What is the Purpose of Verification & Validation within the Systems Engineering Life Cycle?

Verification and Validation, as separate systems engineering processes are often confused with each other, depending on the functional domain.

They are also frequently bundled together as 'testing'. In our role delivering systems engineering training and client consultancy, we are often asked 'What are your top tips for effective Verification and Validation?'

The first point of order is to establish the definition of each process. With a clear understanding of the purpose it is possible to address how to best achieve that purpose.

The ISO/IEC 15288:2015 as incorporated in the International Council On Systems Engineering (INCOSE) Handbook V4.0, defines Verification as providing objective evidence that a system or system element fulfils its specified requirements and characteristics. Essentially, has the system or product been built right.

Validation, however, is defined as providing objective evidence that the services provided by a system when in use comply with stakeholders' requirements, achieving its intended use in its intended operational environment. Have we built the right product in line with the stakeholders need?

It may come as no surprise that both processes are dependent to a large degree on definition and management of requirements. How do we know if we have built the right product or to the right specification if these are not captured and accessible?

Tip 1

Engage with the system stakeholder(s) and capture the high-level stakeholder requirements in a database where they can be reviewed, revised and traced through the development life cycle effectively. As the life cycle progresses through system and sub-system requirements then traceability back to the stakeholder requirements is key to validating that the stakeholder vision is being realised. Start by validating requirements, continue by validating the engineering design and finally validate the complete system.

Requirements and design reviews at decision gates along the life cycle provide an opportunity to assess and validate if the correct product is being built. Don't be tempted to skip these to reduce effort and budget.

Tip 2

From a verification perspective, when defining requirements consider verification criteria at each level of requirement. This does not necessarily have to be a complete test case or script at this stage, but a scenario in which, if the condition is met, confidence is high that the requirement has been met.

Do not leave system verification to later in the life cycle, where rework can be costly.

Tip 3

There are several candidate verification actions that can be executed through the systems engineering project. These often parallel with the validation actions; verification of stakeholder and system requirements, verification of system architecture, verification of design and of the entire system. Ensure that the actions taken reflect the entire life cycle and are carried out incrementally as the project progresses.

Tip 4

Dependencies between specifications, design and associated verification artefacts can be extensive on all but the smallest projects.

Create and maintain a Requirements Verification and Traceability Matrix (RVTM). Completion of this will provide confidence for system acceptance.

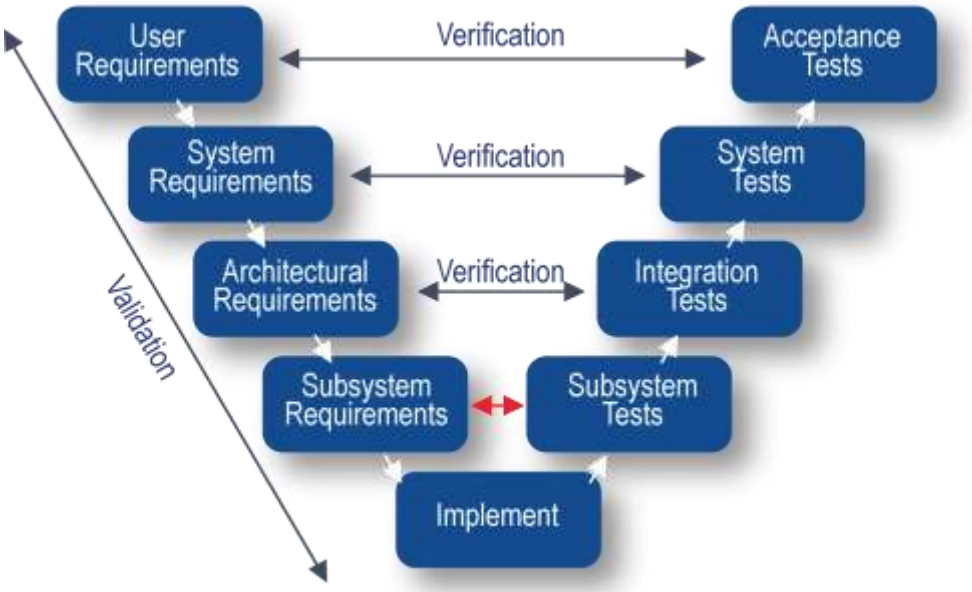
Conclusion

From concept to delivery, the development of systems, and in extension, systems of systems are becoming ever more complex. With that complexity comes cost.

To mitigate the cost of re-work within the development, or worse - the reputation damage due to a product recall, it is critical that verification and validation are addressed at an appropriate level for the project in hand. It also important that verification and validation is carried out in a coordinated manner with other technical processes such as Transition, Implementation, and Integration.

These processes have dependencies on and are dependent on other elements within the life cycle.

Verification and Validation are key processes but should not be addressed in isolation.



TECHNICAL ARTICLE

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