UNIT 7:

System Integration, Test, and Evaluation (SITE)

The system testing life cycle is an integral part of system development, and it helps to ensure that an application meets the requirements of its end users. One phase of this life cycle is system integration testing, which allows developers to identify problems with the various components within a software system's interface.

System Integration, Test, and Evaluation (SITE) is a crucial phase in the development and deployment of complex systems, such as software applications, hardware systems, or large-scale technological solutions. It involves combining individual components or subsystems into a complete system and verifying its performance against predefined requirements and specifications. SITE ensures that the system functions as intended, performs as expected, and meets the desired quality and performance standards.

7.1 SITE Fundamentals

System integration, test, and evaluation (SITE) is the sequential, bottoms-up process of:

1. Incrementally interfacing previously verified system items and configuration items (CIs)—consisting of PARTS, SUBASSEMBLIES, ASSEMBLIES, SUBSYSTEMS and PRODUCTS—at Integration Points (IPs), beginning with the lowest level.
2. Conducting functional and qualification tests of the integrated test article to verify all capabilities comply with specification and design requirements.
3. Evaluating the test results for compliance and optimizing test article performance.

Objective of SITE:

The objective of SITE is to subject a test article of a SYSTEM, item, or configuration item (CI) to a range of test cases, input stimuli and conditions representative of a prescribed OPERATING ENVIRONMENT so that the achievement of each capability requirement and its performance can be verified.

7.2 Key Elements of SITE

SITE (System Integration, Testing, and Evaluation) refers to a phase in the development and implementation of complex systems, where different components are integrated, tested, and evaluated as a whole. Here are the key elements of SITE:

System Integration: Integration involves combining various subsystems, components, modules, or units of a system into a cohesive and functional whole. **It includes connecting hardware and software components, establishing communication channels, and ensuring compatibility and interoperability among different elements.** System integration aims to verify that the integrated system operates as intended and meets the specified requirements.

Test Planning: Test planning involves developing a comprehensive strategy and approach for testing the integrated system. **It includes defining test objectives, identifying test scenarios and test cases, determining the required test environment, specifying test data, and allocating resources.** Test planning ensures that testing activities are structured and organized to achieve reliable and effective results.

KIRAN SAKOTA, KATHMANDU

Test Execution: Test execution refers to the actual implementation of the planned tests. It involves conducting various types of tests, such as functional testing, performance testing, usability testing, security testing, and compatibility testing, to verify the system's behavior and performance under different conditions. Test execution aims to identify defects, errors, or deviations from the expected functionality and to assess the system's overall quality.

Test Evaluation: Test evaluation involves analyzing the test results and assessing the system's performance against predefined criteria and requirements. It includes comparing actual outcomes with expected outcomes, identifying discrepancies or issues, and determining the severity and impact of any identified problems. Test evaluation provides insights into the system's strengths, weaknesses, and areas for improvement.

Defect Management: Defect management is an essential element of SITE that involves tracking, documenting, and managing defects or issues identified during testing. It includes capturing detailed information about each defect, prioritizing them based on their severity and impact, assigning responsibilities for resolution, and tracking the progress of defect resolution efforts. Effective defect management ensures that identified issues are addressed and resolved in a timely manner.

Documentation: Documentation is crucial during SITE to capture and record information related to integration, testing, and evaluation activities. It includes creating test plans, test cases, test scripts, test results, defect reports, and other relevant documentation. Well-documented processes and outcomes facilitate effective communication, knowledge transfer, and future reference.

7.3 Planning for SITE

SITE success begins with insightful planning to identify the test objectives; roles; responsibilities, and authorities; tasking, resources, facilities; and schedule. Testing, in general, involves two types of test plans:

- The Test and Evaluation Master Plan (TEMP).
- The System Integration and Verification Plan (SIVP).

The Test and Evaluation Master Plan (TEMP).

The Test and Evaluation Master Plan (TEMP) is a document that outlines the overall strategy and approach for conducting testing and evaluation activities during the development, acquisition, or modification of a system. The TEMP serves as a comprehensive guide for the entire test and evaluation process and is typically created early in the system development lifecycle.

The System Integration and Verification Plan (SIVP)

The System Integration and Verification Plan (SIVP) is a document that outlines the strategy, approach, and activities for integrating system components and conducting verification testing. The SIVP is typically developed during the system integration phase and serves as a guide for ensuring successful integration and verification of the system. The SIVP identifies objectives, organizational roles and responsibilities, tasks, resource requirements, strategy for sequencing testing activities, and schedules. Depending on contract requirements, the SIVP may include **delivery, installation, and checkout at a User's designated job site.**

KIRAN SAROTA, KATHMANDU

7.4 Establishing the Test Organization

One of the first steps following approval of the SIVP (System Integration Verification Plan) is establishing the test organization and assignment of roles, responsibilities, and authorities. Key roles include Test Director, Lab Manager, Tester, Test Safety Officer or Range Safety Officer (RSO), Quality Assurance (QA), Security Representative, and Acquirer/User Test Representative.

Test Director Role

The Test Director is a member of the System Developer's program and serves as the key decision authority for testing. The primary Test Director responsibilities are:

- Develop and implement the SIVP(System Implementation Verification Plan)
- Plan, coordinate, and synchronize test team task assignments, resources, and communications.
- Identify, assess, and minimize test risks.
- Review and approve test conduct rules and test procedures.
- Accomplish contract test requirements.
- Preserve test data and results.
- Conduct failure investigations.

Lab Manager Role

The Lab Manager is a member of the System Developer's program and supports the Test Director. The primary Lab Manager responsibilities are:

- Implement the test configuration and environment.
- Acquire of test tools and equipment.
- Create the laboratory notebook.
- Support test operator training.

Tester Role

As a general rule, system, product, or service developers should not test their own designs; it is simply a conflict of interest. However, at lower levels of abstraction, programs often lack the resources to adequately train testers. So, System Developers often perform their own informal testing. For some contracts Independent Verification and Validation (IV&V) Teams, internal or external to the program or organization, may perform the testing.

7.5 Developing Test Cases (TCs) and Acceptance Test Procedures (ATPs)

Developing Test Cases (TCs) and Acceptance Test Procedures (ATPs) is a crucial part of the software development and testing process. These documents outline the specific test scenarios, conditions, and steps to be executed to ensure that the software meets the desired requirements and functions correctly.

An Acceptance Test Plan is performed by software testers to determine if the software meets the customer's requirements, that is, it is ready for the customer to accept the software into their environment. An Acceptance Test Plan (ATP) describes the acceptance testing process, such as the features to be tested, pass/fail criteria, approach to testing, checklists, roles and responsibilities, resource

KIRAN SAPKOTA, KATHMANDU

requirements and schedules. It also defines the functionality to be tested, the requirements verified by the test, test preconditions, test steps and test post-conditions.

Sample for Test cases and ATP:

Test Case Template for Project	
Project Name	Library MS
Module Name	Login
Created By	Karan
Created Date	2/16/2080
Peer Review By	Kiran
Peer Reviewed Dat	2/16/2080

Scenario TID	Scenario Desciption	Test Case ID	Pre Condition	Steps to Execute	Expected Result	Actual Result	Status	Executed QA Name	Misc (Comments)	Pri
1	Login	T1	Open LMS	Insertes User Roll No and password	Login and redirect to dasboard with valid roll no and password	Redirected to dashboard	Pass			
2	Sign UP	T3	Open LMS	Email	Proper email	Invalid email accepted	Fail		must have valid email	
				phone	proper contact	Invalid email accepted	fail			

7.6 Performing SITE Tasks

SITE, as with any system, consists of three phases: pre-testing phase, testing phase, and a post- testing phase. Each phase consists of a series of tasks for integrating, testing, evaluating, and verifying the design of an item's or configuration item.

Task 1.0: Perform Pre-test Activities

- Task 1.1 Configure the test environment.
- Task 1.2 Prepare and instrument the test article(s) for SITE.
- Task 1.3 Integrate the test article into the test environment.
- Task 1.4 Perform a test readiness inspection and assessment.

Task 2.0: Test and Evaluate Test Article Performance

- Task 2.1 Perform informal testing.
- Task 2.2 Evaluate informal test results.
- Task 2.3 Optimize design and test article performance.
- Task 2.4 Prepare test article for formal verification testing.
- Task 2.5 Perform a "dry run" test to check out ATP.

Task 3.0: Perform Post-test Follow-up Actions

- Task 3.1 Prepare item verification test reports (VTRs).
- Task 3.2 Archive test data.
- Task 3.3 Recondition test article(s) for delivery, if permissible.

KIRAN SAKOTA, KATHMAN

7.7 Common Integration and Test Challenges and Issues

SITE practices often involve a number of challenges and issues for SEs. Let's explore some of the more common ones.

Challenge 1: SITE Data Integrity

Deficiencies in establishing the test environment, poor test assumptions, improperly trained and skilled test operators, and an uncontrollable test environment compromise the integrity of engineering test results.

Challenge 2: Biased or Aliased SITE Data Measurements

Challenge 3: Preserving and Archiving Test Data

The end technical goal of SITE and system verification is to establish that a system, product, or service fully complies with its System Performance Specification (SPS). The validity and integrity of the compliance decision resides in the formal acceptance test procedure (ATP) results used to record objective evidence. Therefore, ALL test data recorded during a formal ATP must be preserved by archiving in a permanent, safe, secure, and limited access facility.

Challenge 4: Test Data Authentication

When formal test data are recorded, the validity of the data should be authenticated, depending on end usage. Authentication occurs in a number of ways. Generally, the authentication is performed by an Independent Test Agency (ITA) or individual within the Quality Assurance (QA) organization that is trained and authorized to authenticate test data in accordance with prescribed policies and procedures.

Challenge 5: Dealing with One Test Article and Multiple Integrators and Testers

Because of the expense of developing large complex systems, multiple integrators may be required to work sequentially in shifts to meet development schedules. This potentially presents problems when integrators on the next shift waste time uninstalling undocumented "patches" to a build from a previous shift.

Challenge 6: Insufficient Time Allocations for SITE

Perhaps one of the most SERIOUS challenges is making time allocations for SITE activities due to poor program planning and implementation.

KIRAN SAKOTA, KATHMANDU