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Software Engineering

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What is Software?

Software is:

- Instructions (computer programs) when executed, provide desired function and performance.
- Data structures that enable the programs to adequately manipulate information, and
- Documents that describe the operation and use of programs.

Software Characteristics

- Software is developed or engineered
- Software doesn’t “wear out”.
- Most software is custom-built

Software Engineering

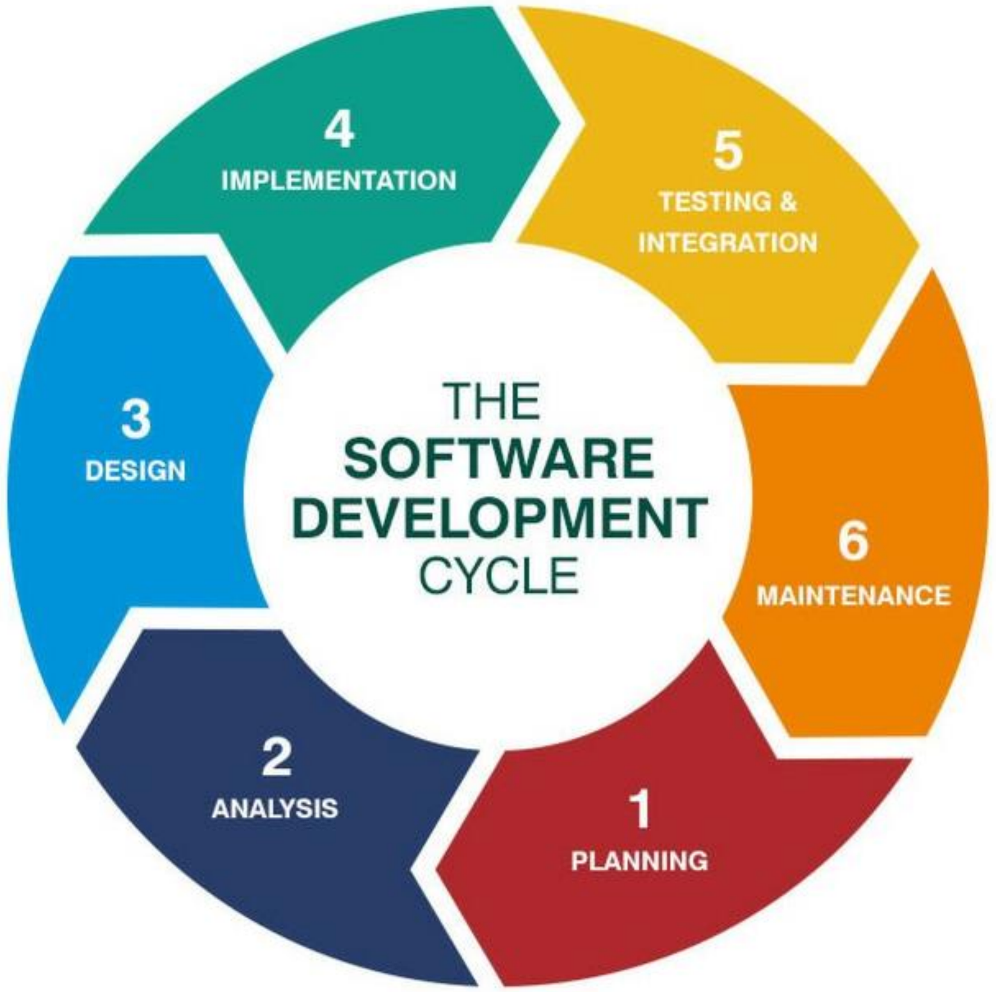
The application of a systematic, disciplined, quantifiable approach to the development, operation and maintenance of software. *IEEE Standards Collection: Software Engineering*, IEEE Standard 610.12-1990, IEEE, 1993).

Ensure Quality, Timely delivery, Within budget

Employ a set of processes, methods and tools.

Software Development Lifecycle

Software Development Life Cycle (SDLC) is a process used by the software industry to design, develop and test high quality software's.



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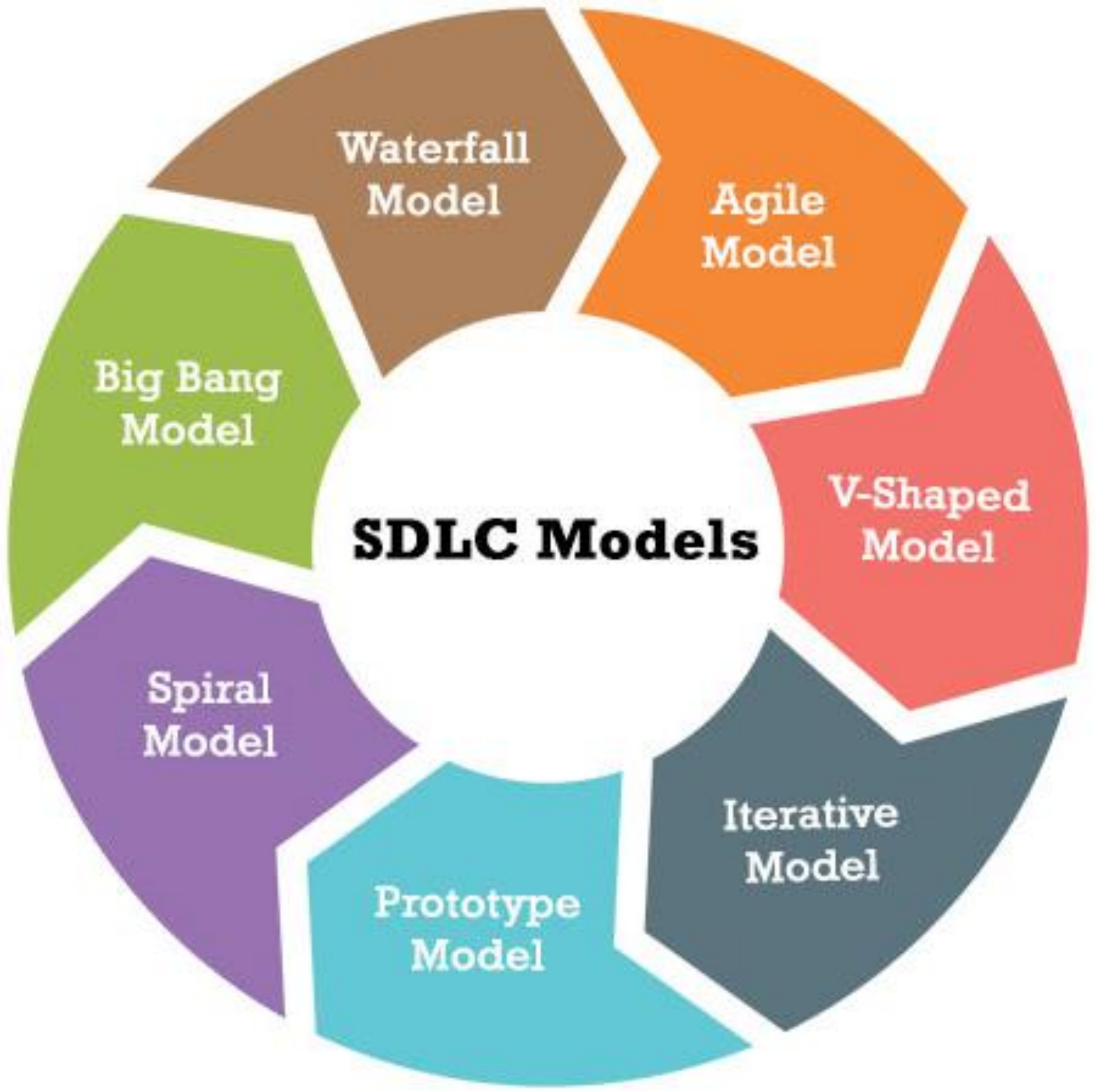
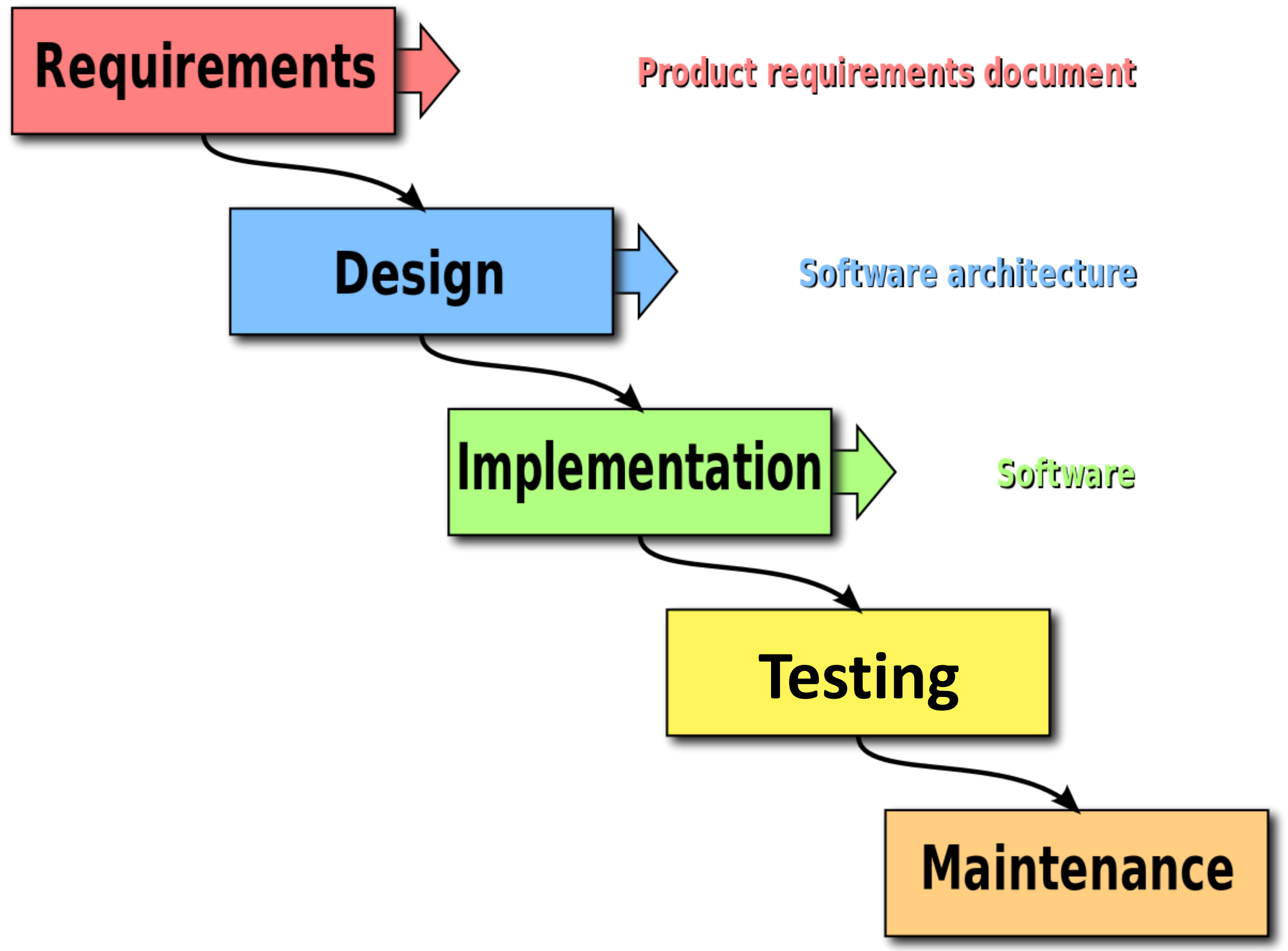
Software Models

SDLC Models


SDLC Models
Waterfall Model
Agile Model
V-Shaped Model
Iterative Model
Prototype Model
Spiral Model
Big Bang Model

Water Fall Model



Use Cases for Water Fall Model

THE REQUIREMENTS ARE PRECISELY DOCUMENTED

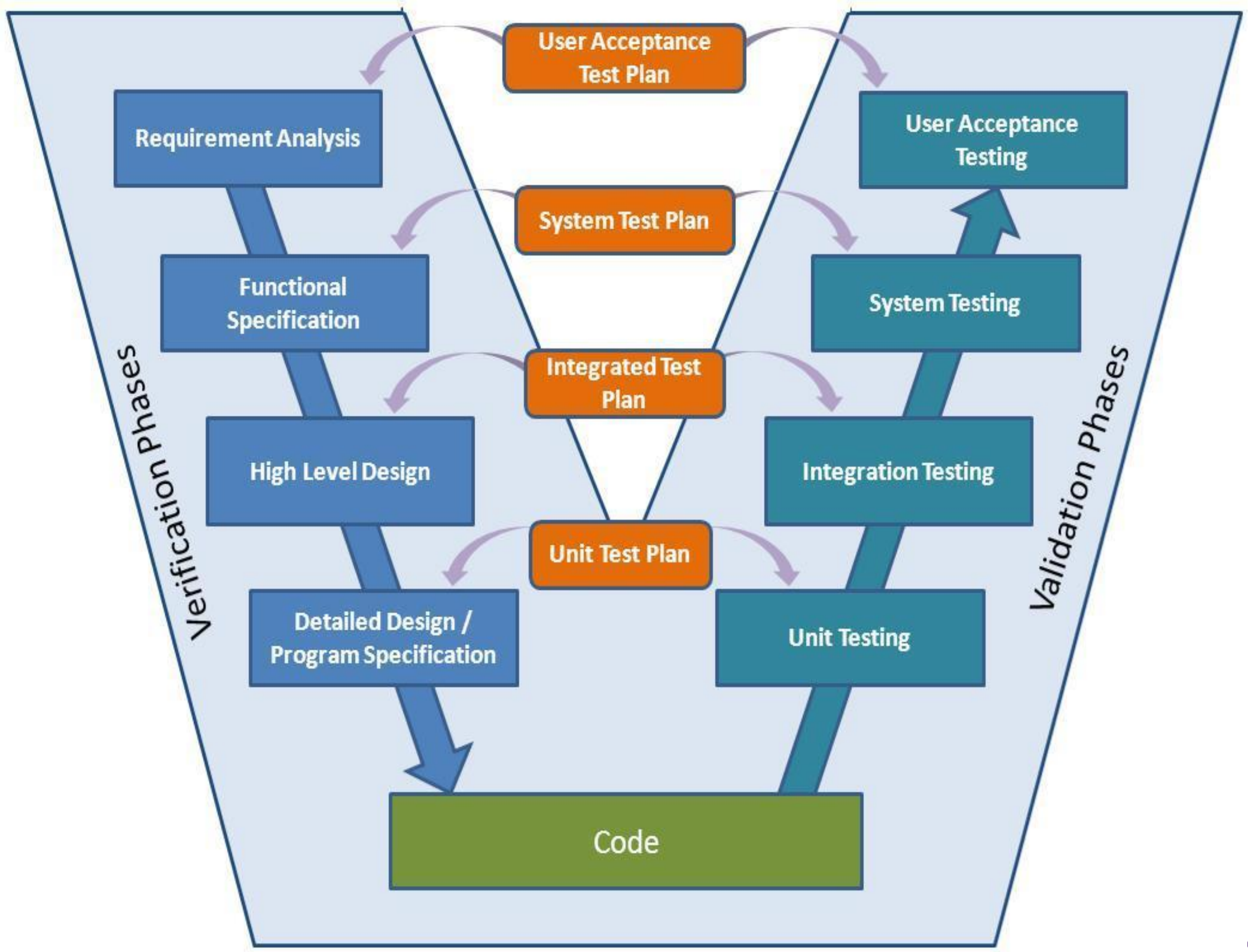
PRODUCT DEFINITION IS STABLE

THE TECHNOLOGIES STACK IS PREDEFINED

NO AMBIGUOUS REQUIREMENTS

THE PROJECT IS SHORT

V Model

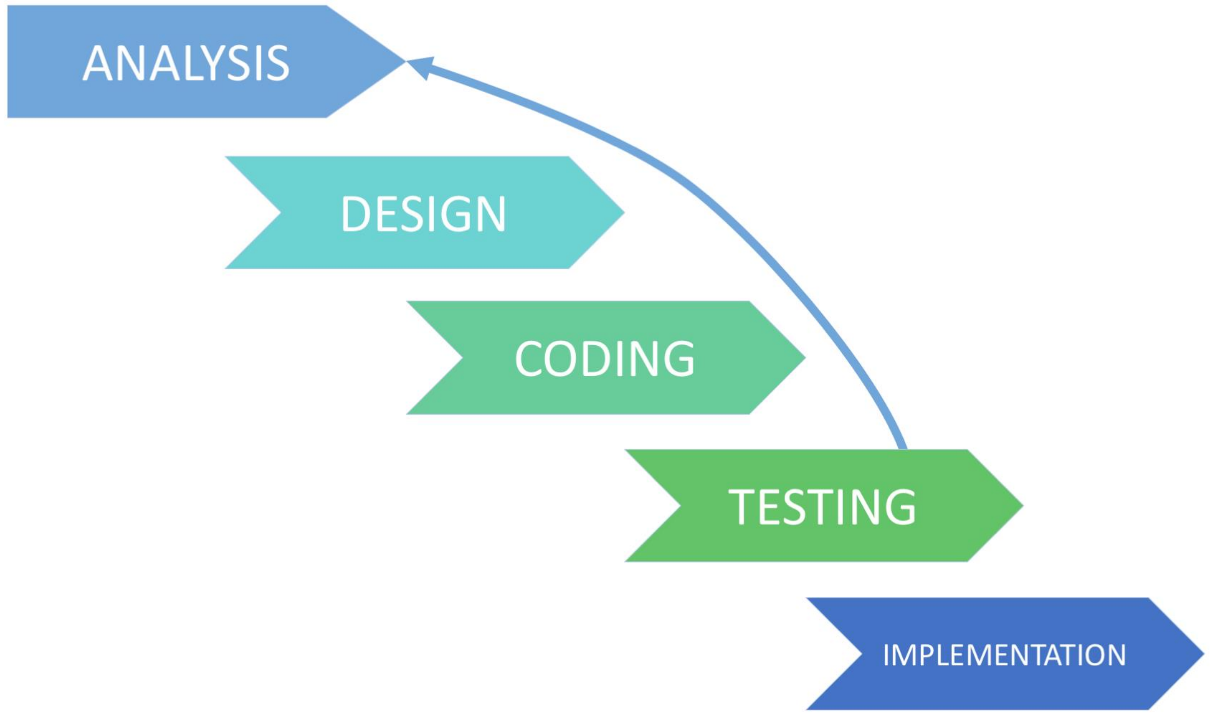


Verification Phases
Validation Phases
User Acceptance Test Plan
Requirement Analysis
User Acceptance Testing
System Test Plan
Functional Specification
System Testing
Integrated Test Plan
High Level Design
Integration Testing
Unit Test Plan
Detailed Design / Program Specification
Unit Testing
Code

Use Cases for V-Model

- FOR THE PROJECTS WHERE AN ACCURATE PRODUCT TESTING IS REQUIRED
- REQUIREMENTS ARE STRICTLY PREDEFINED
- FOR THE SMALL AND MID-SIZED PROJECTS

Iterative Models

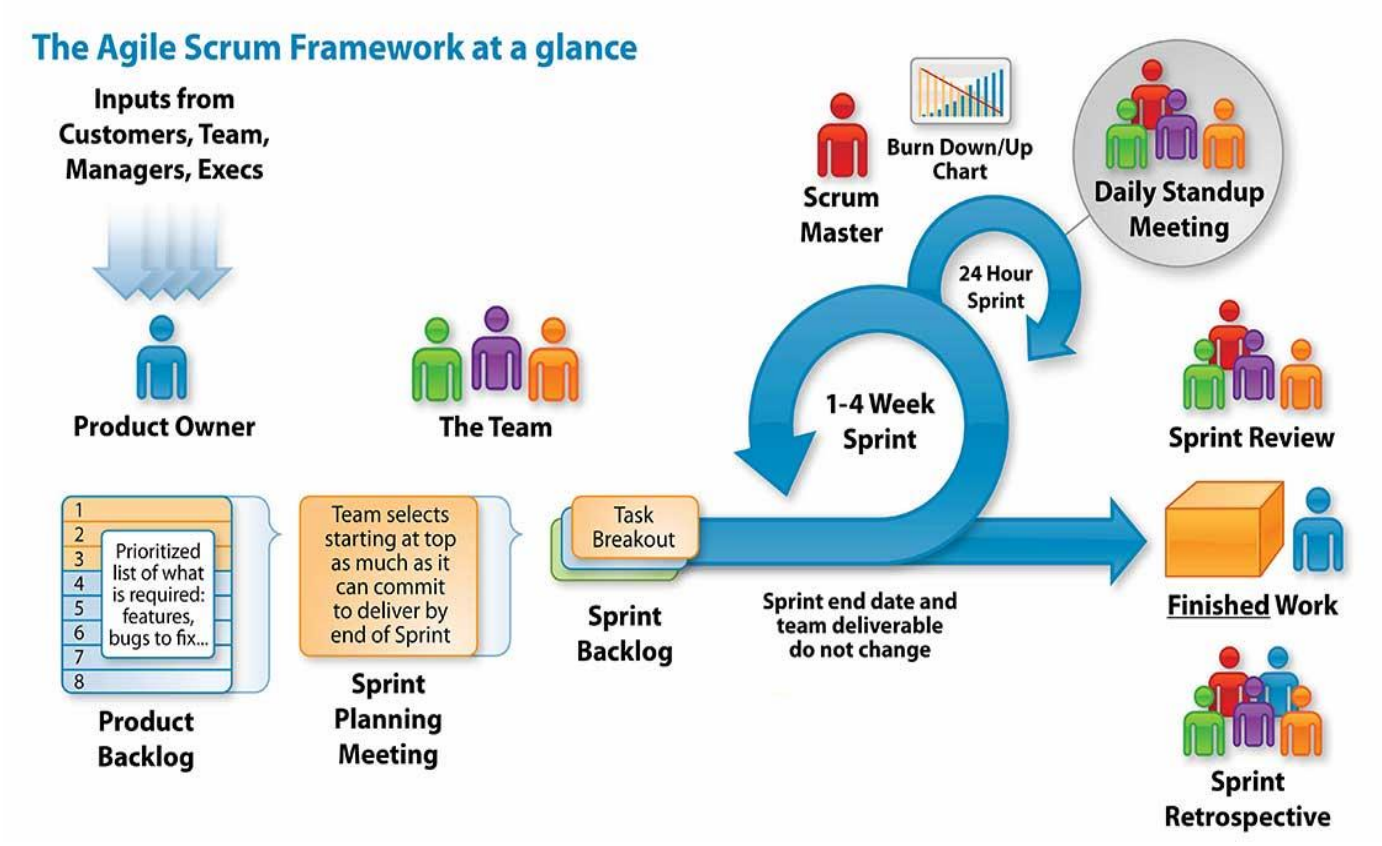


Use Cases for Iterative Models

APPLIED TO THE LARGE-SCALE PROJECTS

THE MAIN TASK IS PREDEFINED, BUT THE DETAILS MAY ADVANCE WITH TIME

Agile Scrum


The Agile Scrum Framework at a glance
Inputs from Customers, Team, Managers, Execs
Product Owner
The Team
Scrum Master
Burn Down/Up Chart
Daily Standup Meeting
24 Hour Sprint
1-4 Week Sprint
Sprint Review
1
2
3
4
5
6
7
8
Prioritized list of what is required: features, bugs to fix...
Team selects starting at top as much as it can commit to deliver by end of Sprint
Task Breakout
Sprint Backlog
Sprint end date and team deliverable do not change
Finished Work
Product Backlog
Sprint Planning Meeting
Sprint Retrospective

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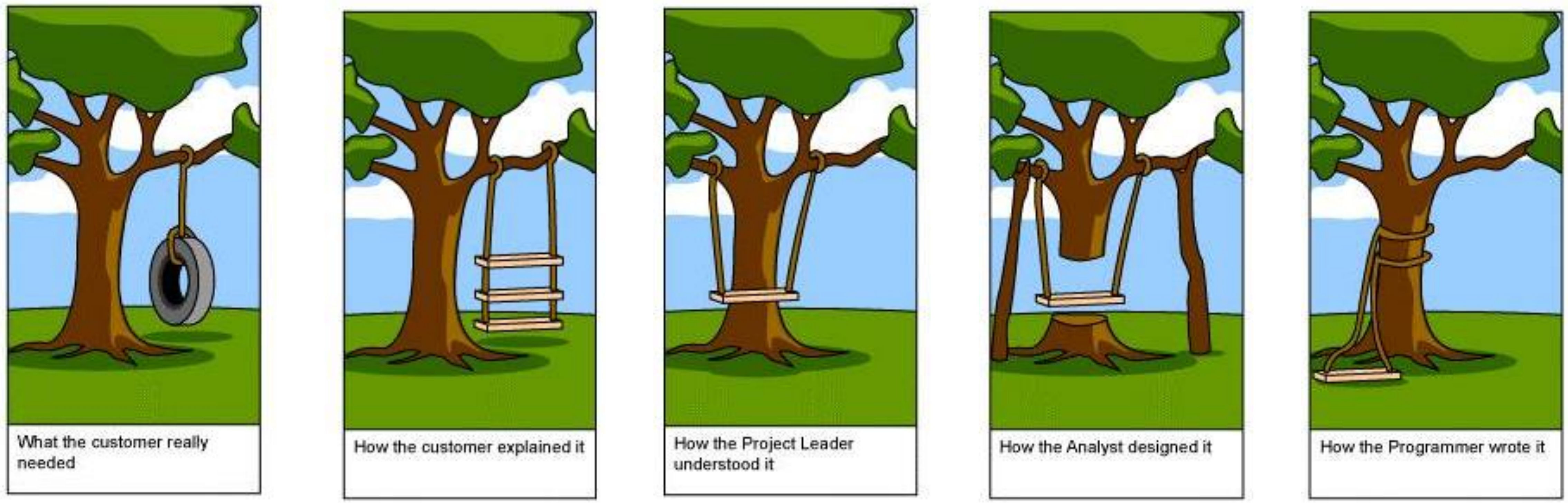
Requirement Management

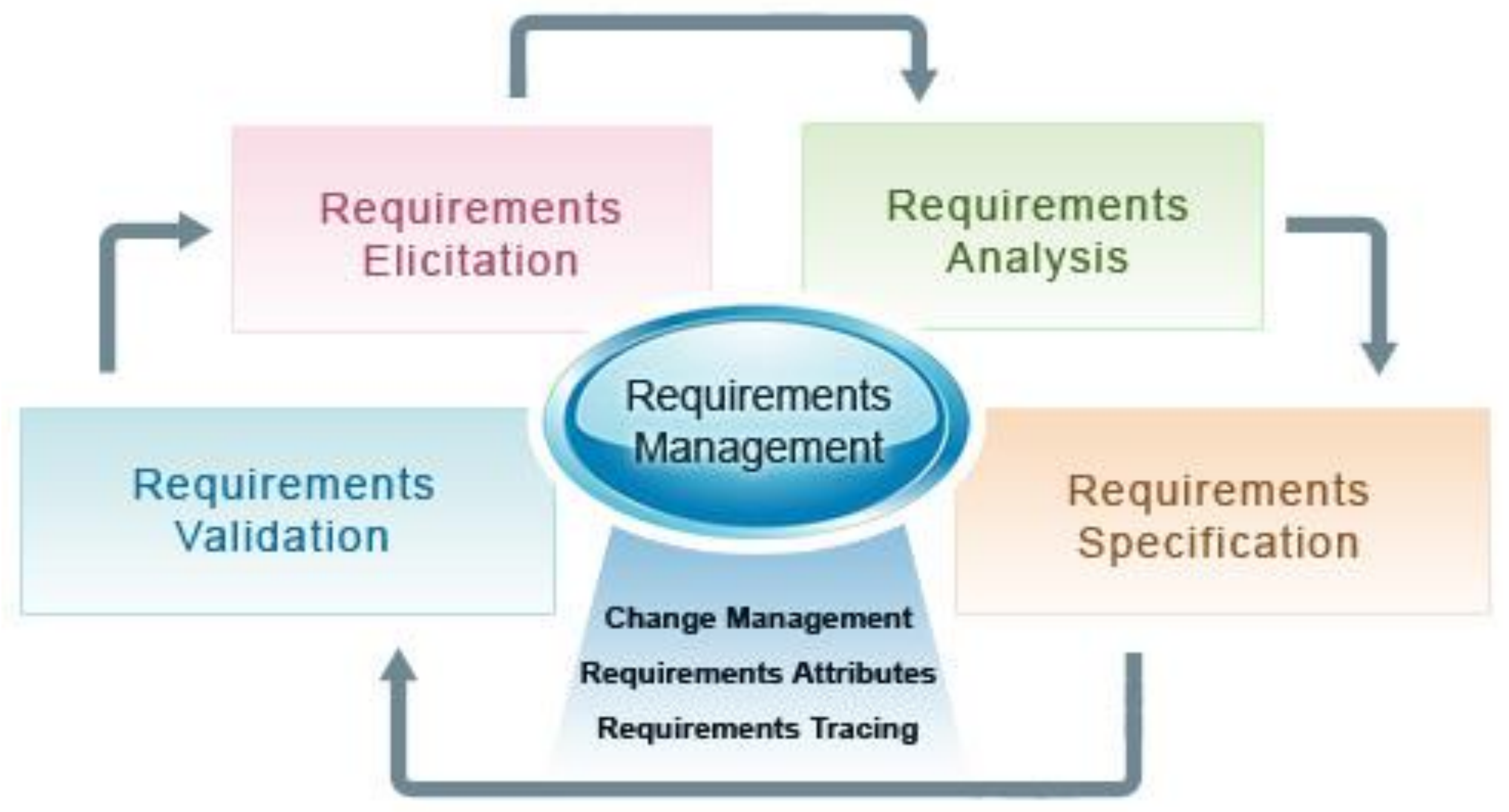
Requirement (Mis) Management


What the customer really needed
How the customer explained it
How the Project Leader understood it
How the Analyst designed it
How the Programmer wrote it

What is Requirement?

A Software requirements specification (SRS) is a complete description of the behavior of a system to be developed and may include a set of use cases and non-functional requirements.

Requirement Management



Requirement Traceability

- The requirements should be **Tagged**
- Design to the Requirement
- Code should trace to design
- Unit test cases to code
- System test cases to the Requirements

A project without adequately traced work products is difficult to sustain

Design

What is Software Architecture

Software architecture refers to the fundamental structures of a **software** system and the discipline of creating such structures and systems. Each
structure comprises **software** elements, relations among them, and properties of both elements and relations.

The architecture of a system describes its major components, their relationships (structures), and how they interact with each other.

What is Software Design

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

Modularize - is a technique to divide a software system into multiple discrete and independent modules
Concurrency – Modules executing in parallel
Cohesion - is a measure that defines the degree of intra-dependability within elements of a module.
Coupling - is a measure that defines the level of inter-dependability among modules of a program

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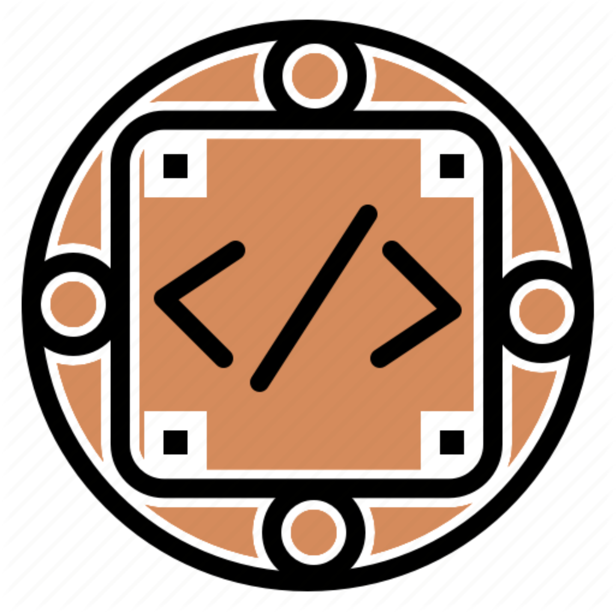
Implementation

Key Objective of Implementation



- Translate the design into code that will satisfy requirements. The software implemented should be
  - **Complete:** everything that is in the requirements and design is implemented
  - **Consistent:** no mismatched interfaces and consistent with the design
  - **Stylistic**: exhibits good programming style
    (e.g., safe constructs, information hiding, well defined types, reasonable module sizes and complexity, well-defined module interfaces, avoids side effects)
  - **Understandable:** code should be constructed that is easy to read, not necessarily easy to write
  - **Modifiable:** again this is a living document
  - **Confirmable, Verifiable and testable:** you can tell when you've met the design and requirements

Coding Principles and Concepts

Before you write one line of code be sure you -

- Understand the problem you're trying to solve
- Avoid developing an elegant program that solves the wrong problem.
- Understand basic design principles and concepts
- Create a set of unit tests that will be applied once the component you code is completed
- Test cases can be automated or manual.

As you begin writing code, remember

- Code is read much more often than it is written
- The goal of coding guidelines is to improve the productivity of all software development: Easier, more reliable, faster
- Comment as you go. It only takes a few seconds. Don't wait for later
- Source code is a language for people, not just computers
- • Ask yourself: "How will the next person know that?"

Unit Testing

UNIT TESTING FOCUSES VERIFICATION EFFORT ON THE SMALLEST UNIT OF SOFTWARE DESIGN – THE SOFTWARE COMPONENT OR DESIGN

USING THE COMPONENT LEVEL-DESIGN AS A GUIDE, IMPORTANT CONTROL PATHS ARE TESTED TO UNCOVER ERRORS WITHIN THE BOUNDARY OF THE MODULE

WHITE-BOX ORIENTED APPROACH

Unit Testing Considerations

Test Module Interfaces	If data do not enter and exit properly, all other tests are moot
Examine Local Data Structures	Local data structures should be exercised and the local impact on global data should be ascertained(if possible) during unit testing
Test Boundary Conditions	Considered to be most important task of unit test step. Test cases that exercise data structure, control flow and data values **just below, at and just above maxima and minima** are very likely to uncover errors
Test all Independent Paths	Selective testing of execution paths is an essential task during the unit test. Test cases should be designed to uncover errors due to erroneous computations, incorrect comparisons, or improper control flow. Basis path and loop testing are effective techniques for uncovering a broad array of path errors
Test all Error Handling Paths	General tendency is to incorporate error handling into software and then 'never test it'. This should not be the case.

Boundary Testing

Boundary testing is the process of testing between extreme ends or boundaries between partitions of the input values.

The basic idea in boundary value testing is to select input variable values at their:

Minimum; Just above the minimum; Just below the maximum; Maximum

An exam has a pass boundary at 50 percent, merit at 75 percent and distinction at 85 percent; What would be the boundary conditions

Corner test cases

In engineering, a **corner case** involves a problem or situation that occurs only outside of normal operating parameters

Corner case occurs outside of normal operating parameters

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Software Configuration Management

What is Software Configuration Management

The art of coordinating software development to minimize confusion.

Art of identifying, organizing and controlling modifications to the software being built, with the goal of maximizing productivity and minimizing mistakes.

An *umbrella activity* that forms part of *Software Quality Assurance*

Consists of Processes, Tools and Techniques to systematically manage the changes to software

Identify all items that collectively define the software configuration and manage changes to these items (*Version Control* and *Change Control)*

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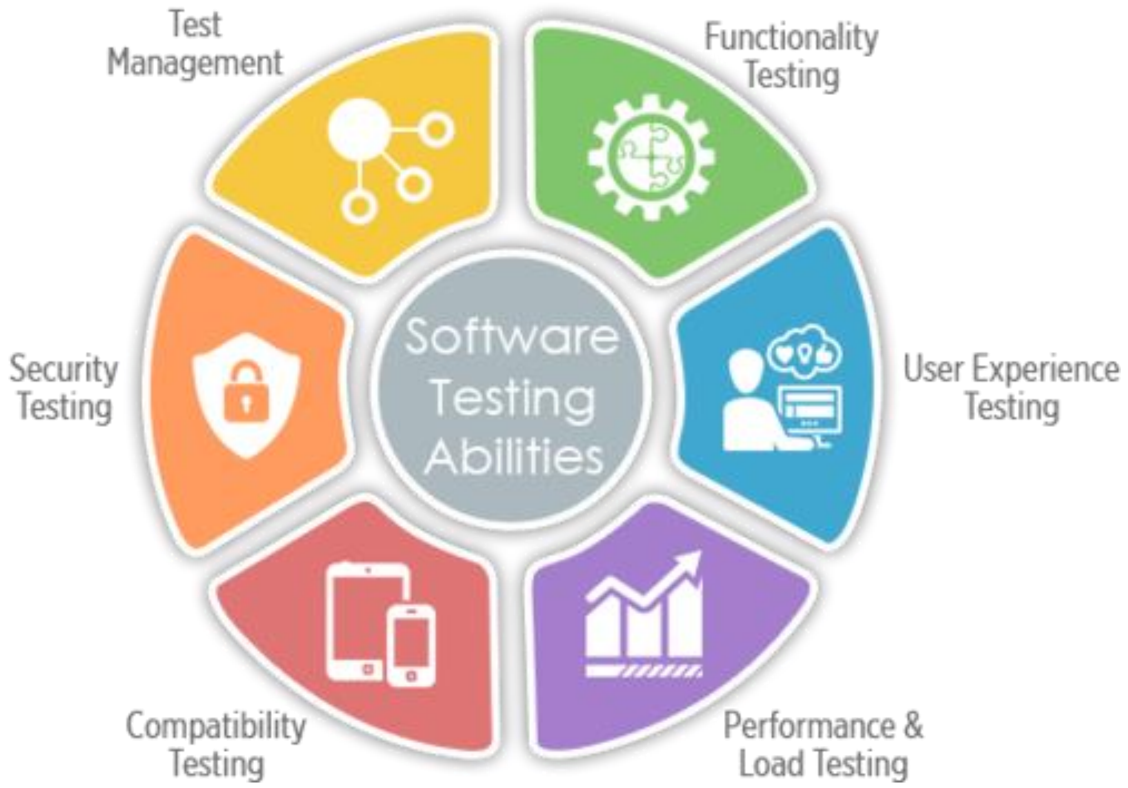
Software Testing

Software Testing

Testing is any activity aimed at evaluating an attribute or capability of a program or system and determining that it meets the required results.



Test Levels – Based on Target of Testing

Unit Testing

- Generally white-box, Stubs are used.
- Done at component level
- Testing of functionality, non functional
- Performed by the development team

Integration Testing

- Testing module interfaces
- Incremental approach
- Non-incremental (big-bang) approach
- Architecture Driven

Test Levels – Based on Target of Testing

System Tests

- Functional System Requirements
- Non-functional system requirements
  - security, speed, accuracy, and reliability.
- Test environment like the production environment
- External interfaces to other applications, utilities, hardware devices, or the operating environment

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Release and Maintenance

Release Process

Objectives of a release process

- Provide right version and documentation to customer
- Archive for future use
- Systematic handling of post release defects

Records Created

- Release checklist
- Release notes
- Post release defects

Need of Maintenance

- Requirement priorities
- Initial systems would not be complete
- Flexibility in product/software to allow customer expectations
- Changes due to time
- Influence of technology, business, competition, late priority realization
- Control initial investment
- Customer default expectations of post purchase support
- Quality expectations

Types of Maintenance

Adaptive

- Modifying the system to cope with changing environment

Perfective

- Implementing new or changed user requirements with functional enhancements

Corrective

- Fixing errors found by users

Preventive

- Increasing maintainability or reliability to prevent problems in future