Product Integration
Verification
Validation
Product Integration

Purpose

- Assemble the product from the product components, ensure the product, as integrated, functions properly and deliver the product.
Product Integration Overview

- Product integration may be thought of as a one-time assembly of the product components at the conclusion of design phase but it is generally conducted incrementally.

- Product Integration addresses the integration of product components into more complex components or into complete products.
The basis for effective product integration is an integration strategy that uses combinations of techniques in an incremental manner.

- An integration strategy should be developed early in the project, concurrently with product development plans and specifications.
- The integration plan should identify a sequence for receipt, assembly, and activation of the various components that make up the product.
Establishing the product integration strategy including the following:

- Integration sequence
- Work to be done
- Responsibilities for each activity
- Resources required
- Schedule to be met
- Procedures to be followed
- Tools required
- Environment
- Personnel skills
Review the integration strategy with developers and test and integration teams to confirm its feasibility and revise as necessary.

Document and place under control the rationale used for decisions made and deferred.

Assess the integration strategy on a continuing basis.
Considerations for Integration Test Planning

- What modules should be integrated first?
- How many modules should be integrated before integration testing starts?
- What order should be used to integrate the modules?
- Should there be more than one skeleton?
  - How is each skeleton defined?
  - Are there distinct build levels?
- How much testing should be done on each skeleton?
Establish and maintain the environment needed to support the integration of the product components

The product integration strategy may identify needs for an environment that must be acquired or developed

The product integration environment may include the reuse of existing organizational resources
The environment required at each step of the product integration may include:

- Test equipment
- Simulators
- Pieces of real equipment
- Recording devices
Detailed procedures for the integration of the product components include such things as:

- The number of incremental iterations to be performed
- The details of the expected tests
- Other evaluations to be carried out at each stage
Detailed criteria

- Can include criteria indicating the readiness of a product component for integration or its acceptability
- Can be defined for how the product components are to be verified and the functions they are expected to have
- May also include the degree of simulation permitted for a product component to pass a test
- May describe the environment for the integration test

The details include how the assembled product components and final integrated product are to be validated and delivered
Ensure Interface Compatibility

- Product component interface requirements, specifications, and designs must be managed effectively to help ensure that all implemented interfaces will be complete and compatible.

- The interfaces should include, in addition to product component interfaces, all the interfaces with the environment as well as other environments for verification, validation, operations, and support.
Ensure Interface Compatibility - 2
Review Interface Descriptions for Completeness

- Review all interface data for completeness
- Ensure that product components and interfaces are marked to ensure easy and correct connection to the joining product component
- Review the adequacy of interface descriptions on a periodic basis to ensure no deviation between the existing descriptions and the products being developed, processed, produced or bought
Manage Internal and External Interface Descriptions

- Management of the interfaces includes:
  - Maintaining the consistency and compatibility of the interfaces throughout the development cycle
  - Resolving conflict, noncompliance, and change issues
  - Maintaining a repository for interface data that is accessible to project participants
Confirm Readiness of Product Components for Integration

- Confirm that each product component is compliant with its interface requirements
  - Ensure that the product components are delivered to the product integration environment in accordance with the planned product integration strategy
  - Verify the receipt of each product component
  - Verify the configuration status of the product component against the expected configuration
  - Verify the configuration status of the accompanying interface documentation against the expected configuration
  - Perform pre-checks of all physical interfaces before connecting product components together
Assemble and conduct product or product component checkout using an iterative approach moving from the initial product components through the interim assemblies of product components to the product as a whole.

Checkout includes examining and evaluating the assembled product components for performance, suitability, and readiness.

Ensure that the actual product checkout results are compared against the expected results.

Verify and validate assembled and checked out product components per the integration and verification strategies.
Apply Verification & Validation Activities Prior to Packaging

- Use verification and validation techniques to:
  - Ensure that the integrated product meets the specified requirements
  - Ensure the project has confidence that the as-built product will perform its intended functionality in its intended operational environment

- Verification techniques include inspections, testing, analyses, and demonstration

- Verification methods commonly applied prior to packaging and delivery include:
  - Load, stress, and performance testing
  - Functional decomposition based testing
  - Operational scenario testing
Configuration audits should also be conducted prior to packaging and delivery to ensure that:

- The product or product component that is in final checkout satisfies the customer and product requirements and all approved change requests and nothing more.

- The documentation that is to be delivered to the customer/end user matches the delivered product or product component.

It is recommended that verification and validation results that have been conducted throughout the development lifecycle be used as input to this final configuration audit.
Packaging and Delivery

- Review the requirements, design, product, test results, and documentation to ensure that issues affecting the packaging and delivery of the product are identified and resolved.
- Prepare the operational site for the installation of the product.
- Deliver the product and related documentation and verify receipt.
- Install the product at the operational site and verify correct operation.

Graphic of Package – Present with Bow
Acceptance Testing (Final Verification)

- The purpose of Acceptance Testing is to confirm that a product or product component is ready for operational use.
- The Acceptance Test is performed for or in conjunction with someone else to demonstrate that the confidence is justified.
- The primary issue is usability and reliability – will the product or product component support operational use?
- Acceptance criteria should be discussed and agreed upon in advance of the actual acceptance testing.
Summary

◆ Product Integration presents the concepts to achieve complete product integration through progressive assembly of product components, in one stage or in incremental stages, according to a defined integration strategy.

◆ The integration plan should identify a sequence for receipt, assembly, and activation of the various components that make up the product.
Product Integration presents the idea of applying (Product Integration, Verification, and Validation) in successive triplets until the product is ready for packaging and delivery.

Product Integration stresses the effective management of all interfaces to ensure that all interfaces will be complete and compatible.
Summary - 3

- Verification is used to assure that selected work products meet their specified requirements.
  - Verification assures “You built it right”

- Validation is used to demonstrate that a product or product component fulfills its intended use when placed in its intended operational environment.
  - Validation assures “You built the right thing”