An Introduction to Software Engineering & Software Testing Life Cycle

Lesson2: Introduction to Software Testing Life Cycle

Lesson Objectives

➤ **To understand the following topics:**

- What is Software Quality?
- Other definitions
- Quality Assurance & Quality Control
- Importance of QA/QC
- What is V&V?
- Static and Dynamic V&V
- Static and Dynamic Techniques
- Why V&V?
- Types of V&V
- What is Life Cycle ?

Lesson Objectives

➢ **To understand the following topics:**

- – Software Testing Lifecycle

- – Different tasks involved in STLC

- – Different activities in each tasks

- – Task 1: Sales & Initial Planning

- – Task 2: Create Test Strategy

- – Task 3: Analyze and Design Testware

- – Task 4: Test execution and analysis

What is Software Quality?

➤ **Quality is the totality of features and characteristics of a product or service that bear on its ability to satisfy stated and implied needs**

➤ **Software Quality means:**
  - Total conformance to user requirements and   specifications
  - Absence of Defects
  - Fitness of Use

Other definitions

➤ **Errors:**
  – Mistakes we make

➤ **Defects:**
  – Defects are the results of errors

➤ **Failures:**
  – Software failures are the results of Defects, observed while running the software
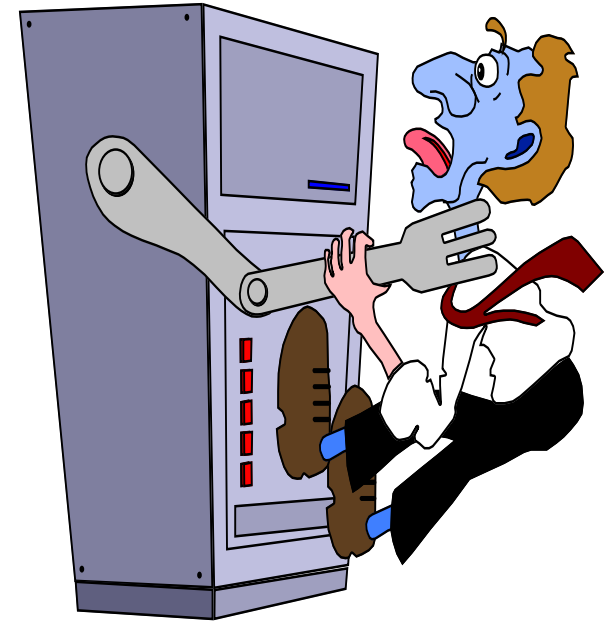
Quality Assurance & Quality Control

Quality Assurance

- ➤ **Ensures that the product is developed correctly**
- ➤ **Prevention activity**
- ➤ **E.g. Process definition, planning**
- ➤ **Done at the beginning of project**

Quality Control

- ➤ **Ensures that the product developed is correct**
- ➤ **Detection and correction activity**
- ➤ **E.g. Reviews and Testing**
- ➤ **Carried out after initiation**

Importance of QA/QC

"All QC/QA activities are important, because all lead to quality software, if practiced correctly. However, if you allow me to choose one only, my choice is Formal Technical Reviews. If conducted properly, they are the single-most effective ways to uncover and fix defects while they are still inexpensive to find and fix."

Roger Pressman

What is V&V?

➢ **Verification.**

  – Determine whether the artifacts of each phase of SDLC fulfill the requirements of the previous phase.

  – Are we building the product correctly?

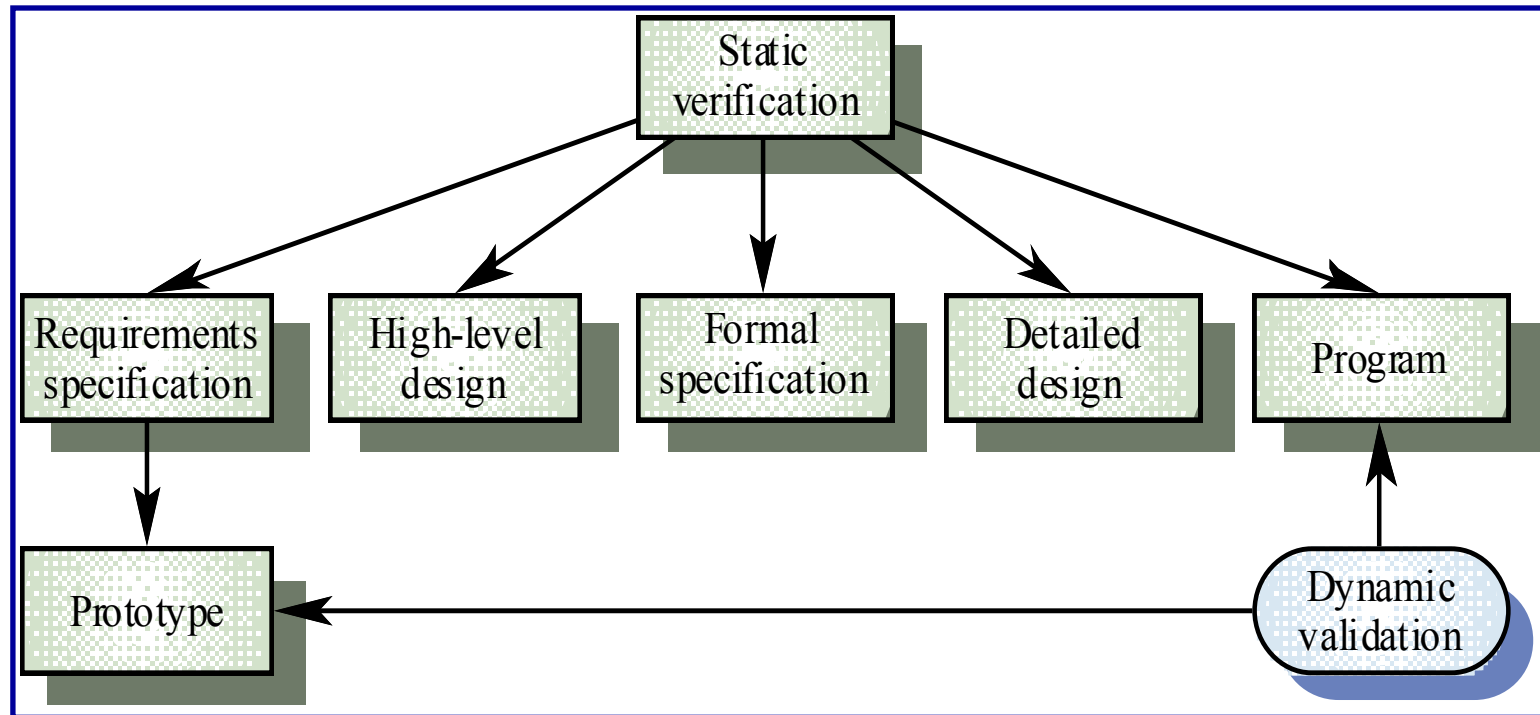 – Also called as static technique or Review

➢ **Validation**

  – Determine whether the artifacts of each phase of the SDLC are in tune with the customer requirements.

  – Are we building the correct product?
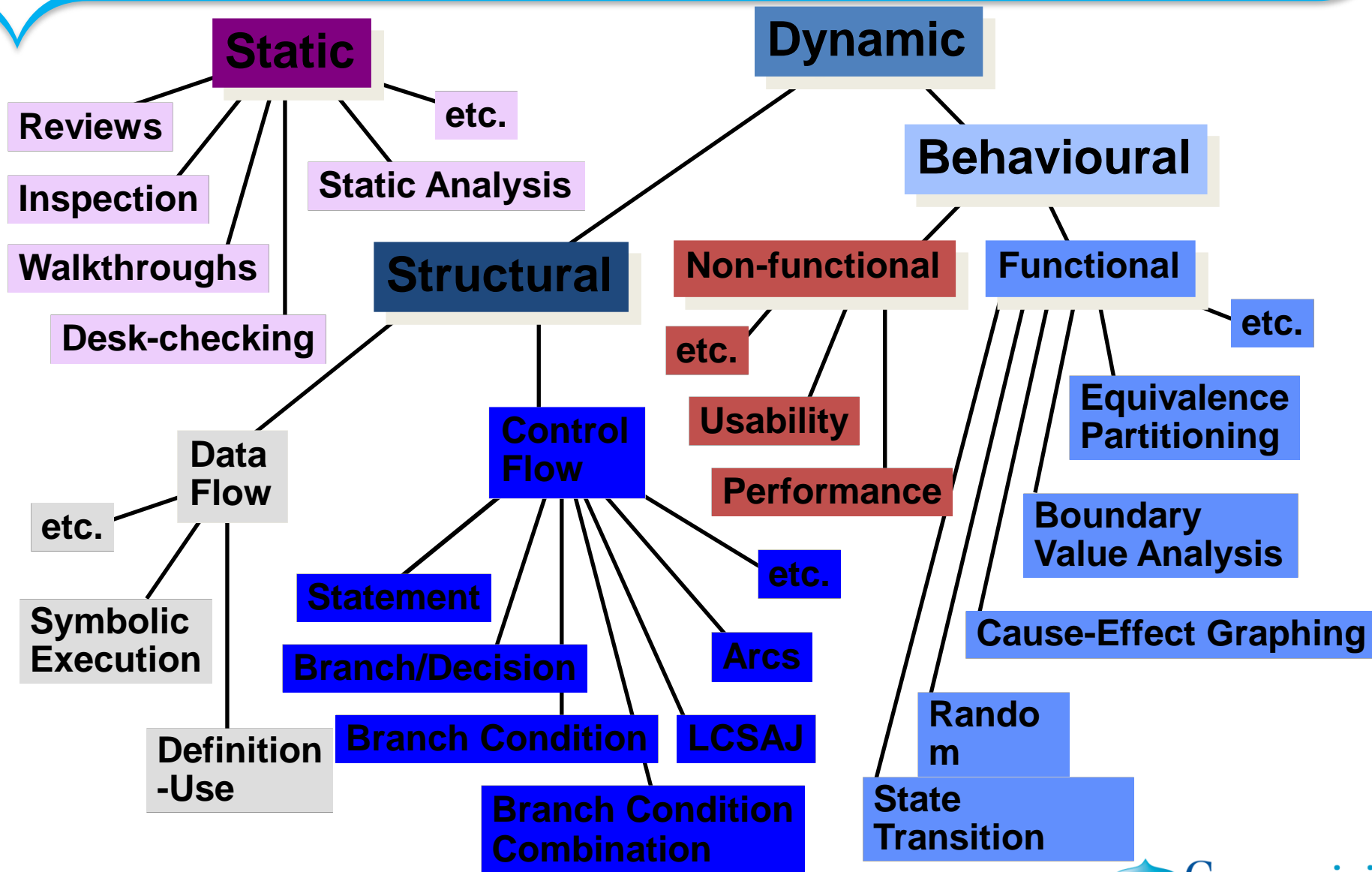
  – Also called as dynamic technique or Testing

Static and Dynamic V&V

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Static and Dynamic Techniques

Static

Reviews

Inspection

Walkthroughs

Desk-checking

etc.

Static Analysis

Structural

Data Flow

etc.

Symbolic Execution

Definition-Use

Control Flow

Statement

Branch/Decision

Branch Condition

Branch Condition Combination

Arcs

LCSAJ

etc.

Dynamic

Behavioural

Non-functional

etc.

Usability

Performance

Functional

etc.

Equivalence Partitioning

Boundary Value Analysis

Cause-Effect Graphing

Random

State Transition

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Why V&V?

- ➢ **V&V is required because :**
  - – Software construction is a complex task.
  - – Software construction is a Human activity
  - – Humans make mistakes
  - – Discipline and Methodology for construction reduce mistakes but cannot eliminate mistakes
- ➢ **V&V is about evaluating the products and processes used for producing the products**
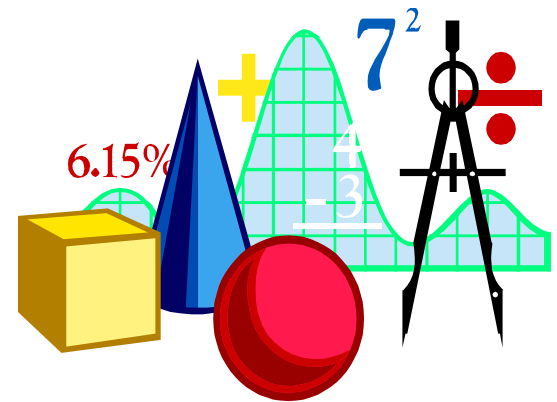- ➢ **V&V is NOT about evaluating the producers**

Types of V&V

- ➢ **Reviews**
    - – Project Plans, Schedules, and Costs
    - – Requirements, Functional Specifications, and Design
    - – Test Plans, Test Specifications, Test Scripts,
    - – Source Code

- ➢ **Testing of Software**
    - – Unit
    - – Integration
    - – System
    - – Customer Acceptance

What is Life Cycle ?

- ➢ **Lifecycle in simple term refers to the sequence of changes from one form to other form**

- ➢ **Every entity has a lifecycle from its inception to retire**

- ➢ **In a similar way, Software is also an entity**

- ➢ **Just like developing software involves a sequences of steps, testing also has steps which should be executed in a definite sequence**

- ➢ **This phenomenon of executing the testing activities in a systematic and planned way is called testing life cycle**
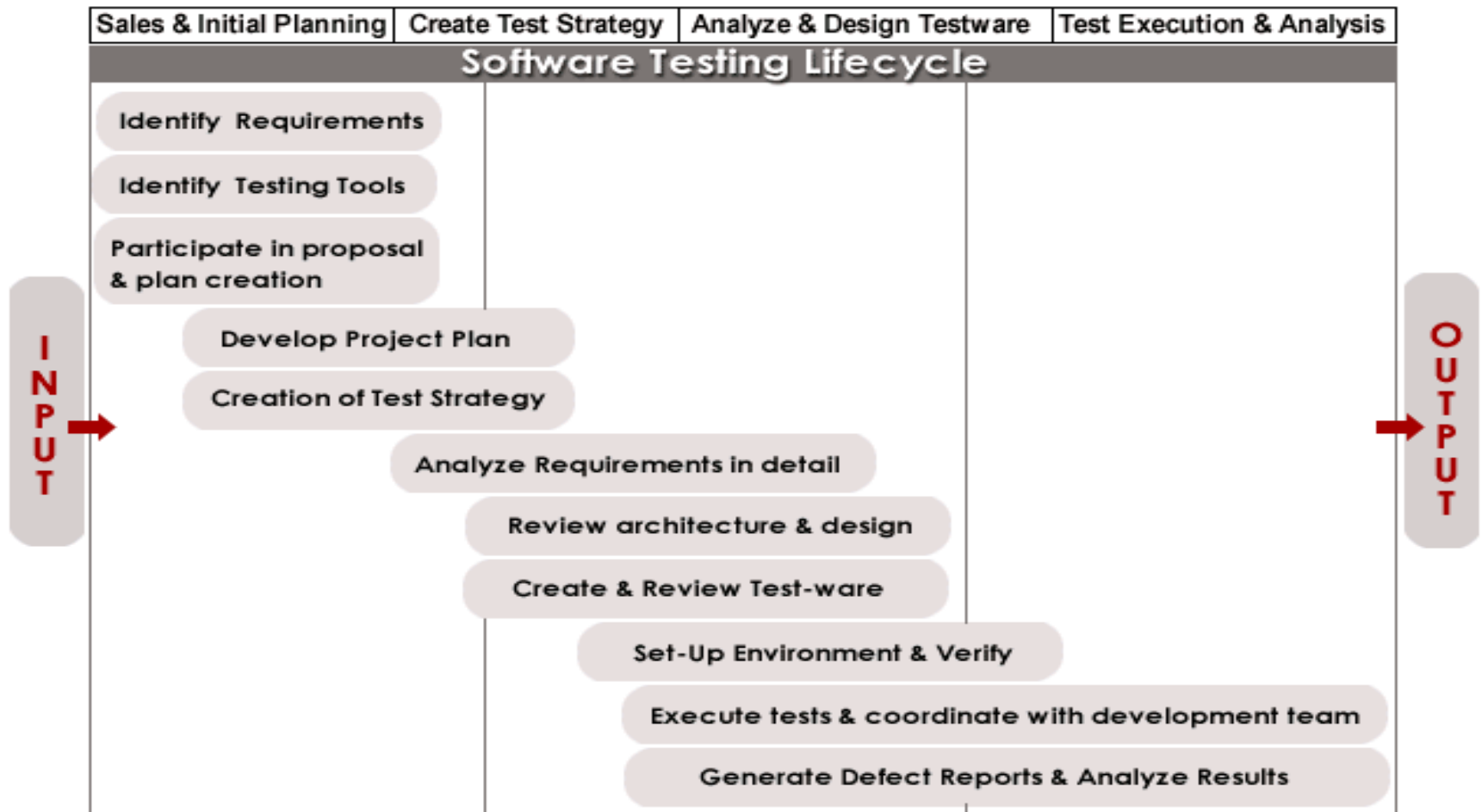
Software Testing Lifecycle

The full business, from initial thinking to final use, is called the product's life cycle."

--- Cem Kaner

"It is the preprocess, the process and post process involved in testing the
 Product."

Software Test Life Cycle (STLC)

Sales & Initial Planning	Create Test Strategy	Analyze & Design Testware	Test Execution & Analysis

Software Testing Lifecycle

Identify Requirements

Identify Testing Tools

Participate in proposal & plan creation

Develop Project Plan

Creation of Test Strategy

Analyze Requirements in detail

Review architecture & design

Create & Review Test-ware

Set-Up Environment & Verify

Execute tests & coordinate with development team

Generate Defect Reports & Analyze Results

INPUT

OUTPUT

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Different tasks involved in STLC

Software Testing Life Cycle is broadly classified into four types:

➤ **Task 1:** Sales & Initial Planning

➤ **Task 2:** Create Test Strategy

➤ **Task 3:** Analyze & Design Testware

➤ **Task 4:** Test Execution & Analysis

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Different activities in each tasks

- **Lifecycle in simple term refers to the sequence of changes from one form to other form**
- **Every entity has a lifecycle from its inception to retire**
- **In a similar way, Software is also an entity**
- **Just like developing software involves a sequences of steps, testing also has steps which should be executed in a definite sequence**
- **This phenomenon of executing the testing activities in a systematic and planned way is called testing life cycle**

Task 1: Sales & Initial Planning

- ➢ **'Sales & Initial Planning' in tune has three major activities like**
  - – Identify Requirements
  - – Identify Testing Tool
  - – Participate in proposal & plan creation

Task 1: Sales & Initial Planning - Identify Requirements

➢ **Details about this activity :** This task ensure that requirements related to designing & performing software testing at various stages is adequately captured like,

- – Business and functional requirements
- – Non-functional requirements
- – Data related requirements
- – Environment related requirements

Task 1: Sales & Initial Planning - Identify Requirements

➢ **Roles and Responsibilities**

➢ **Tasks to be perform by Test Manager with PM / Technical Architect / Business Analyst :**

- Identify testable and non testable items from requirements
- Ensure all non functional requirements like Usability, Security, Reliability, Performance, Stress, transaction are captured
- The data requirements for each level of testing and types of testing are captured
- Verify if the production database at client has some sensitive data and information in it
- Data structure & relationships are analyzed and the business rules associated with the tables & columns are to be captured
- Identify how exceptions, errors and deviations are to be handled
- Identify risks and assumptions and mitigation plan. Unanswered questions can be marked as pending until the project progresses
- Obtain client sign-off on the requirements & baseline the requirement

Task 1: Sales & Initial Planning - Identify Testing Tool

- ➢ **Identify Testing Tools :** Identify the need and feasibility of tools to be used based on project profitability, enhanced delivery capability and ease & effectiveness of testing.

- ➢ **Testing tools could be used for the following purposes:**
  - Functional Testing
  - Performance Testing
  - Website Monitoring,
  - Data Generation
  - Data Upload
  - Defect Tracking
  - Application Security Testing
  - Data Migration testing

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Task 1: Sales & Initial Planning - Identify Testing Tool

➢ **Details about this activity :** Some of the tools should be chosen by default, e.g. Bug Tracking Tool, Unit Testing Tool, but the tool expert must consider the following:

- Evaluate needs for testing tools
- Impact of the tool usage on the cost/time and effort for the project
- Infrastructure changes, licensing and availability of the tool to be accessed
- Revise estimates for testing effort based on the tools selected
- The deal team/ PM shall place a helpdesk request if tools have to be procured
- Based on the timelines for availability of tools, project schedule & timelines may be revised

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Task 1: Sales & Initial Planning - Participate in proposal & plan creation

➢ **Details about this activity:**

  – The testing activities, effort estimates, cost estimates & milestones are determined based on the previous activities

  – These are now factored into the proposal to the client & an initial project plan is developed

Task 1: Sales & Initial Planning - Participate in proposal & plan creation

➤ **Roles and Responsibilities :**

➤ **Tasks to be perform by test manager :**
- Estimate the testing effort & cost for the project and integrate the same with the overall project effort in the proposal
- Identify the Size and roles of testing team, Major testing milestones, Hardware and Software requirements for testing and Data back-up & roll back facilities
- Review the proposal using the proposal review checklist
- Raise resource requisitions
- Integrate all testing activities identified into the creation of phase one project plan

Task 2: Create Test Strategy

- ➢ **'Create Test Strategy' in tune has two major activities like :**
  - – Develop Detailed Project Plan
  - – Creation of Test Strategy

Task 2: Create Test Strategy - Develop Detailed Project Plan

➢ **Develop Detailed Project Plan :** Once the deal for the approval to go ahead with the project is obtained, detail planning needs to be executed.

➢ **Roles and Responsibilities :**

➢ **Tasks to be perform by test manager along with PM:**
  - Confirm the resource requisitions and raise a helpdesk request for hardware, software requirements etc.
  - Update the project plan periodically as and when there is any changes

Task 2: Create Test Strategy - Creation of Test Strategy

➢ **Details about this activity**

– Based on the technology, the level/type of testing and the results of the initial requirements analysis, specific testing deliverables which will become the basis for creating a test strategy need to be defined and use the available Test Strategy Templates.

Task 2: Create Test Strategy - Creation of Test Strategy

- ➢ **Roles and Responsibilities :**
- ➢ **Some of the tasks to be perform like :**
  - – Set the testing objectives
  - – Define scope based on the requirements
  - – Identify the types of testing required
  - – Determine the levels of testing involved in the project
  - – Define Entry and Exit criteria
  - – Define Test environment requirements with respect to test infrastructure requirements, test bed set up, configuration management process
  - – Identify various cycles of testing
  - – Identify the core functionality and the risk associated with it

Task 2: Create Test Strategy - Creation of Test Strategy

- Identify Test Data Requirements, Test Procedures, Special Considerations and time to prepare test cases from several test scenarios, for all types of tests
- Identify what and how the data will be scrubbed for functional and performance testing
- Plan for test data and it source and the method for replicating data from the production environment, tools required for data creation
- Identify the data requirements for integration and system, if required
- Identify the test stubs and harness required plus how they should be designed
- Identify how test results (test reports, defects raised) shall be reproduced

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Task 3: Analyze and Design Testware

➢ **'Analyze and Design Testware' in tune has five major activities like :**
  – Analyze and Detail Requirements
  – Review Architecture and Design
  – Design Testware
  – Review Design of Testware
  – Set Up Test Environment

Task 3: Analyze and Design Testware - Analyze and Detail Requirements

➤ **Details about this activity :**

– The main goal here is to understand and detail the requirements to be able to design and develop the Testware.

– Any gaps in requirements, functional or non-functional should be identified & resolved at this stage

Task 3: Analyze and Design Testware - Analyze and Detail Requirements

- ➢ **Roles and Responsibilities :**
- ➢ **Some tasks to be perform by Test Manager with PM / Technical Architect / Lead and Business Analyst :**
  - – Ensure that the requirements are complete, testable, comprehensive and consistent
  - – Ensure that all aspects of requirements like functionality, usability, GUI, security, reliability, portability etc. are adequately detailed
  - – Ensure that, based on the business processes, the performance testing team has created transaction and user profiles
  - – Identifying the source, access, approximate volume and ways of generating data required, analyze the data requirements in detail for every level
  - – Revisit the list of testable and non-testable items and make required changes if any

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Task 3: Analyze and Design Testware - Analyze and Detail Requirements

- Revisit the list of risks and assumptions identified during the initial requirements analysis
- Identify gaps in the time, effort and cost estimation of the project between the initial requirement analysis and this detailed one
- Adequately detail the data related requirements and responsibility to create test data is identified
- Define methods/ life cycle to record, report & track test results. Define reports that will be generated on a periodic basis. Define approach to analyze the test results
- For security testing, understand the application from both functionality and security perspective. Decompose the application. Ensure that for security testing different user profiles of an application are available to the tester
- For data migration testing, data to be migrated has to be identified along with existing relationships & associated business rules

Task 3: Analyze and Design Testware - Review Architecture and Design

➢ **Details about each activity:**

➢ **Review Architecture and Design**
  – The objective is to ensure that the architecture & design are developed/provided and have adequately implemented all testing related requirements.

➢ **Ensure that the design is testable**
  – In case of Object Oriented design the appointed architect from the testing team should review the elements of object-oriented software design that may cause testing problems. e.g. to limit the use of class inheritance, to limit the state behavior of objects, to avoid overly complex classes.
  – In the case of performance testing the aim is to convert non-functional requirements get converted into the appropriate design.
  – In case of application security testing the architecture/design that has been developed/provided should be sufficient to list or decompose into low level components.
  – The test lead along with the technical architect/ lead shall perform formal architecture/ design walk through to ensure traceability of test requirements into design and that the design is testable.

Task 3: Analyze and Design Testware - Design Testware

➢ **Details about this activity :** Based on the scope of the project, analyze the requirements and design the Testware accordingly.

➢ **Key components of designing Testware include:**
  - Design test cases, scripts & test scenario
  - Design test environment and libraries
  - Design test data and test stubs
  - Design test harness, if required Design methods to log, track, analyze and report test results

Task 3: Analyze and Design Testware - Design Testware

➢ **Roles and Responsibilities :**

➢ **Tasks to be perform by test manger along with test lead :**

- Design test cases, scripts & scenario for Functional Testing, Performance Testing, Security Testing and Data Migration testing
- Design test environment & libraries
- Design test data and test stubs for different levels (Unit, Integration, System, UAT) and modes (manual/automated) of testing
- Impact Analysis in case of existing Testware.
- If the Testware already exists identify the impact of the new functionality on the existing Testware

Task 3: Analyze and Design Testware - Review Design of Testware

➢ **Details about this activity:**

 – At least one level of formal review/walkthrough of all components of the Testware should be performed to ensure adequacy of test design & reduce rework

 – The peer review by the Business Analyst or the Domain expert as applicable. For Security testing the Team Lead would be responsible for reviewing the Testware

 – After all internal reviews have been completed get the test cases along with the test data reviewed by the client

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Task 3: Analyze and Design Testware - Set Up Test Environment

➢ **Details about this activity:**

➢ **Set Up Test Environment :**
   – The configuration of test environment is detailed in the test strategy. Hardware is set up as per specifications, specific versions of software are installed and Databases are set up with initial data to be used for testing. All this is done to perform various levels & types of testing

Task 3: Analyze and Design Testware - Set Up Test Environment

- ➤ **Roles and Responsibilities :**
- ➤ **Tasks perform by IT support and test lead :**
  - Review & clarify the specifications for different test environment at various project locations (onsite/ offshore)
  - Install the necessary hardware and software
  - Set up databases as per specifications
  - Upload any initial test data if required
  - Set up testing tools, defect tracking tools
  - Test the setup of the environment at each location & address any issues

Task 4: Test execution and analysis

➢ **'Test execution and analysis' in tune has three major activities like :**

– Execute tests & coordinate with development team

– Defect Reporting & Analyze Test Result

– Considerations for independent Test Assignments

Task 4: Test execution and analysis - Execute tests & coordinate with development team

➢ **Details about this activity :**

➢ **Execute tests & coordinate with development team :**

- Testing may be performed at various levels (unit, integration, system, UAT) at various project locations and with various types (functional, performance, usability, and security).

- Typically unit testing is performed by the development team. Other types of testing may be performed by a separate testing team.

- For such a situation formal procedures for handover should be defined and implemented. Similarly, a formal procedure should be defined and implemented for handover of the tested code, along with test results and status of defects detected.

Task 4: Test execution and analysis - Execute tests & coordinate with development team

➢ **Roles and Responsibilities :**

➢ **Tasks to be perform by testers, test lead / manager & the team lead :**
- The team lead shall complete release notes and handover to the test lead to identify modules/ code to be tested
- The test lead shall allocate tasks to the testers as per plan
- Testers shall prepare for execution of the test. Specific data & further detailed test scenarios, scripts, test cases would have to be created. Cases may be prioritized for testing
- Tester shall review the environment installation for completion
- Testers shall execute the test, record the results and log defects using agreed upon tools

Task 4: Test execution and analysis - Execute tests & coordinate with development team

➢ **The team lead shall review the test results, analyze the code, and assign the open defects to developers. After the bug fixes, testing team have to perform another iteration of testing**

➢ **The test lead shall verify the test results for accuracy, complete the release note and bug report. These are then handed over to the development team (client or Kanbay). If the reports have to be submitted to the client, then additional report providing the analysis of the test results shall be created.**

➢ **All the above steps to be repeated until all tests are executed successfully with either zero defects or with an acceptable level of defects.**

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Task 4: Test execution and analysis - Defect Reporting & Analyze Test Result

➢ **Details about this activity:**

- – Analysis in functional testing refers to identifying the defects, their causes, studying the defect patterns and analyzing them.

- – Consolidation of defects in the defect reports would primarily be the responsibility of the testing team while analyzing the causes of defects would be the responsibility of the development team.

- – Defect reports or Client reports also provide information to the development team/client on the quality of the product, stating the risks and issues faced during testing and making recommendations on the product quality and future testing process improvements.

Task 4: Test execution and analysis - Defect Reporting & Analyze Test Result

➢ **Roles and Responsibilities:**

➢ **Tasks to be perform by Test Manager / Performance Analyst :**
  - **For Performance Testing** – Analyze the Response Time per transaction, Transaction Response Time Distribution, Total Hits/Second and related graphs.
  - **For Functional Testing** -- Analyze the Test Results to determine defects, their priority and severity. If the testing activity is a part of development project being executed by Kanbay, root causes of defects should be determined along with the development team and fixes identified. In other cases this could be joint activity with the client team.
  - **For Application security testing** -- The threat maps will be populated that will show the coverage of threats tested for. A security threat report will be prepared which will list the vulnerabilities identified as well as some mitigation suggestions.
  - **For Data Migration Testing** -- Data in the target and source database are compared & validated post migration.

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Task 4: Test execution and analysis - Considerations for independent Test Assignments

➢ **Details about this activity :**

➢ **Considerations for independent Test Assignments :**
  – For independent functional testing projects, performance testing projects or application security testing projects all the above workflows and phases are applicable. Certain upstream activities such as reviewing design, reviewing sample code to meet performance and security requirements and performing application tuning would be out of scope.

Summary

➢ **In this lesson, you have learnt:**

- Software Testing Life Cycle (STLC) is the testing process which is executed in systematic and planned manner.

- In STLC process, different activities are carried out to improve the quality of the product.

- There are different testing phases in testing life cycle like

  - Sales and Initial Planning

  - Create Test Strategy

  - Analyze & Design Testware

  - Test Execution & Analysis

- Details about each activity & Roles and Responsibilities in each activities

Summary

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Review Question

➤ **Question 1: Identify Requirements , Identify Testing Tool and Participate in proposal & plan creation are the activities of Create Test strategy.**

  – True/ False

➤ **Question 2: Which of the following tasks to be performed by Test Manager with PM / Technical Architect / Lead and Business Analyst in analyze and Design Testware?**

  – a) Ensure that the requirements are complete, testable, comprehensive and consistent

  – b) Set the testing objectives

  – c) Estimate the testing effort & cost for the project and integrate the same with the overall project effort in the proposal

  – d) All of the mentioned

Knowledge Check

Review Question

➤ **Match the following :**

1. Sales and Initial planning	A. Set-up Environment
2. Create Test Strategy	B. Execute tests and coordinate with development team
3. Analyze & Design Testware	C. Identify Requirements
4. Test Execution & Analysis	D. Develop Project Plan & create test strategy