Test management

Prof. Durga Prasad Mohapatra
Professor
Dept. of CSE, NIT Rourkela

Test Management

- Test management is concerned with both test resource and test environment management.
- It is the role of test management to ensure that new or modified service products meet the business requirements for which they have been developed or enhanced.

Key elements of test management

1. Test organization.
2. Test planning.
3. Detailed test design and test specifications.
4. Test monitoring and assessment.
5. Product quality assurance.

Test organization

- It is the process of setting up and managing a suitable test organizational structure and defining explicit roles.
- The project framework under which the testing activities will be carried out is reviewed, high-level test phase plans are prepared, and resource schedules are considered.
- Test organization also involves the determination of configuration standards and defining the test environment.

Test planning

- The requirements definition and design specifications facilitate the identification of major test items and these may necessitate updating the test strategy.
- A detailed test plan and schedule is prepared with key test responsibilities being indicated.

Detailed test design and test specifications

- A detailed design is the process of designing a meaningful and useful structure for the tests as a whole.
- It specifies the details of the test approach for a software functionality or feature and identifying the associated test cases.

Test monitoring and assessment

- It is the ongoing monitoring and assessment to check the integrity of development and construction.
- The status of configuration items should be reviewed against the phase plans and the test progress reports prepared, to ensure the verification and validation activities are correct.

Product quality assurance

- The decision to negotiate the acceptance testing program and the release and commissioning of the service product is subject to the 'product assurance' role being satisfied with the outcome of the verification and validation activities.
- Product assurance may oversee some of the test activity and may participate in process reviews.

Test Organization I

- Since testing is viewed as a process, it must have an organization such that a testing group works for better testing and high quality software.

The testing group activities:

- Maintenance and application of test policies
- Development and application of testing standards
- Participation in requirement, design and code reviews
- Test planning
- Test execution
- Test measurement
- Test monitoring
- Defect tracking
- Acquisition of testing tools
- Test reporting

Test Organization II

- The staff members of such a testing group are called ***test specialists or test engineers or simply testers.***
- A tester is not a developer or an analyst.
- He does not debug the code or repair.
- He is responsible for ensuring that testing is effective and quality issues are being addressed.
- The skills a tester should possess are
  - Personal and Managerial Skills
  - Technical Skills

Personal and Managerial Skills

- Testers must be able to contribute in policy-making and planning the testing activities.
- must be able to work in a team.
- must be able to organize & monitor information, tasks, and people.
- must be able to interact with other engineering professionals, software quality assurance staff, and clients.
- should be capable of training & mentoring new testers.
- should be creative, imaginative, and experiment-oriented.
- must have written and oral communication skills.

Technical Skills I

- Testers must be technically sound, capable of understanding software engineering principles and practices.
- must be good in programming skills.
- must have an understanding of testing basics, principles, and practices.
- must have a good understanding and practice of testing strategies and methods to develop test cases.

Technical Skills II

- must have the ability to plan, design, and execute test cases with the goal of logic coverage.
- must have technical knowledge of networks, databases, operating systems, etc. needed to work in a project environment.
- must have the knowledge of configuration mgt.
- must have the knowledge of test-ware and the role of each document in the testing process.
- must have knowledge about quality issues & standards.

Structure of Testing Group

- Testing is an important part of any software project.
- One or two testers are not sufficient to perform testing, especially if the project is too complex and large.
- Therefore, many testers are required at various levels.
- Figure 1 shows different types of testers in a hierarchy.

Structure of Testing Group contd…..

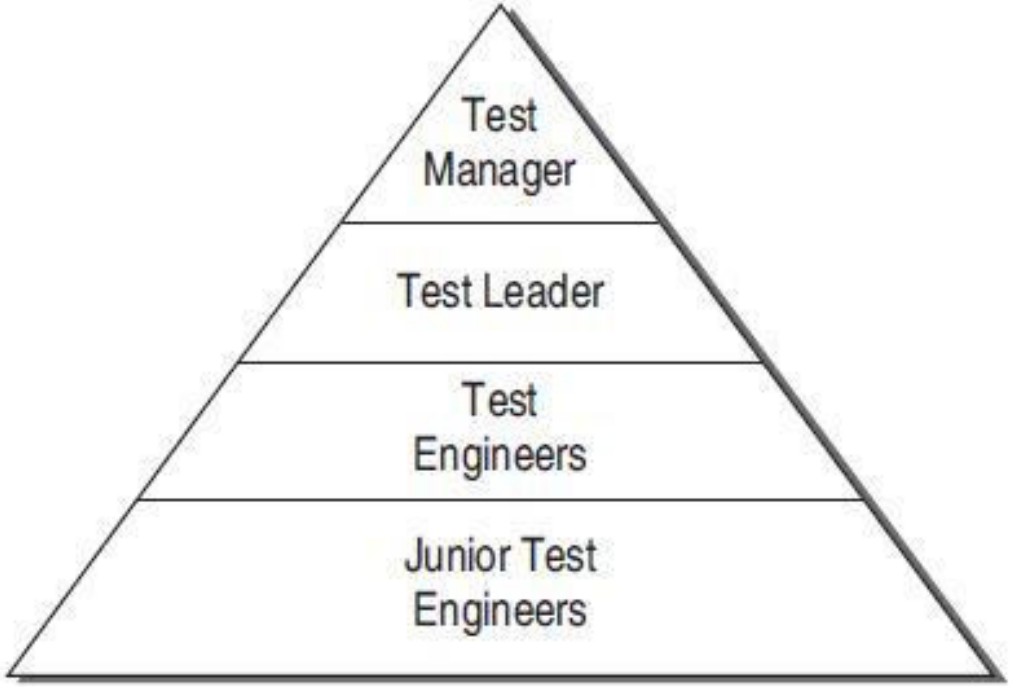


Figure 1: Testing Group Hierarchy

Responsibilities of Test Manager

- He is the key person in testing group who will interact with project management, quality assurance, and marketing staff.
- Takes responsibility for making test strategies with detailed master planning and schedule.
- Interacts with customers regarding quality issues.
- Acquires all the testing resources including tools.
- Monitors progress of testing & controls the events.
- Participates in all static verification meetings.
- Hires and evaluates the test team members.

Responsibilities of Test Leader

- Planning testing tasks given by the test manager.
- Assigning testing tasks to test engineers who are working under him.
- Supervising test engineers. (*prime responsibility*)
- Acquires all the testing resources including tools.
- Helping the test engineers in test case design, execution, and reporting.
- Providing tool training, if required.
- Interacting with customers.

Responsibilities of Test Engineers

- Designing test cases.
- Developing test harness.
- Set-up test laboratories and environment.
- Maintain the test and defect repositories.

Junior Test Engineers

- Junior test engineers are newly hired testers.
- They usually are trained about the test strategy, test process, and testing tools.
- They participate in test design and execution with experienced test engineers.

Test Planning

- According to the test process as discussed in STLC, testing also needs planning as is needed in SDLC. Since software projects become uncontrolled if not planned properly, the testing process is also not effective if not planned earlier.
- Moreover, if testing is not effective in a software project, it also affects the final software product. Therefore, for a quality software, testing activities must be planned as soon as the project planning starts.
- A *test plan* is defined as a document that describes the scope, approach, resources, and schedule of intended testing activities.

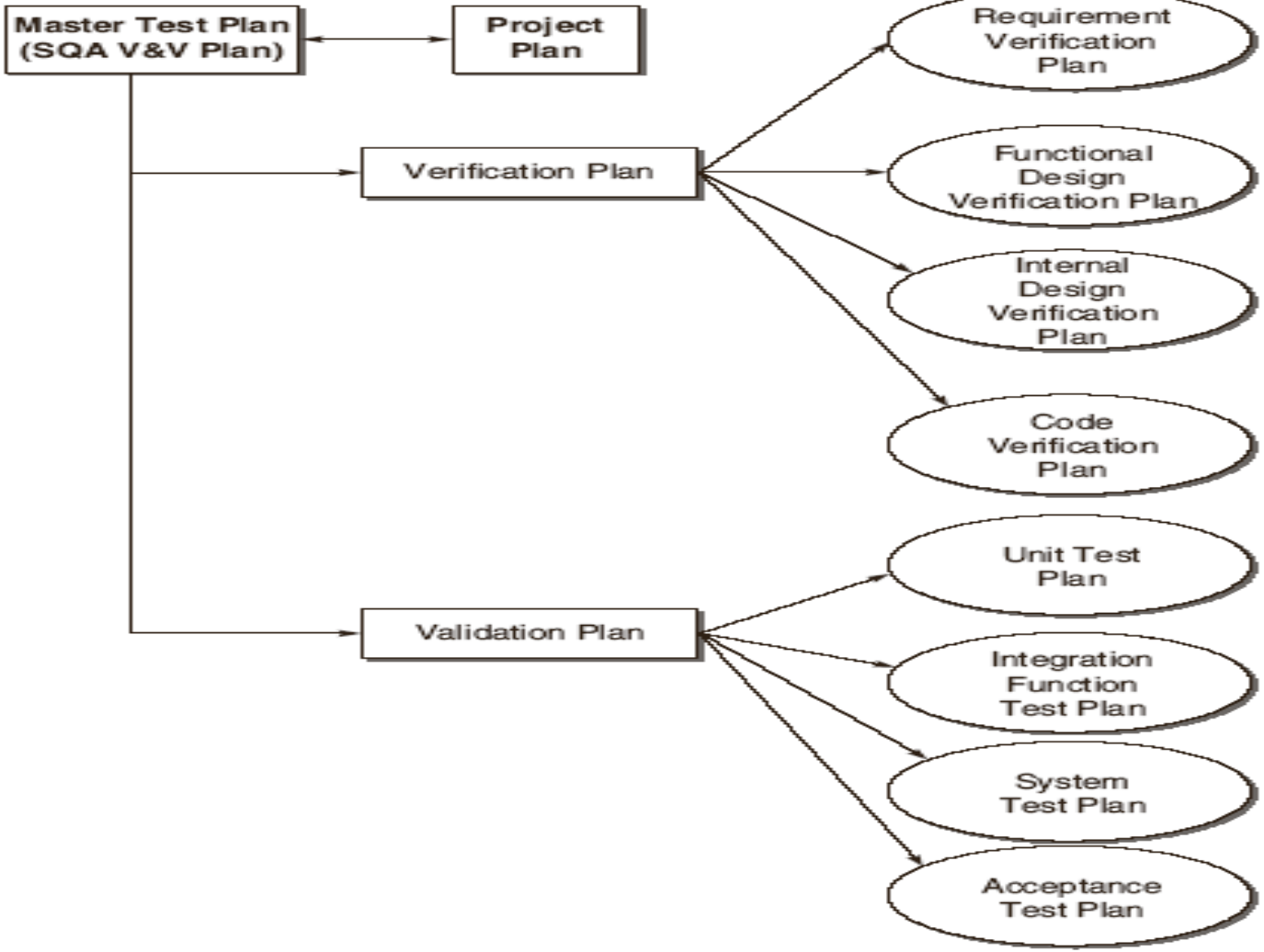
Test Planning cont…..

- Test plan is driven with the business goals of the product. In order to meet a set of goals, the test plan identifies the followings:
  1) Test items
  2) Features to be tested
  3) Testing tasks
  4) Tools selection
  5) Time and effort estimate
  6) Who will do each task
  7) Any risks
  8) Milestones

Test Plan Components

- Test Plan Identifier
- Introduction
- Test-Item to be tested
- Features to be tested
- Features not to be tested
- Approach
- Item Pass/Fail Criteria
- Suspension criteria and resumption requirements
- Test deliverables
- Testing tasks
- Environmental needs
- Responsibilities
- Staffing and training needs
- Scheduling
- Risks and contingencies
- Testing costs
- Approvals

Test Plan Hierarchy



Detailed Test Design And Test Specifications

- ***The ultimate goal of test management is to get the test cases executed.***
- Till now, test planning has not provided the test cases to be executed.
- Detailed test designing for each validation activity maps the requirements or features to the actual test cases to be executed.
- One way to map the features to their test cases is to analyse the following:
    1. Requirement traceability
    2. Design traceability
    3. Code traceability

Test Design Specification

A test design specification should have the following components according to IEEE recommendation:

- ***Identifier*** A unique identifier is assigned to each test design specification with a reference to its associated test plan.
- ***Features to be tested*** The features or requirements to be tested are listed with reference to the items mentioned in SRS/SDD.
- ***Approach refinements*** In the test plan, an approach to overall testing was discussed. Here, further details are added to the approach.
- For example, special testing techniques to be used for generating test cases are explained.

Test Design Specification

- ***Test case identification*** The test cases to be executed for a particular feature/ function are identified here, as shown in Table 1.

Table 1. Traceability matrix

Requirement/ Feature	Functional Design	Internal Design/Code	Test cases
R1	F1, F4, F5	abc.cpp, abc.h	T5, T8,T12,T14

- Moreover, test procedures are also identified.

Test Design Specification

- The test cases contain input/output information and the test procedures contain the necessary steps to execute the tests.
- Each test design specification is associated with test cases and test procedures.
- A test case may be associated with more than one test design specifications.

Test Design Specification

- ***Feature pass/fail criteria*** The criteria for determining whether the test for a feature has passed or failed, is described.

Test Case Specifications

- Since the test design specifications have recognized the test cases to be executed, there is a need to define the test cases with complete specifications.
- The test case specification document provides the actual values for input with expected outputs.
- One test case can be used for many design specifications and may be re-used in other situations.
- A test case specification should have the following components according to IEEE recommendation:

Test Case Specifications

- ***Test case specification identifier*** A unique identifier is assigned to each test case specification with a reference to its associated test plan.
- ***Purpose*** The purpose of designing and executing the test case should be mentioned here.
- It refers to the functionality you want to check with this test case.

Test Case Specifications

- ***Test items needed*** List the references to related documents that describe the items and features, e.g. SRS, SDD, and user manual.
- ***Special environmental needs*** In this component, any special requirement in the form of hardware or software is recognized.
- Any requirement of tool may also be specified.

Test Case Specifications

- ***Special procedural requirements*** Describe any special condition or constraint to run the test case, if any.
- ***Inter-case dependencies*** There may be a situation that some test cases are dependent on each other.
- Therefore, previous test cases which should be run prior to the current test case must be specified.

Test Case Specifications

- ***Input specifications*** This component specifies the actual inputs to be given while executing a test case.
- The important thing while specifying the input values is

  - not to generalize the values, rather specific values should be provided.
- For example, if the input is in angle, then the angle should not be specified as a range between 0 and 360, but a specific value like 233 should be specified.
- If there is any relationship between two or more input values, it should also be specified.

Test Case Specifications

- ***Test procedure*** The step-wise procedure for executing the test case is described here.
- ***Output specifications*** Whether a test case is successful or not is decided after comparing the output specifications with the actual outputs achieved.
- Therefore, the output should be mentioned complete in all respects.
- As in the case of input specifications, output specifications should also be provided in specific values.

Example

There is a system for railway reservation system. There are many functionalities in the system, as given below:

S. No.	Functionality	Function ID in SRS	Test cases
1	Login the system	F3.4	T1
2	View reservation status	F3.5	T2
3	View train schedule	F3.6	T3
4	Reserve seat	F3.7	T4
5	Cancel seat	F3.8	T5
6	Exit the system	F3.9	T6

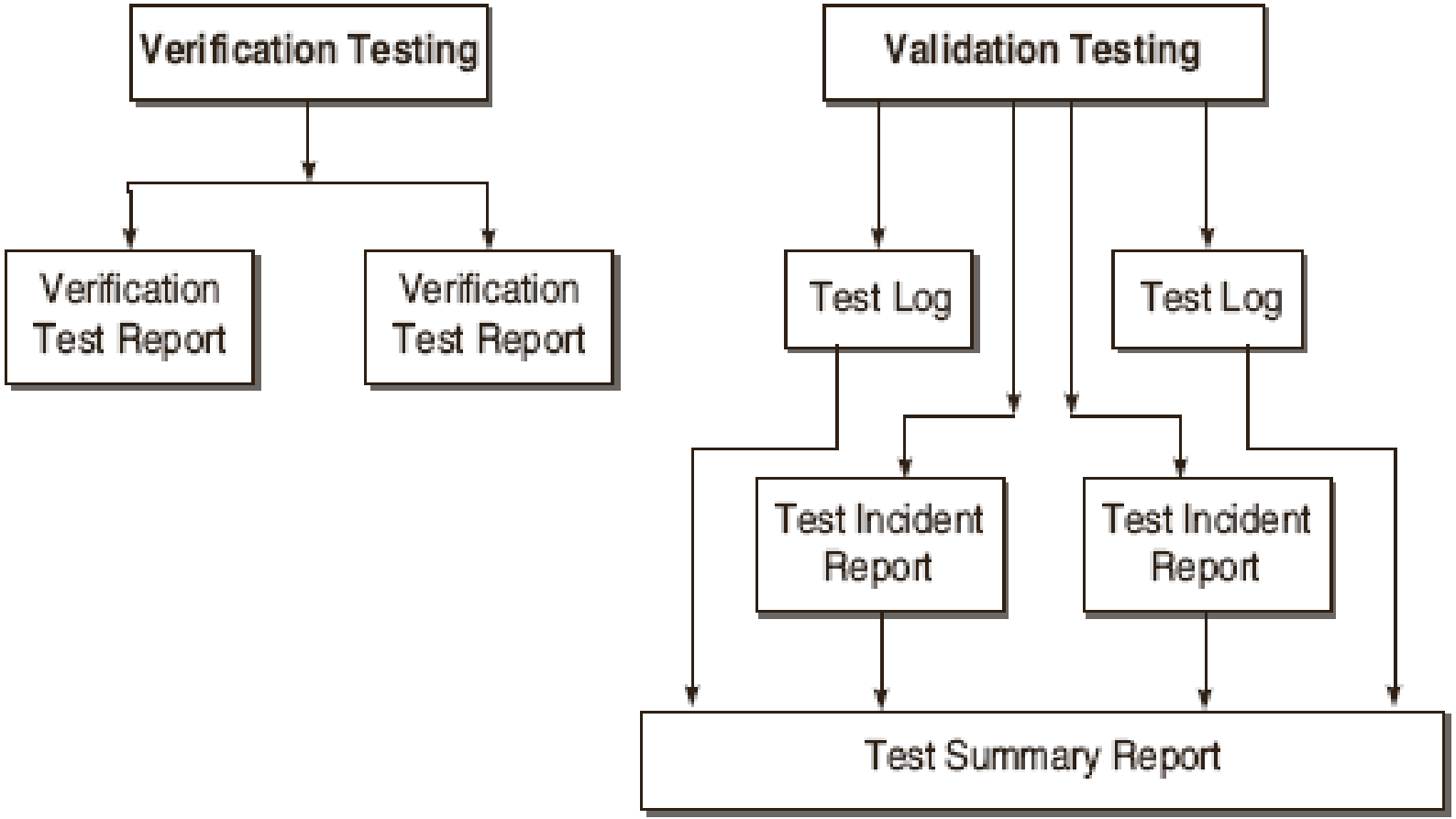
Test specification to 'view reservation status'

- **Test case Specification Identifier**
  T2
- **Purpose**
  To check the functionality of 'View Reservation Status'
- **Test Items Needed**
  Refer function F3.5 in SRS of the system.
- **Special Environmental Requirements**
  Internet should be in working condition. Database software through which the data will be retrieved should be in running condition.
- **Special Procedural Requirements**
  The function 'Login' must be executed prior to the current test case.
- **Inter-case Dependencies**
  T1 test case must be executed prior to the current test case execution.
- **Input Specifications**
  Enter PNR number in 10 digits between 0–9 as given below:
  4102645876
  21A2345672
  234
  asdgggggggg
- **Test Procedure**
  Press 'View Reservation status' button.
  Enter PNR number and press ENTER.
- **Output Specifications**
  The reservation status against the entered PNR number is displayed as S12 or RAC13 or WL123 as applicable.

Test Procedure Specifications

- A test procedure is a sequence of steps required to carry out a test case or a specific task.
- This can be a separate document or merged with a test case specification.

Test Result Specifications



Test Result Specifications

- **Test Log**
- Test log is a record of the testing events that take place during the test.
- Test log is helpful for bug repair or regression testing.
- The developer gets valuable clues from this test log, as it provides snapshots of failures.

Test Result Specifications

Format for preparing a test log according to IEEE:

- Test log identifier
- Description - Mention the items to be tested, their version number, and the environment in which testing is being performed.

Test Result Specifications

- Activity & event entries - Mention the followings:

  (i) Date

  (ii) Author of the test

  (iii) Test case ID

  (iv) Name the personnel involved in testing

  (v) For each execution, record the results and mention pass/fail status

  (vi) Report any anomalous unexpected event, before or after the execution

Sample test log for Example

- **Test Log Identifier**
  TL2
- **Description**
  Function 3.5 in SRS v 2.1. The function tested in Online environment with Internet.
- **Activity and Event Entries**
  Mention the following:
  (i) Date: 22/03/2009
  (ii) Author of test: XYZ
  (iii) Test case ID: T2
  (iv) Name of the personnel involved in testing: ABC, XYZ
  (v) For each execution, record the results and mention pass/fail status
  The function was tested with the following inputs:

Inputs	Results	Status
4102645876	S12	Pass
21A2345672	S14	Fail
234	Enter correct 10 digit PNR number	Pass
asdgggggggg	RAC12	Fail

  (vi) Report any anomalous unexpected event before or after the execution.
  Nil

Test Result Specifications

Test Incident Report

- This is a form of bug report.
- It is the report about any unexpected event during
- testing which needs further investigation to resolve the bug.
- Therefore, this report completely describes the execution of the event.
- It not only reports the problem that has occurred but also compares the expected output with the actual results.

Test Result Specifications

- Components of a test incident report
  - Test incident report identifier
  - Summary - Identify the test items involved, test cases/procedures, &the test log associated with this test.

Test Result Specifications

- Incident description - It describes the followings:

  (i) Date and time

  (ii) Testing personnel names

  (iii) Environment

  (iv) Testing inputs

  (v) Expected outputs

  (vi) Actual outputs

  (vii) Anomalies detected during the test

  (viii) Attempts to repeat the same test

Test Result Specifications

- Impact - The originator of this report will assign a severity value/rank to this incident so that the developer may know the impact of this problem and debug the critical problem first.

Sample test incident report for Example

- **Test Incident Report Identifier**
  TI2
- **Summary**
  Function 3.5 in SRS v 2.1. Test Case T2 and Test Log TL2.
- **Incident Description**
  It describes the following:
  (i) Date and time: 23/03/2009, 2.00pm
  (ii) Testing personnel names: ABC, XYZ
  (iii) Environment: Online environment with X database
  (iv) Testing inputs
  (v) Expected outputs
  (vi) Actual outputs
  (vii) Anomalies detected during the test
  (viii) Attempts to repeat the same test

Testing Inputs	Expected outputs	Actual outputs	Anomalies detected	Attempts to repeat the same test
4102645876	S12	S12	nil	–
21A2345672	Enter correct 10 digit PNR number	S14	Alphabet is being accepted in the input.	3
234	Enter correct 10 digit PNR number	Enter correct 10 digit PNR number	nil	–
asdgggggggg	Enter correct 10 digit PNR number	RAC12	Alphabet is being accepted in the input.	5

- **Impact**
  The severity value is 1(Highest).

Test Result Specifications

Test Summary Report

- It is basically an evaluation report prepared when the testing is over.
- It is the summary of all the tests executed for a specific test design specification.
- It can provide the measurement of how much testing efforts have been applied for the test.
- It also becomes a historical database for future projects, as it provides information about the particular type of bugs observed.

Test Result Specifications

- A test summary report contains the following components:

1. **Test summary report identifier**
2. **Description** Identify the test items being reported in this report with the test case/procedure ID.
3. **Variances** Mention any deviation from the test plans, test procedures, if any.

Test Result Specifications

- **Comprehensive statement** The originator of this report compares the comprehensiveness of the testing efforts made with the test plans.
- It describes what has been tested according to the plan and what has not been covered.

Test Result Specifications

- **Summary of results** All the results are mentioned here with the resolved incidents and their solutions.
- Unresolved incidents are also reported.
- **Evaluation** Mention the status of the test results. If the status is fail, then mention its impact and severity level.

Test Result Specifications

- **Summary of activities** All testing execution activities and events are mentioned with resource consumption, actual task durations, etc.
- **Approvals** List the names of the persons who approve this document with their signatures and dates.

Test summary report for Example

- **Test Summary Report Identifier**
  TS2
- **Description**
  SRS v2.1

S. No.	Functionality	Function ID in SRS	Test cases
1	Login the system	F3.4	T1
2	View reservation status	F3.5	T2
3	View train schedule	F3.6	T3
4	Reserve seat	F3.7	T4
5	Cancel seat	F3.8	T5
6	Exit the system	F3.9	T6

- **Variances**
  Nil
- **Comprehensive Statement**
  All the test cases were tested except F3.7, F3.8, F3.9 according to the test plan.
- **Summary of Results**

S. No.	Functionality	Function ID in SRS	Test cases	Status
1	Login the system	F3.4	T1	Pass
2	View reservation status	F3.5	T2	Bug Found. Could not be resolved.
3	View train schedule	F3.6	T3	Pass

- **Evaluation**
  The functions F3.4, F3.6 have been tested successfully. Function F3.5 couldn't be tested as the bug has been found. The bug is that the PNR number entry has also accepted alphabetical entries as wrong

Summary

- Discussed the key elements of test management.
- Presented the structure of testing group.
- Explained the details of test planning.
- Discussed detailed test design and test specifications.
- Presented various testing reports such as
  - Test log
  - Test incidence report
  - Test summary report

References

1. Naresh Chauhan, Software Testing: Principles and Practices, (Chapter – 9), Second Edition, Oxford University Press, 2016.

Thank you