*Focusing on*
**Requirements Analysis**
*and its delieverable*
**SRS**

# Domain Analysis & Requirements

# Note that

We know the Problem

We know (think) that it is feasible to solve it

# Domain Analysis

To understand the Problem one needs to understand the Domain

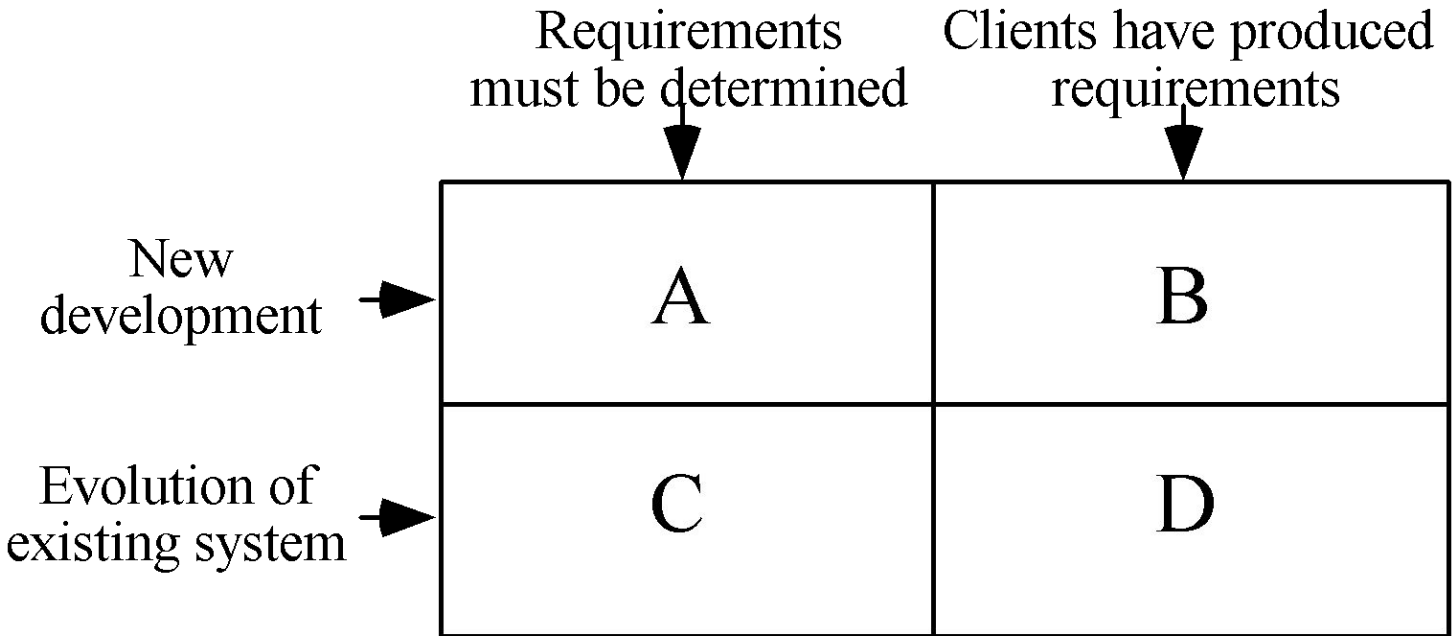
*domain*

*domain expert*

*domain analysis document – general knowledge, customers, environment, current tasks and procedures, competing software ...*

# Where are we to begin?

Which type is the project?



# Problem Definition and Scope

Express problem as:

A *difficulty* the users or customers are facing, OR

An *opportunity* that will result in some benefit such as improved productivity or sales.

A good problem statement is short

Define early, with scope for revision

# Example 1 - Reasonable PD

## Problem Definition:

Build an app that streams music and allows the user to download songs. Creating personalised playlists, recommendations and playback are some of the necessary features required from the user's perspective. A wide range of music tracks, artists, upload features along with curated lists if incorporated can improve the user experience.

# Example 2 - Problem Definition ?

1. **NITC lost and found**

(i) **Problem Definition**

Multiple students tend to lose their belongings on campus, and it can be frustrating to search for them. These items are rarely recovered or returned to the rightful owner. Moreover, the current process involves the college mail space to report lost and found objects. An application for the recovery and discovery of lost items will help solve this issue.

# Example 3 - What ???

Uber is a ride-sharing company that operates a mobile application connecting riders with drivers.The company's problem definition can be described in several ways .

1. Demand and Supply Balancing
2. Safety and Security
3. Technology and Infrastructure
4. Regulatory Compliance
5. Customer Service

# Narrowing Scope

Narrow the *scope* by defining a more precise problem

Exclude some of these things if too broad

Determine high-level goals if too narrow

Kitchen Sink Syndrome

Gold Plating Efforts

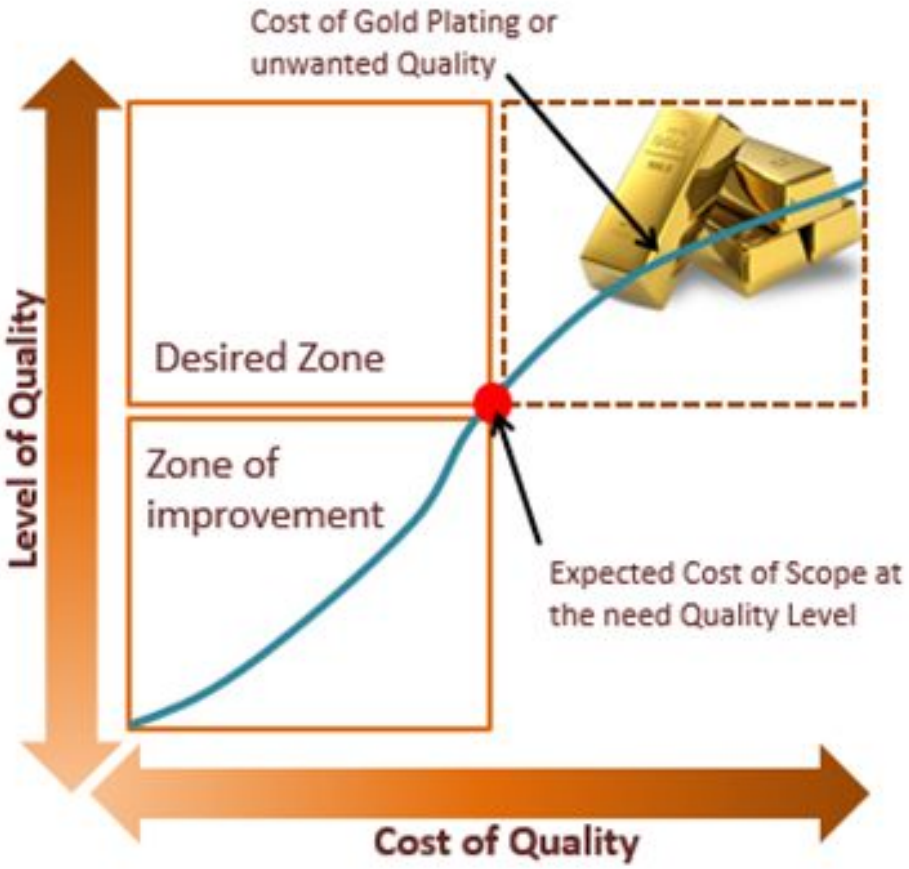
**Scope Creep** - Kitchen Sink Syndrome

Happens when a project's requirements, goals, or vision changes beyond what was originally agreed upon. [*brings in everything but the kitchen sink].* An app like a:

## “Gold Plating”

- when someone works on a product or task beyond the point of diminishing returns
- when you keep tweaking / ‘improving’ something even after finishing it because you *think* you *migh*t be able to offer some value-addition
- Not in the original scope; no real value addition

# Gold-Plating:
## A Challenge in Project Scope Management



Now, the question is:

What is the desired level?

What is the agreed scope?

How to have the contract - SRS?

# Requirement

A statement

- about what the proposed system will do
- that all stakeholders agree
- that must be achieved for the customer's problem to be adequately solved

# Requirement

Short and concise piece of information (sentence, diagram)

Says something about the system (its tasks)

All the stakeholders have agreed that it is valid

(read, understand, review, negotiate, agree, APPROVE)

It helps solve the customer's problem

**A collection of requirements is a *requirements document*.**

# Types of Requirements

Functional

Describe *what* the system should do

**Non-Functional**

**C*onstraints* that must be adhered to during development**

# Functional

1 What *inputs* the system should accept

2 What *outputs* the system should produce

3 What data the system should *store* that other systems might use

4 What *computations* the system should perform

5 The *timing and synchronization* of the above

# Functional

That is, addresses both humans and systems

- Everything that a user of the system needs to know regarding its functionality
- Everything that is relevant to any other system which may interface with this system

# Non Functional Requirements

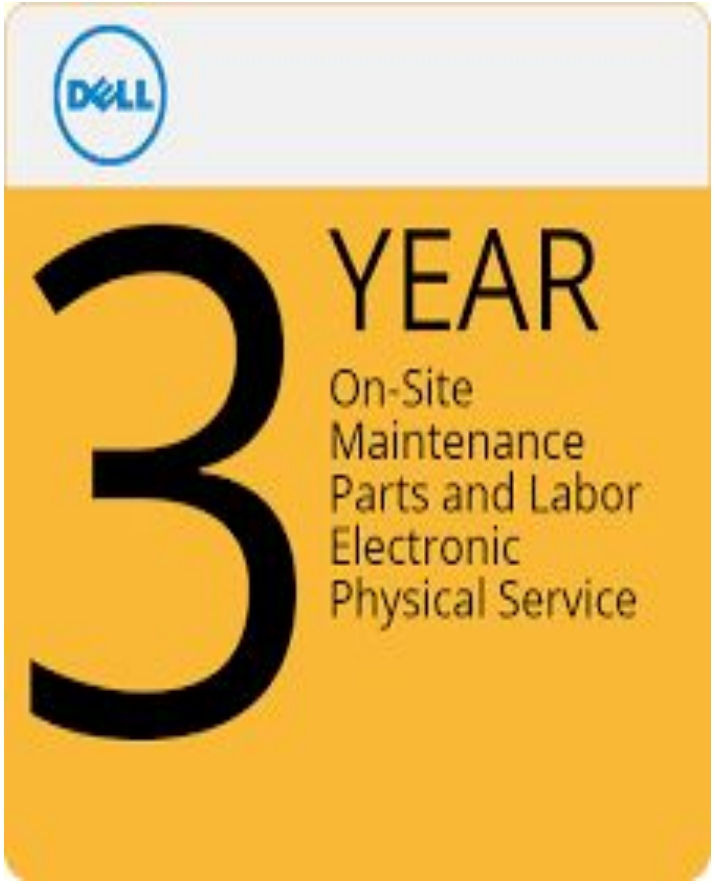
Why is it important?

# Non Functional Requirements

# Non Functional Requirements

- Constraints
- Verifiable, generally Measurable
- Constraints on
  - Design to achieve level of quality required
  - Environment and Technology
  - Project plan and development

# Laptop Purchase


DELL
3
YEAR
On-Site
Maintenance
Parts and Labor
Electronic
Physical Service


HP Care Pack


योगक्षेमं वहाम्यहम्

# Constraints on Design

To achieve usability, efficiency, reliability, maintainability and reusability

Response time* (result in xx milli seconds)

Throughput (transactions per minute)

Resource usage (RAM size and CPU %)

Reliability (MTBF)

**Availability** (downtime) – HDD - *how to measure* - hot swap

Recovery from failure (MTTR and limit on loss of data*)

Future works for maintainability and enhancement

Reusability (Percentage)

# Constraints on Environment Technology

- Platform
  - Hardware
  - OS
- Technology
  - Language
  - DB

# Constraints on Project Plan and Process

- Development Methodology
  - For quality
  - No details in the document
- Cost and Time
  - Budget
  - What to expect, and when [deliverables/milestones]
  - Other catchy clauses
  - Not in requirements, but in “Contract”

# SRS Template

**The one which we will use for the Lab**

**Tweaked a bit for our own use**

**It is better to fill-in the details in a guided way**

***to avoid the problem definition of Uber, which we saw!***

**After the template, we will go back to techniques for gathering and analysing requirements!**

# Techniques for gathering and analysing requirements

# Gathering information

Observation

**Interview**

**Brainstorming**

**Rapid Prototyping**

# Observation

Shadowing users to see what they are doing

Talk while they work

Videotaping

Points of conflicts

The extras, bargains

Useful in complex systems

# Interviewing

Spread over time / Preparations

Specific details – boundary conditions - Limits

Vision – plans for future

Alternative ideas

Minimum acceptable level

Diagrams / Pictures / Scenes of real life

Empathy

# Brainstorming

Moderated

Representatives of stakeholders (how to choose?)

Five – Fifteen

Trigger question

Ideas round the table – Flip chart

Voting to prioritise

Joint Application Design, Six Thinking Hats

# Prototyping

Rapidly implemented

Limited functionalities

*For Feedback, Early testing*

Paper prototyping

UI using rapid prototyping languages

Throwaway vs. Incrememental

# Our Approach

- Screens on Paper
- Inputs - Workflows - Reports
- Use Case Diagrams

# Use Cases

# How the user will use the system?

A *use case* is a typical sequence of actions that a user performs in order to complete a given task

*Use case analysis* models the system from the point of view of how users interact with this system when trying to achieve their objectives.

A *use case model* consists of

a set of use cases

an optional description or diagram indicating how they are related

# Use Case

In general, a use case should cover the *full sequence of steps* from the beginning of a task until the end.

A use case should describe the *user's interaction* with the system and not the computations the system performs.

A use case should be written so as to be as *independent* as possible from any particular user interface design.

A use case should only include actions in which the actor interacts with the computer.

# Scenarios

A scenario is an *instance* of a use case

- It expresses a *specific occurrence* of the use case
  - — a specific actor ...
  - — at a specific time ...
  - — with specific data.

# How to describe a single use case

A. Name: Give a short, descriptive name to the use case.

B. Actors: List the actors who can perform this use case.

C. Goals: Explain what the actor or actors are trying to achieve.

D. Preconditions: State of the system before the use case.

E. Description: Give a short informal description.

F. Related use cases.

G. Steps: Describe each step using a 2-column format.

H. Postconditions: State of the system in following completion.

# The benefits of basing software development on use cases

- They can help to define the *scope* of the system
- They are often used to *plan* the development process
- They are used to both develop and validate the requirements
- **They can form the basis for the definition of testcases**
- They can be used to structure user manuals

# Use cases must not be seen as a panacea

- The use cases themselves must be validated
  — Using the requirements validation methods.

- There are some aspects of software that are not covered by use case analysis.

- Innovative solutions may not be considered.

# Examples
# from the Lab

# A sample usecase for template purpose

Use Case #15 (View My Books)

Author – Aman Singh

Purpose – User can see how many books they have added.

Requirements Traceability – F15

Priority – High. User can check their book availability.

Preconditions – User must have to be login before see him/her added books.

Post conditions – All books will showed which added by him/her.

Actors – User.

Extends – U8.

Flow of Events

1. Basic Flow – User open the Application and login. Click on view my book. Get all details.

2. Alternative Flow – None.

Includes – None.

# SRS Document - Two Extremes

An informal outline of the requirements using a few paragraphs or simple diagrams - requirements *definition*

A long list of specifications that contain thousands of pages of intricate detail - requirements *specification*

Errors happen at extremes

# Factors deciding SRS type and level

- The size of the system
- The need to interface to other systems
- The readership
- The stage in requirements gathering
- The level of experience with the domain and the technology
- The cost that would be incurred if the requirements were faulty

# Important

Prototype

Feedback

Document and Review

Rebuild

*Why waste time and money on invisible steps?*

*Importance of Process, Skills, and Engineering*

# SRS Review

# Each Requirement should

Have **benefits that outweigh the costs** of development (CBA)

Be **important** for the solution of the current problem(80-20)

Be expressed using a **clear and consistent notation**

Be **unambiguous**

Be **logically consistent**

Lead to a system of **sufficient quality**

Be **realistic** with available resources

Be **verifiable******

Be uniquely **identifiable** (Section Number)

**Does not over-constrain the design** of the system (Avoid How)

# SRS Review Points

Sufficiently complete with functional and non-functional requirements and well organized

Provide rationale

Agreed to by all the stakeholders – Contract

# Change Management in Requirements

**Requirements change because:**

Business process changes

Technology changes

The problem becomes better understood

**The never ending process:**

Continued Interaction

CBA

Small vs. Large

Forcing unexpected changes into a partially built system will probably result in a poor design and late delivery

Some changes are enhancements in disguise

Avoid making the system *bigger*, only make it *better*

***Software also becomes old and die (mercy killing?)***

# Difficulties, Risks in Requirement Analysis

Lack of understanding of the domain or the real problem

*Do domain analysis and prototyping*

Requirements change rapidly

*Perform incremental development, build flexibility into the design, do regular reviews*

Attempting to do too much

*Document the problem boundaries at an early stage, carefully estimate the time*

It may be hard to reconcile conflicting sets of requirements

*Brainstorming, JAD (***facilitator, end users, developers, observers, mediators and experts)** *sessions, competing prototypes*

It is hard to state requirements precisely

*Break requirements down into simple sentences and review them carefully, look for potential ambiguity, make early prototypes*

# SAMPLE SRS - Borrow & Lend

A few UC diagrams and Use Cases

# READ the ANTI-SRS article

Object-Oriented

**Software Engineering**

Practical software development

*using*

UML

&

Java

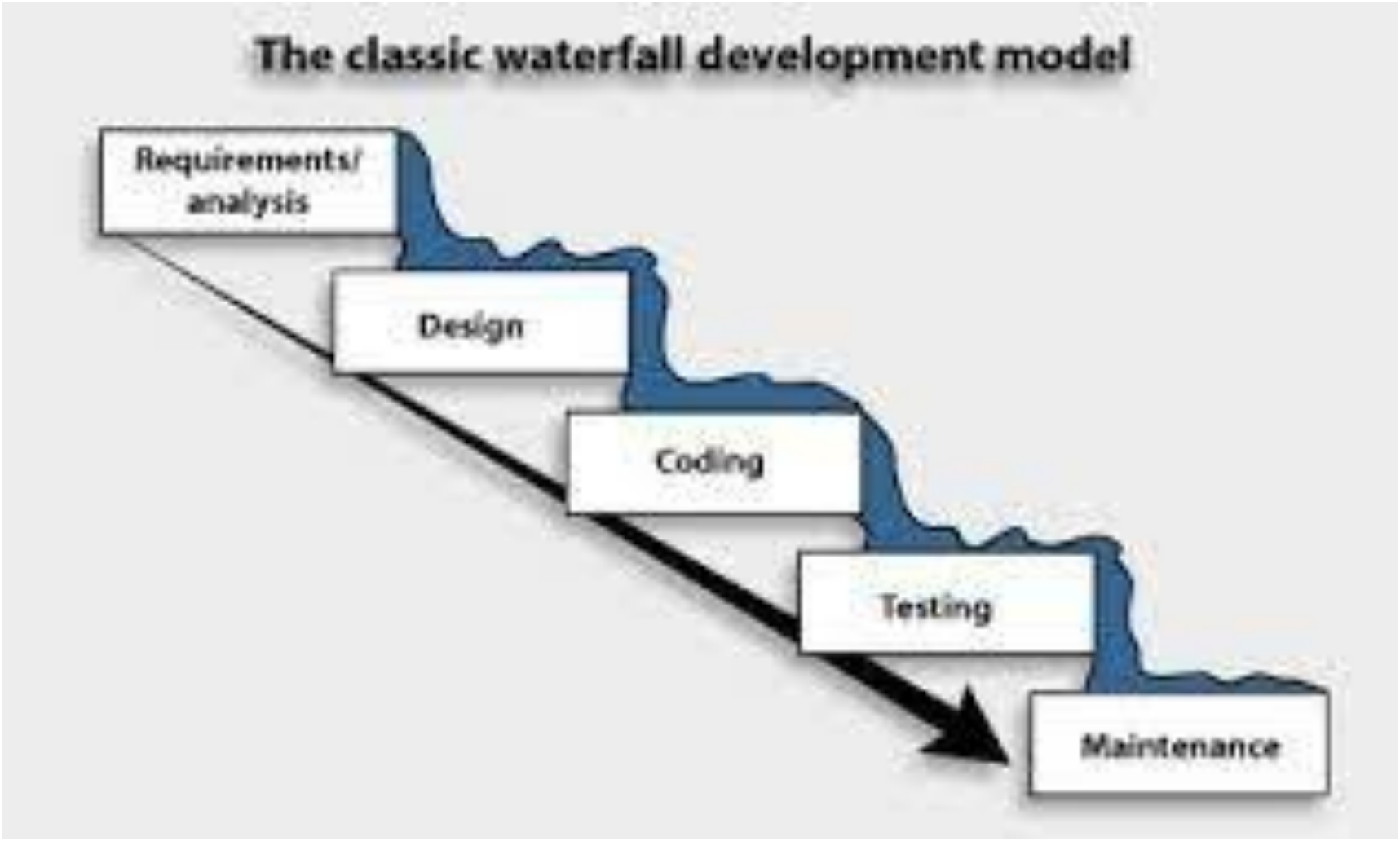
## Different Process Models

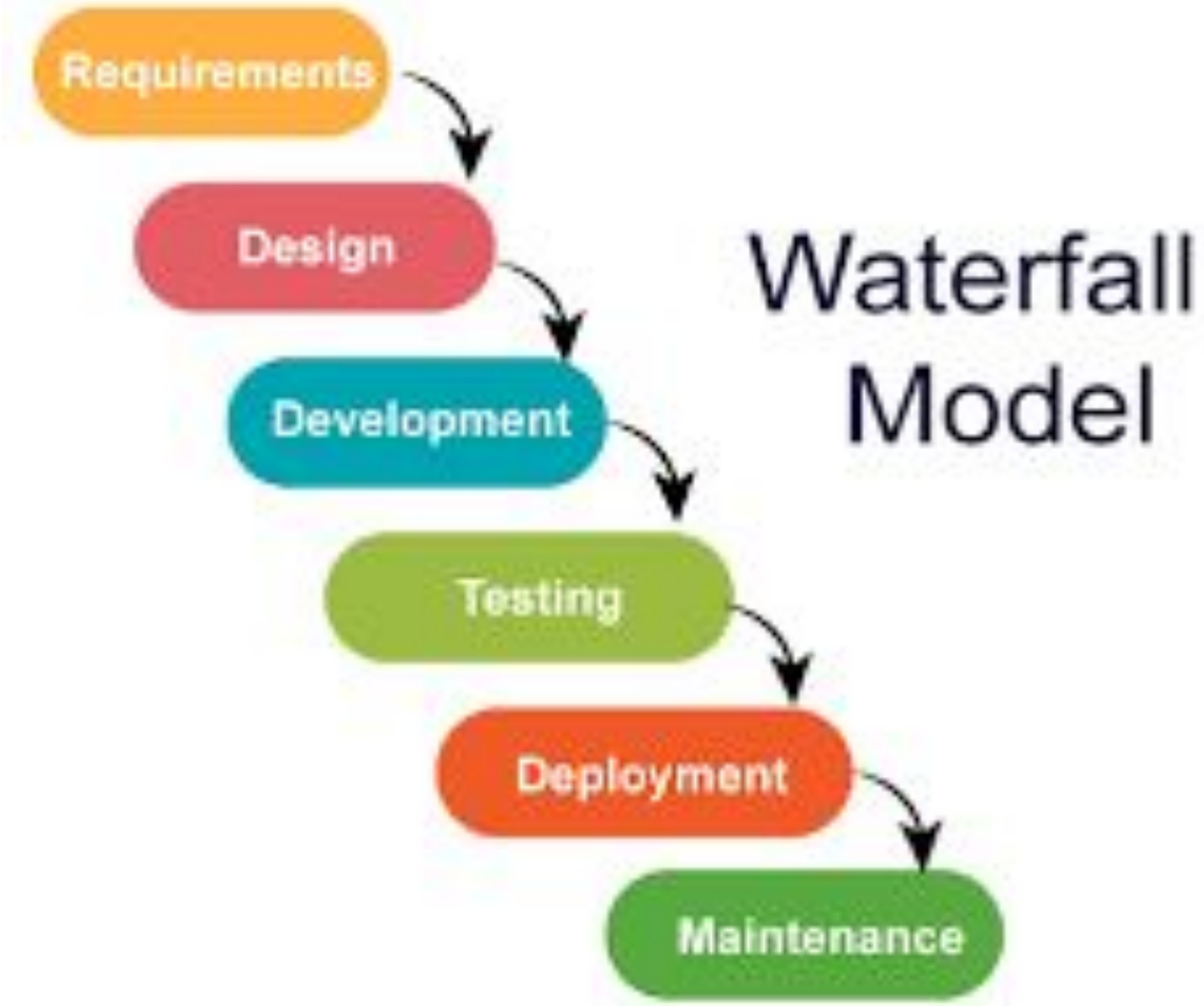
specification-oriented,

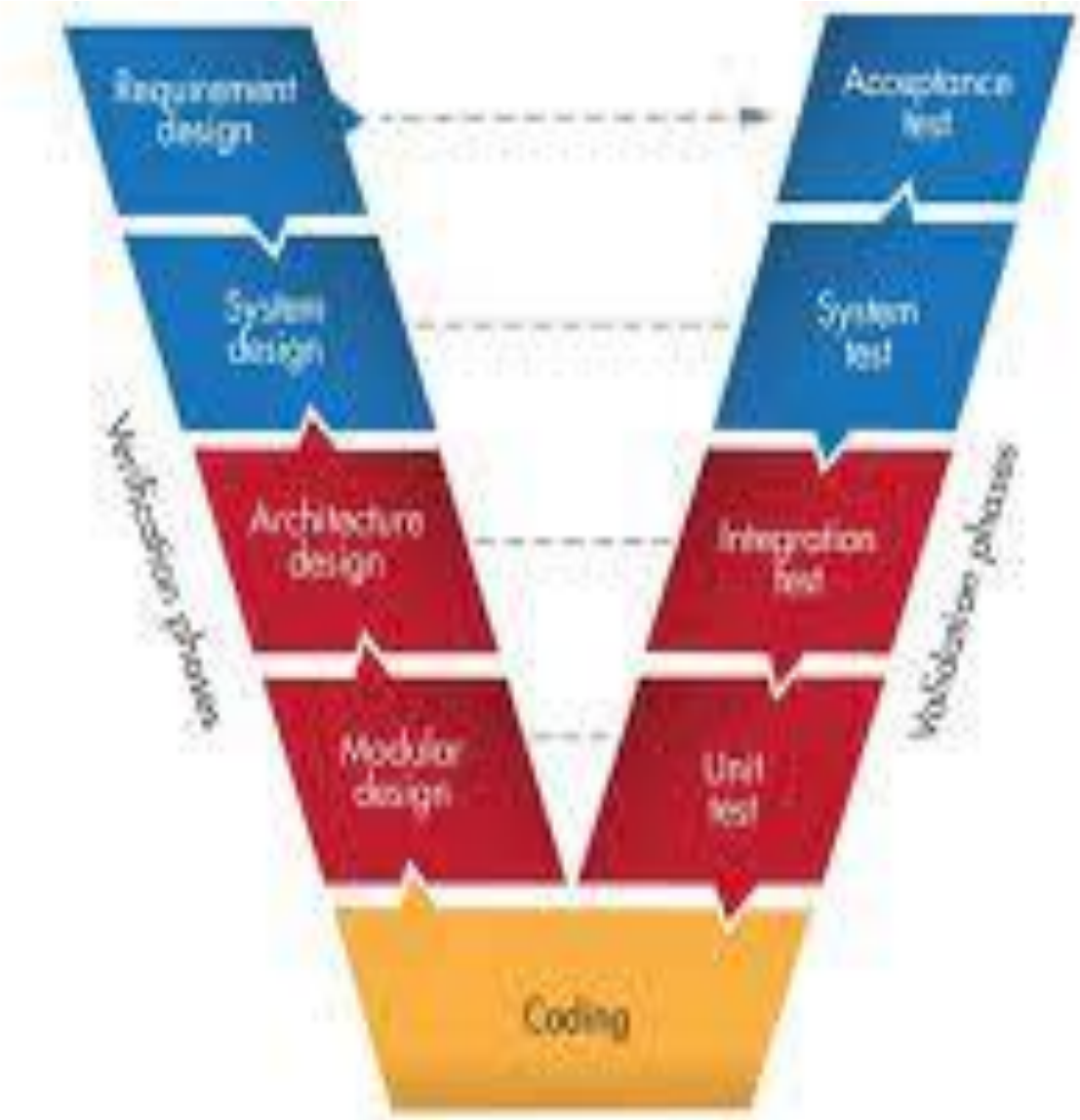
prototype-oriented,

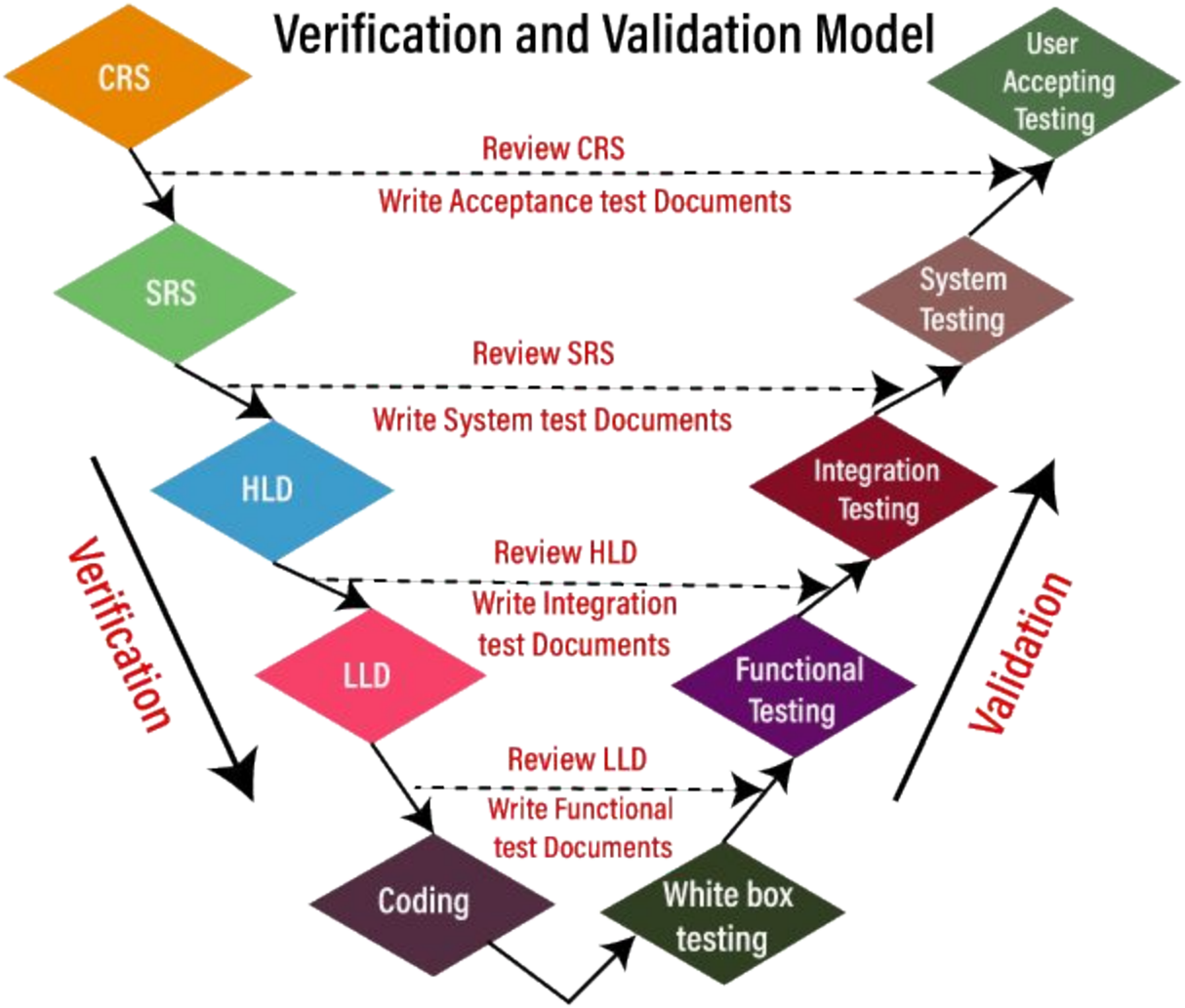
simulation-oriented,

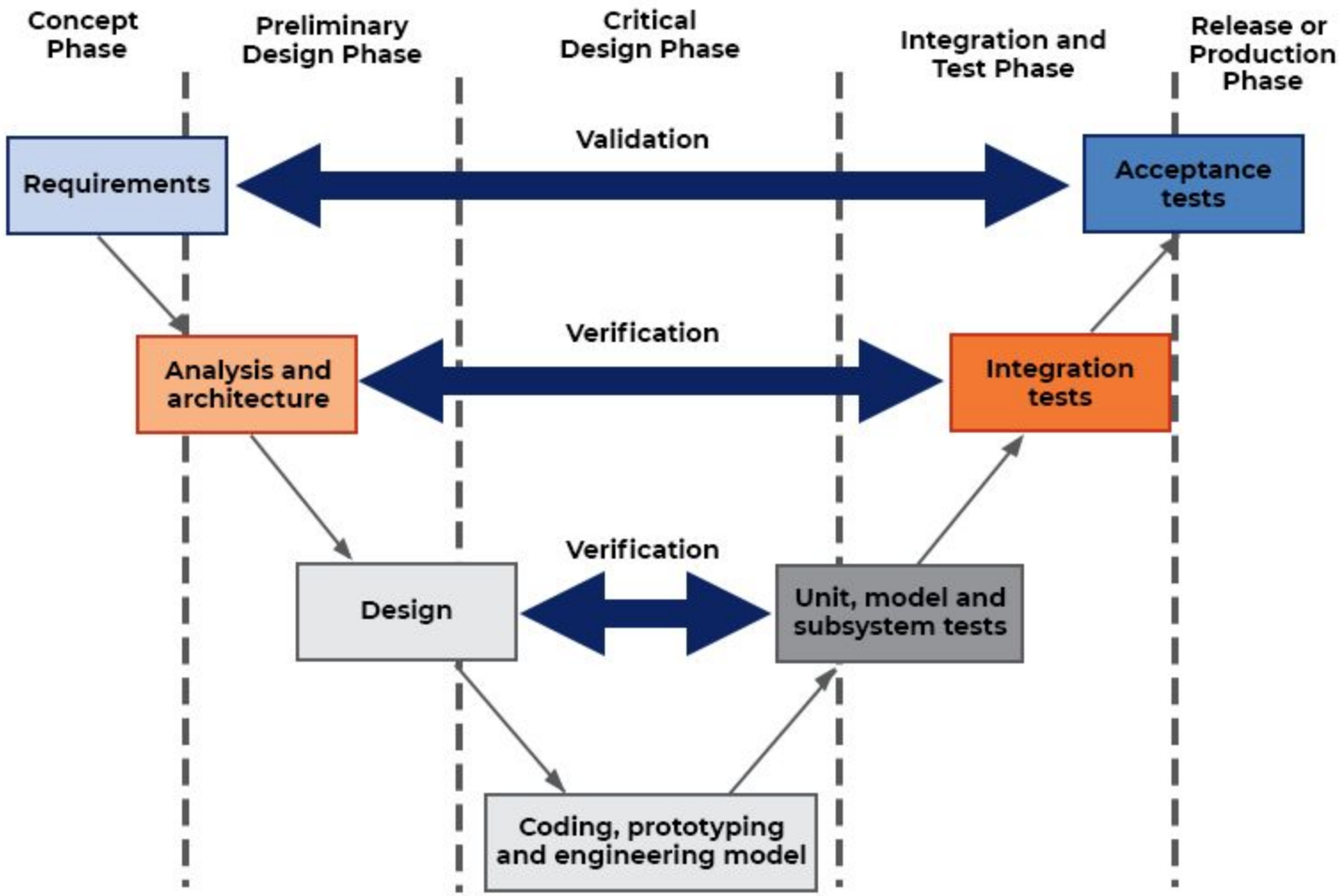
automatic transformation-oriented,


The classic waterfall development model
Requirements/ analysis
Design
Coding
Testing
Maintenance

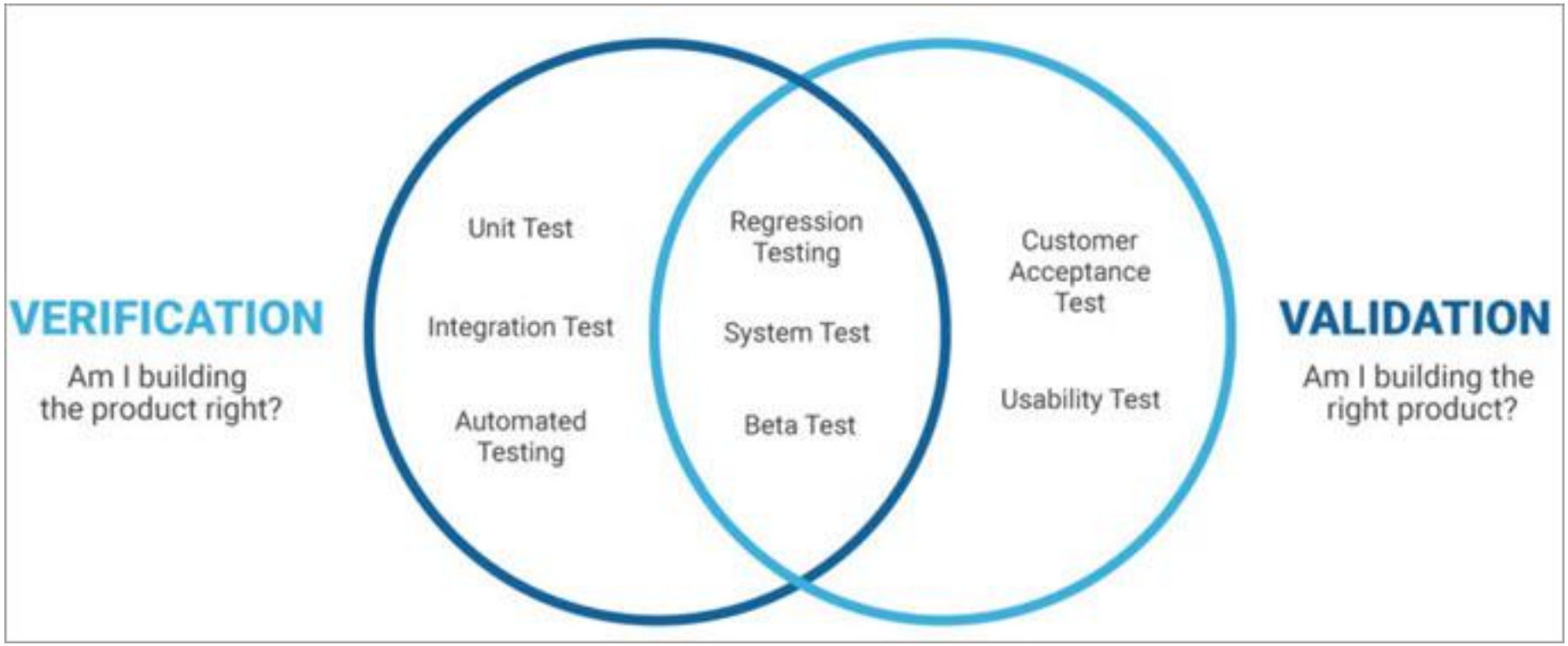

Requirements
Design
Development
Testing
Deployment
Maintenance
Waterfall Model


Requirement design
Acceptance test
System design
System test
Architecture design
Integration test
Modular design
Unit test
Coding
Verification phases
Validation phases


Verification and Validation Model
CRS
User Accepting Testing
Review CRS
Write Acceptance test Documents
SRS
System Testing
Review SRS
Write System test Documents
HLD
Integration Testing
Review HLD
Write Integration test Documents
LLD
Functional Testing
Review LLD
Write Functional test Documents
Coding
White box testing
Verification
Validation


Concept Phase
Preliminary Design Phase
Critical Design Phase
Integration and Test Phase
Release or Production Phase
Validation
Requirements
Acceptance tests
Verification
Analysis and architecture
Integration tests
Verification
Design
Unit, model and subsystem tests
Coding, prototyping and engineering model

| Verification | Validation |
| --- | --- |
| Are we implementing the system right? | Are we implementing the right system? |
| Evaluating products of a development phase | Evaluating products at the closing of the development process |
| The objective is making sure the product is as per the requirements and design specifications | The objective is making sure that the product meets user's requirements |
| Activities included: reviews, meetings, and inspections | Activities included: black box testing, white box testing, and grey box testing |
| Verifies that outputs are according to inputs or not | Validates that the users accept the software or not |
| Items evaluated: plans, requirement specifications, design specifications, code, and test cases | Items evaluated: actual product or software under test |
| Manual checking of the documents and files | Checking the developed products using the documents and files |


VERIFICATION
Am I building the product right?
Unit Test
Integration Test
Automated Testing
Regression Testing
System Test
Beta Test
Customer Acceptance Test
Usability Test
VALIDATION
Am I building the right product?

# Software Verification

Software verification provides objective evidence that the design outputs of a particular phase of the software development life cycle meet all of the specified requirements for that phase.

Software verification looks for consistency, completeness, and correctness of the software and its supporting documentation, **as it is being developed,** and provides support for a subsequent conclusion that software is validated.

Software testing is one of many verification activities intended to confirm that software development output meets its input requirements. Other verification activities include various static analyses, code and document inspections, walkthroughs, and reviews.

# Software Validation

**Software validation** is a primarily part of the design validation for a finished product.

Software validation is termed as "**confirmation by examination and provision of objective evidence that software specifications conform to user needs and intended uses, and that all requirements implemented through software can be consistently fulfilled.**"

In practice, software validation activities may occur both during, as well as at the end of the software development life cycle to ensure that all requirements have been fulfilled.

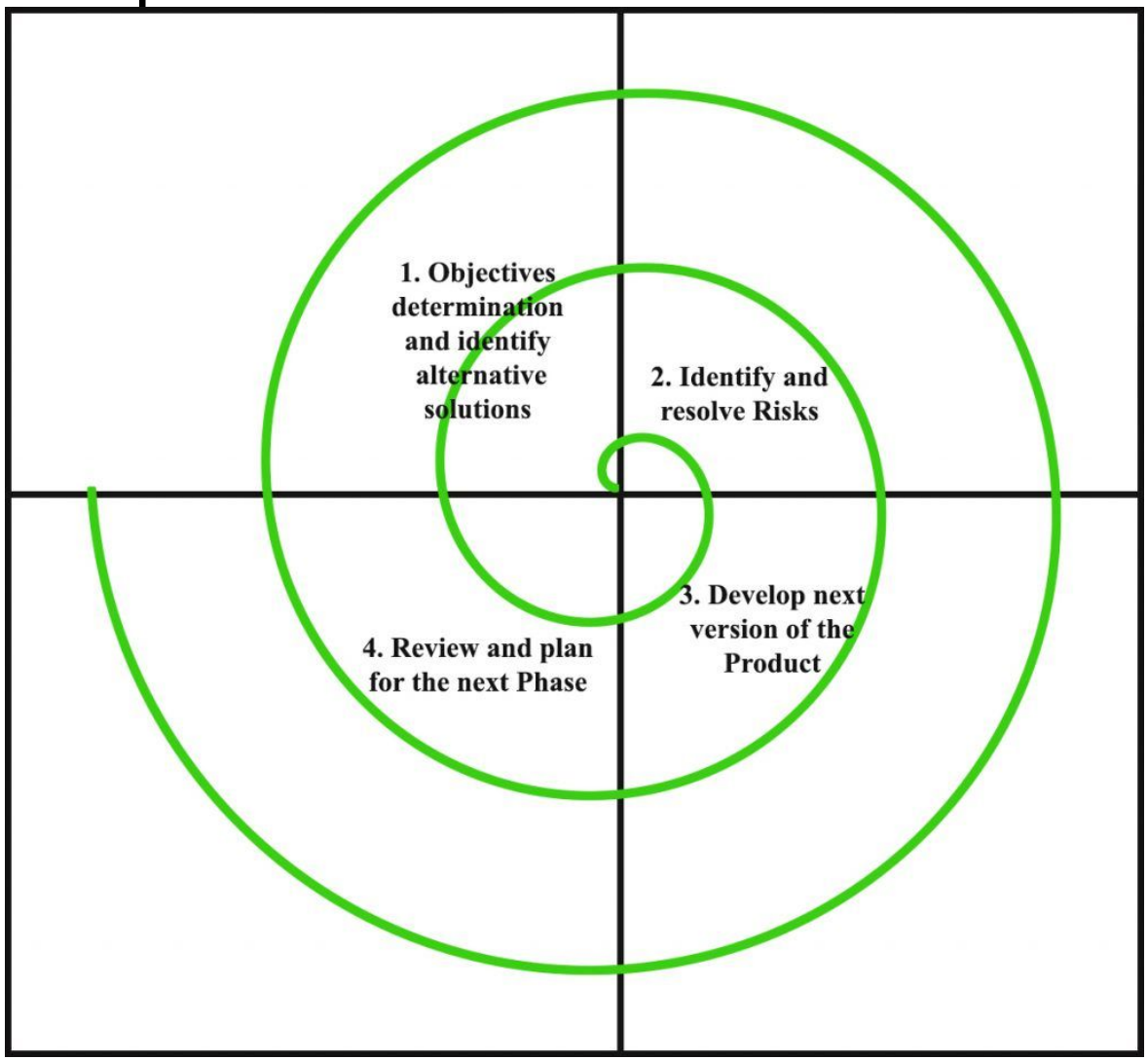
**UAT is the fundamental validation activity.**

# Moving on to the present!

# Agile Approach and manifesto

22 years before

# Boehm's spiral model



# Agile Approach

- Agile is a term used to describe software development approaches that employ continual planning, learning, improvement, team collaboration, evolutionary development, and early delivery.

- It encourages flexible responses to change.

# Two Distinguishing Features

**Adaptive** than Predictive

**People-Oriented** than Process-Oriented

# Waterfall vs Agile

- Agile follows an incremental approach whereas the Waterfall is a sequential design process.
- Agile performs testing concurrently with software development whereas in Waterfall methodology testing comes after the “Build” phase.
- Agile allows changes in project development requirement whereas Waterfall has no scope of changing the requirements once the project development starts.

# Waterfall vs Agile

- Waterfall is a Liner Sequential Life Cycle Model whereas Agile is a continuous iteration of development and testing in the software development process.

- Agile methodology is known for its flexibility.

# Not Really!

The Manifesto for
Agile Software Development

**We are uncovering better ways of developing software by doing it and helping others do it.**

**Through this work we have come to value**

# The Manifesto for Agile Software Development

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

# Two Distinguishing Features

**Adaptive** than Predictive

**People-Oriented** than Process-Oriented

# What is Agility?

Effective (rapid and adaptive) response to change (team members, new technology, requirements)

Effective communication in structure and attitudes among all team members, technological and business people, software engineers and managers.

# What is Agility?

Drawing the customer into the team. Eliminate "us and them" attitude.

Planning in an uncertain world has its limits and plan must be flexible.

Organizing a team so that it is in control of the work performed.

Emphasize an incremental delivery strategy.

# Agile - Why?

The modern business environment is fast-paced and ever-changing. It represents a reasonable alternative to conventional software engineering for **certain classes** of software projects. It has been demonstrated to deliver successful systems quickly.

# What Steps are important?

May be termed as “software engineering lite”

The basic activities- communication, planning, modelling, construction and deployment remain. But they morph into a minimal task set that push the team toward construction and delivery sooner.

The only really important work product is an operational “software increment” that is delivered.

# Agility andthe Cost of Change

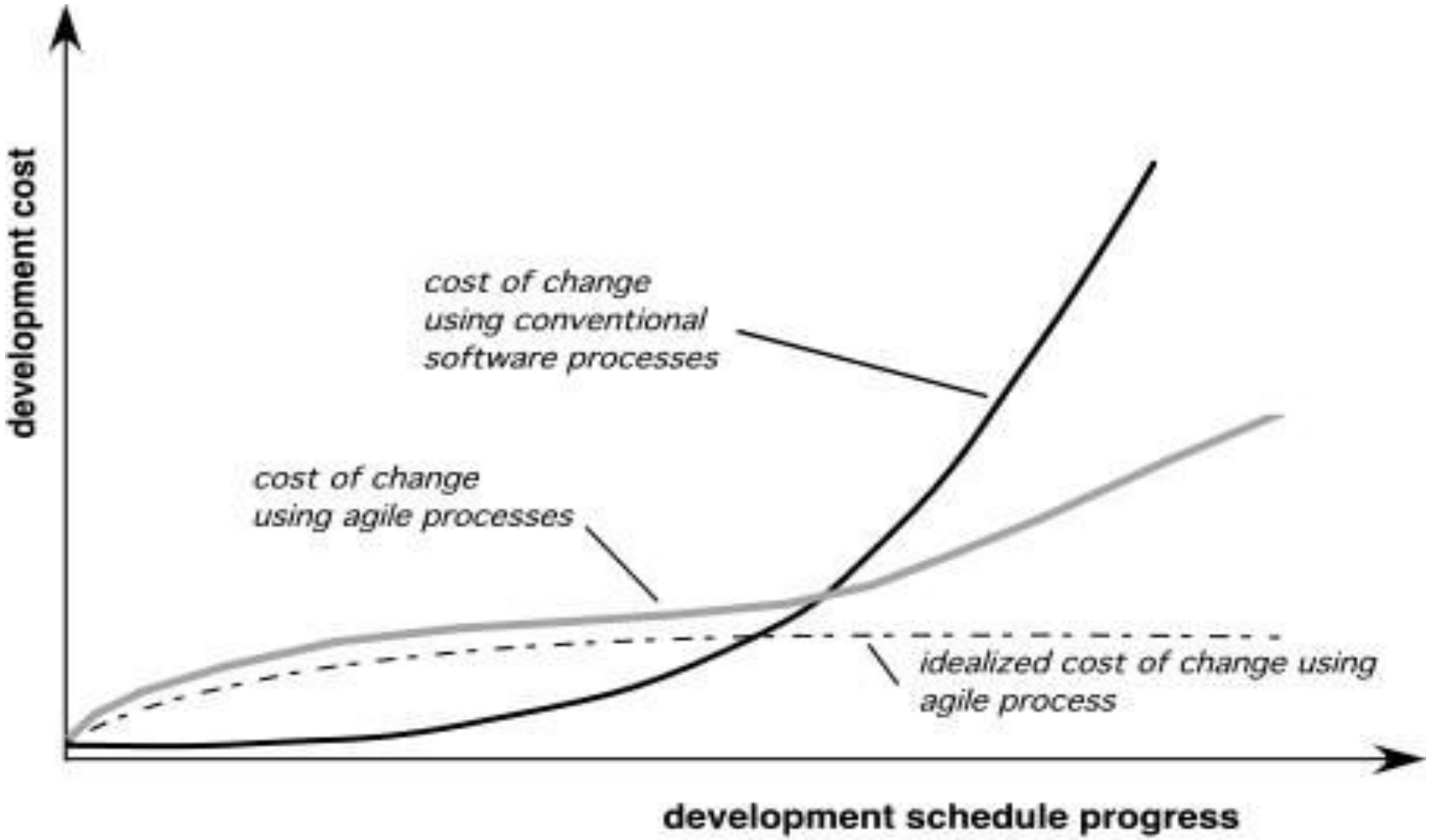
- Conventional wisdom :
  - The cost of change increases nonlinearly as a project progresses.
  - It is relatively easy to accommodate a change when a team is gathering requirements early in a project.
  - If there are any changes, the costs of doing this work are minimal.
  - But if in the middle of validation testing, a stakeholder is requesting a major functional change.
  - Then the change requires a modification to the architectural design, construction of new components, changes to other existing components, new testing and so on.
  - Costs escalate quickly.

# Agile and the Cost of Change

A well-designed agile process may "flatten" the cost of change curve by coupling incremental delivery with agile practices such as continuous unit testing.

Thus team can accommodate changes late in the software project without dramatic cost and time impact.

# Agility and the Cost of Change



# An Agile Process

Is driven by customer descriptions of what is required.

Recognizes that plans are short-lived (some requirements will persist, some will change. Customer priorities will change)

Develops software iteratively with a heavy emphasis on construction activities (design and construction are interleaved, hard to say how much design is necessary before construction. Design models are proven as they are created. )

# An Agile Process

Analysis, design, construction and testing are not predictable.

Thus has to Adapt as changes occur due to unpredictability.

Delivers multiple ‘software increments’, deliver an operational prototype or portion of an OS to collect customer  feedback for adaption.

# SW Development

A quick Review

# Story So Far

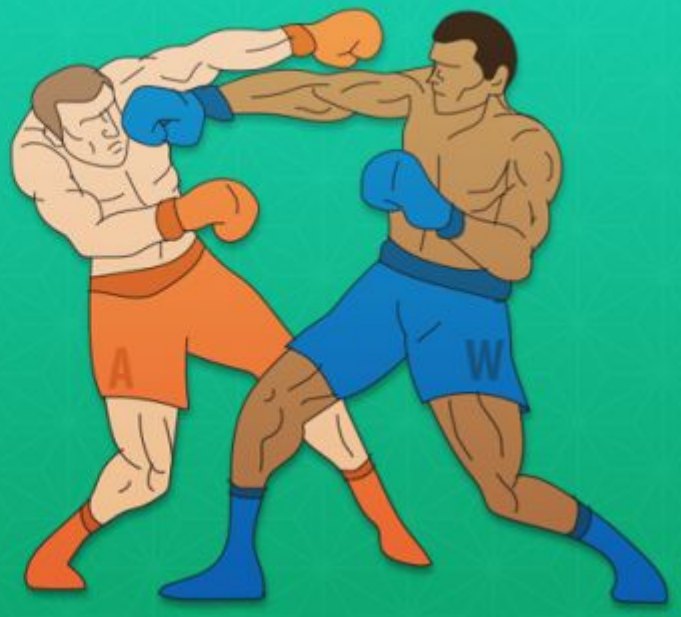
- Recent Discipline
- Started with errors
- Errors were costly
- Not Art, But Science - Actually Engineering
- Borrowed from other Engineering Disciplines
- Quite Strict
- Waterfall Model
  - Operation Successful, Patient Died
- V Model, Boehm’s Spiral Model

# How to save the patient

- Avoiding the We - They conflict
- Customer centric
- Appreciating the complexity
- Acknowledging the limitations

- and then finally, AGILE  2001

# Agile Vs. Waterfall: Showdown for Software Development Domination



# The major difference

Question: When is a software project completed?

Answers:

When SDLC is over

**When the client accepts it**

# Points, and where we lack

1. Quality
2. **Communication**
3. *Project Efficiency*
4. **Flexibility**
5. Customer Satisfaction

Standup/SCRUM meetings and other ceremonies

be on time

be prepared

all the best for those meetings!