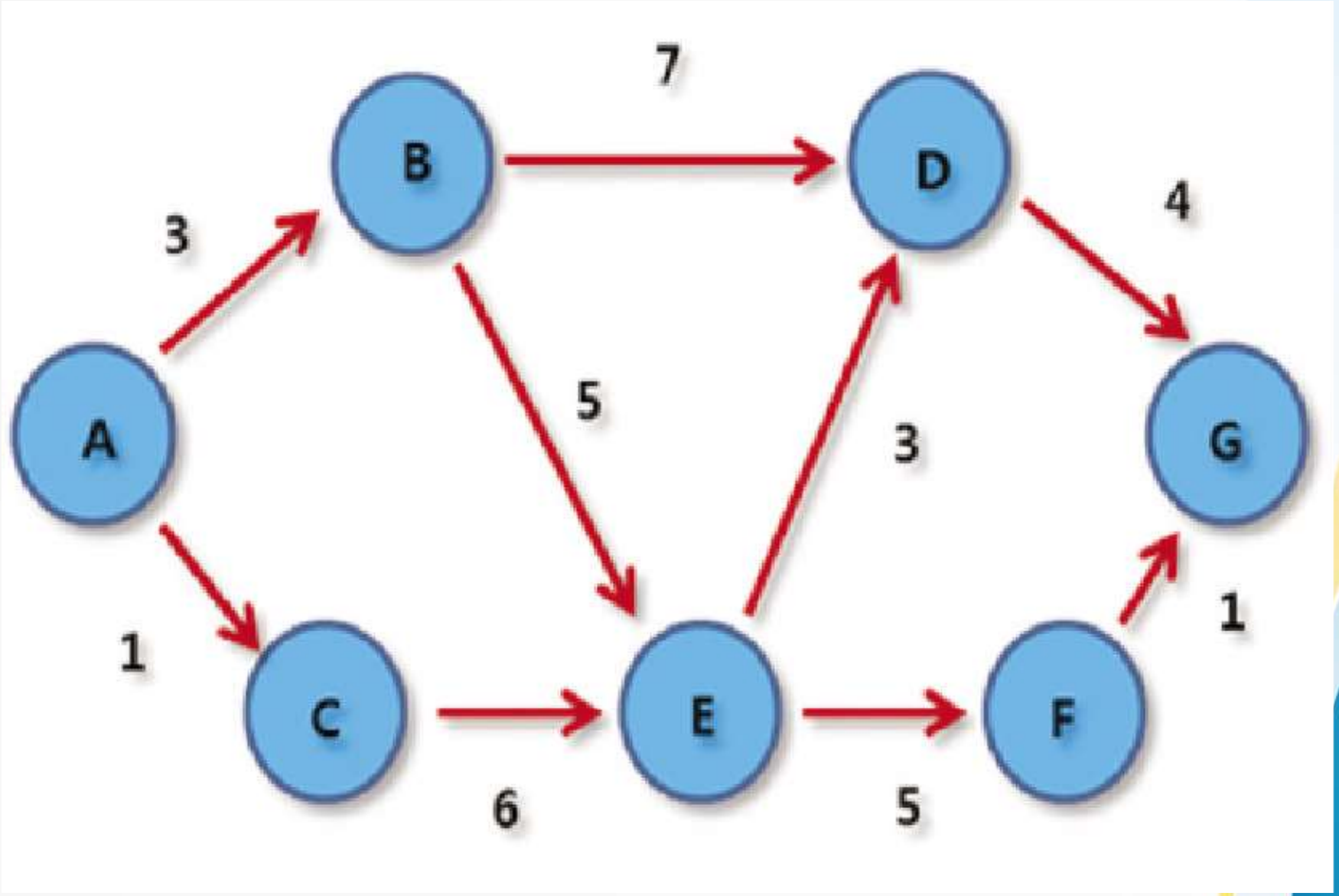


Features of WBS:

- Structure.
- Description.
- Coding.
- Depth.
- Level of Detail.

Activity Charts : Representation of WBS:

- Network of boxes and arrows.
- Shows different tasks making up a project.
- Represents the ordering among the tasks.

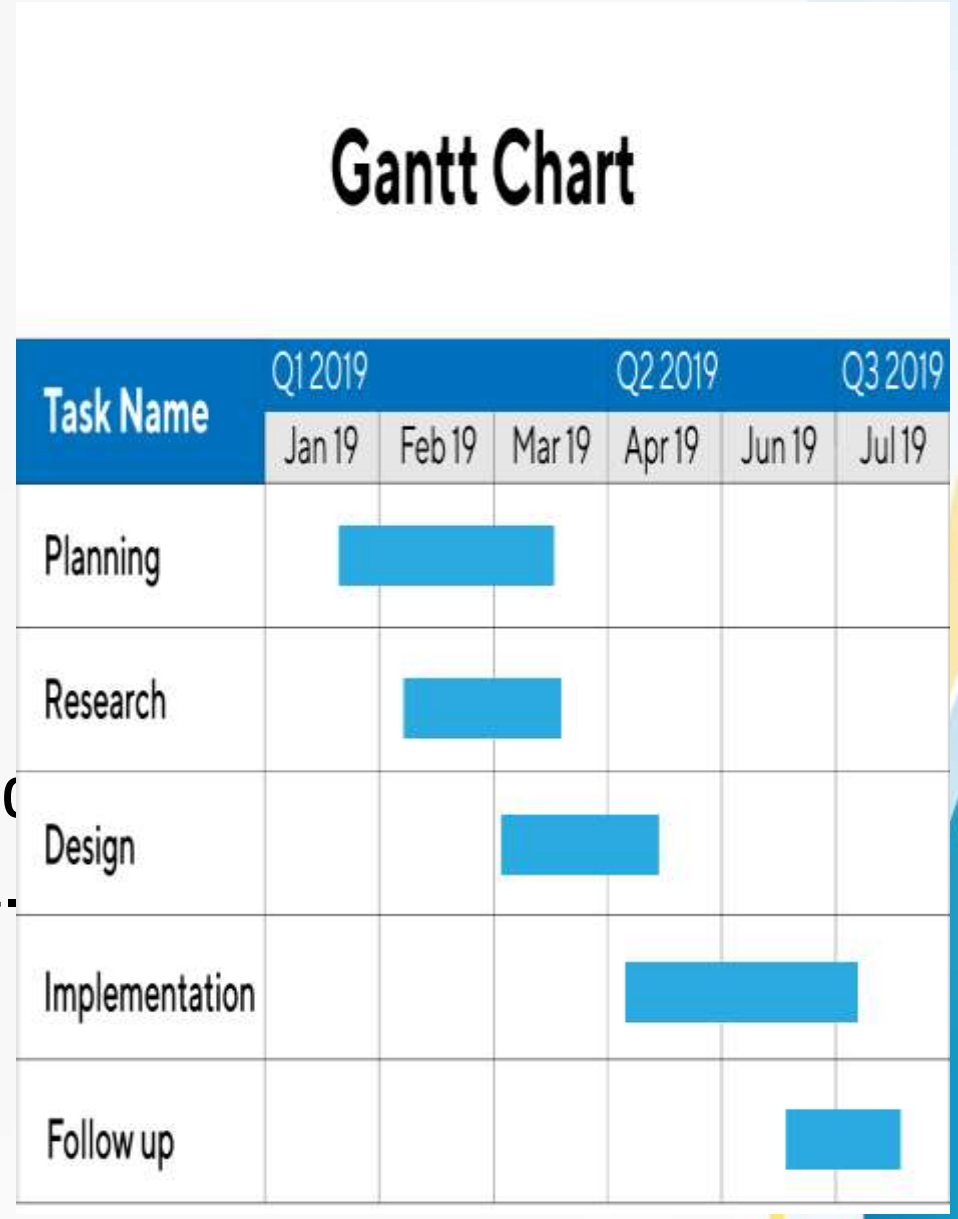

A
B
C
D
E
F
G
7
3
4
5
3
1
1
6
5

Project Evaluation Review Technique(PERT):

- PERT chart is a project management tool used to schedule, organize and coordinate tasks within the project.
- PERT methonology developed by the U.S. Navy in the 1950’s to manage the polaris submarine program.
- PERT is an event-oriented technique
- PERT is a probabilistic model
- Grantt chart, PERT can be both a cost and a time management system.

Grantt Chart:

A grantt chart is a horizontal bar chart developedas a production control tool named after Henry L, Grantt an american engineer and social scientist ferquently used in project management.



Critical Path Method(CPM):

- CPM acts as the basic both for perparation of a schedule and of resource planning.
- The critical path determine the total duration of the project.
- CPM is an activity-oriented technique
- CPM is a deterministic model

Risk Analysis & Management:

- Risk analysis and management are a series of steps that help a software team to understand and manage uncertainty during the development process..
- A risk is a potential problem.
- Managers, Software enginners and customers participate in risk analysis & management.

Software Risk:

- According to webster risk is the possibility of suffering loss.
- Risk in a project or program is a measure of the ability to achieve objectives within cost, schedule and constraints.
- Types of software risk:

Classification I

Classification II

Classification I

- Project Risks
- Technical Risks.
- Business Risks.

Classification II:

- Known Risks.
- Predictable Risks.
- Unperdictable Risks.

Classification I:

- **Project Risks:** The projct schedule will slip and that costs will incnrease.Project risks identify schedule, resource, customer and requirements problem.
- **Technical Risks:**The product quality and the timeliness of the schedule if a technical risks is real then implementation may become difficult or implssible.
- If identify potential design, implementation, interface, verfication and maintenance problems.

Business Risks:

- Market Risk.
- Strategic Risk.
- Management Risk.
- Budget Risk.

Classification II:

- **Known Risks:** That can be uncovered after careful evaluation of the project plan.
- **Predictable Risks:**Predictable Risks are extrapolated from past project experience.

- **Unperdictable Risks:** Unperdictable Risks are the joker in the desk, they can extremely difficult to identify in advance.

Risk Principles:

- Global Perspective.
- Forward looking view.
- Open communication.
- Integrated management.
- Continuous process.
- Shared product vision.
- Team work.

Risk Strategies:

- Reactive Risk Strategies.
- Proactive Risk Strategies.

Risks in software development projects:

- Poorly defined requirements.
- Client requirements changes.
- Poor techniques for cost estimation.
- Dependence on skills of individual developers.

Risk Management Process:

- The risk management activities includes identify, analysis, plan, track and control risks.
  - Risk Assessment.
  - Risk Control.

Risk Assessment:

- Risk assessment is the determination os qualitative value of risk related to a concrete situation and recognized the risk.

- Risk identification.
- Risk analysis.
- Risk Prioritization.

Risk Identification:

- Risk identification is a systematic attempt to specify to the project plan.

Risk Item Checklist:

- Product Size.
- Bussiness Impact.
- Customer Characteristics.
- Process definition.
- Development environment.

Activities in risk identification phase:

- Identify Risks.
- Define Risk Attributes.
- Document.
- Communicate.

Risk Analysis:

- The risk identify all items are analysed using different criterias.
- **Activities in risk analysis:**
- Group similar risks.
- Determine risk derivers.
- Determine sources of risks.
- Estimate risk.

Risk Prioritization:

- The project focus on its most server risks by assessing the risk.
- Let (r) is the likehood of a risk coming trace.
- (s) is the consequence of the problem associated with that risk.
- P=r*s.

Risk Control:

- Risk control is the process of managing risks should outcomes.

- Risk Management Planning.
- Risk Resolution.
- Risk Monitoring.

Risk Management Planning:

- It is a plan for delaing with each significant risk.

Strategies in risk management planning:

- Risk Avoidance.
- Risk monitoring.
- Risk management and contingency planning.

Risk Resoution:

- Risk resolution is the execution of the plan for dealing with each risk.
- The risk has triggered the project manager need to execute the action plan.

Outputs of risk resolution phase:

- Risk status.
- Acceptable risks.
- Reduced rework.
- Corrective actions.
- Problem prevention.

Risk Monitoring:

- Risk monitoring is the continually reassessing of risks as the project proceeds and conditions change.
- RMMM Plan:
- Risk Mitigation , Monitoring and management in the software project plan or the risk management steps are organized.

Requirement Engineering Process:

- **Introduction:**
- Requirement engineering is the sub-discipline of software engineering that is concerned with determine the goal, functions and constraints of software system.

Requirements:

- Requirements management is a systematic approach to eliciting organizing and documenting the requirements of the systems.

Types of Requirements:

- System Requirements.
- User Requirements.

System Requirements:

- System requirements set out the systems functions, services and operational constraints in detail.
- It may be part of the constract betwwen the system buyer and the software developer.

Types of system requirements:

- Functional requirements.
- Non-functional Requirements.
- Domain Requirements.

Functional Requirements:

- The customer should provide statement of service. It should be clear how the system should react to particular inputs and how a particular system.

Problem of Functional Requirements:

- User Intention.
- Developer Interpretation.
- Requirements completness and consistency:

Non-Functional Requirements:

- The system properties and constraints various properties of a system can be: realiability, response tiime, storage requirements.

Types of Non-Functional Requirements:

- Product Requirements.
- Organizational Requirements.
- External Requirements.

Domain Requirements:

- Requirements can be application domain of the system, reflecting, characteristics of the domain.

Problem of Domain Requements:

- Understandability.
- Implicitness.

User Requirements:

- User requirements are defined using natural language lables and diagrams because these are the representation that can be undestood by all users.

- Client Managers.
- System End Users.
- Client Engineers.
- Contract Managers.

Problem of User Requirements:

- Lack of Clarity.
- Requirements Confusion.
- Requirements Mixture.

Software Requirement Specification:

- Software Requirements document is the specification of the system.
- It is not a design document.
- Requirements document is called SRS.

Users of SRS:

- Users, Customer and marketing Personnel.
- Software Developers.
- Test Engineers.
- Project Managers.
- Maintenance Engineers.