

V&V = the Verification and Validation of Deliverables

Verification and validation (V&V) are separated in the *PMBOK® Guide*, but should be viewed as two integrated elements in the process of creating value for the project's client.

Verification is the key output from the Control Quality process in the *PMBOK® Guide* and is focused on ensuring a product service or result complies with the relevant requirements and specifications. This function may involve specific tests and inspections, as well as evaluating¹ any test records and inspection logs completed during the course of the work. At the end of this process you have verified deliverables.

Validation is a scope management process in the *PMBOK® Guide* focused on formalising the acceptance of the project deliverables by the client. You have accepted deliverables at the end of this process.

The problem with separating verification and validation is the two functions, normally referred to by engineers as V&V, are in reality part of a continuum. Verification looks at the basics (structure) of the item being verified such as, performance, design, functionality, and checking that all of the specified tests and inspections were completed correctly; to make sure the deliverable meets the requirements that drove the creation of the item. Validation goes beyond the basics to assess how well the item addresses your stakeholder's needs and expectations while operating in the intended operational environment.

V&V can be a function that is internal to the project team, conducted by independent experts (often called IV&V where I = Independent) may focus on components or be focused on the integrated functioning of an organisational system either as a competed unit, or after the deliverable has incorporated into its operating environment (also called IV&V where I = Integrated).

Regardless of the acronym used², and the people involved, V&V is not a one-off function; rather it is a continuum working towards the final acceptance of the product by the customer. In a simplified view of a

¹ These terms have specific meanings:

Test - A controlled event designed to measure the performance of an entity in controlled circumstances (typically stimulus / load and environment).

Inspection – An activity such as measuring or examining one or more characteristics of a product or service, and comparing the results with specified requirements in order to establish whether conformity is achieved for each characteristic (may involve the conducting of tests).

Evaluation - The formal analysis of existing information or test results in order to inform an acceptance decision or the action of determining the overall worth of a solution and how that worth might be increased, on balance, across the properties of effectiveness, cost, time and achievability

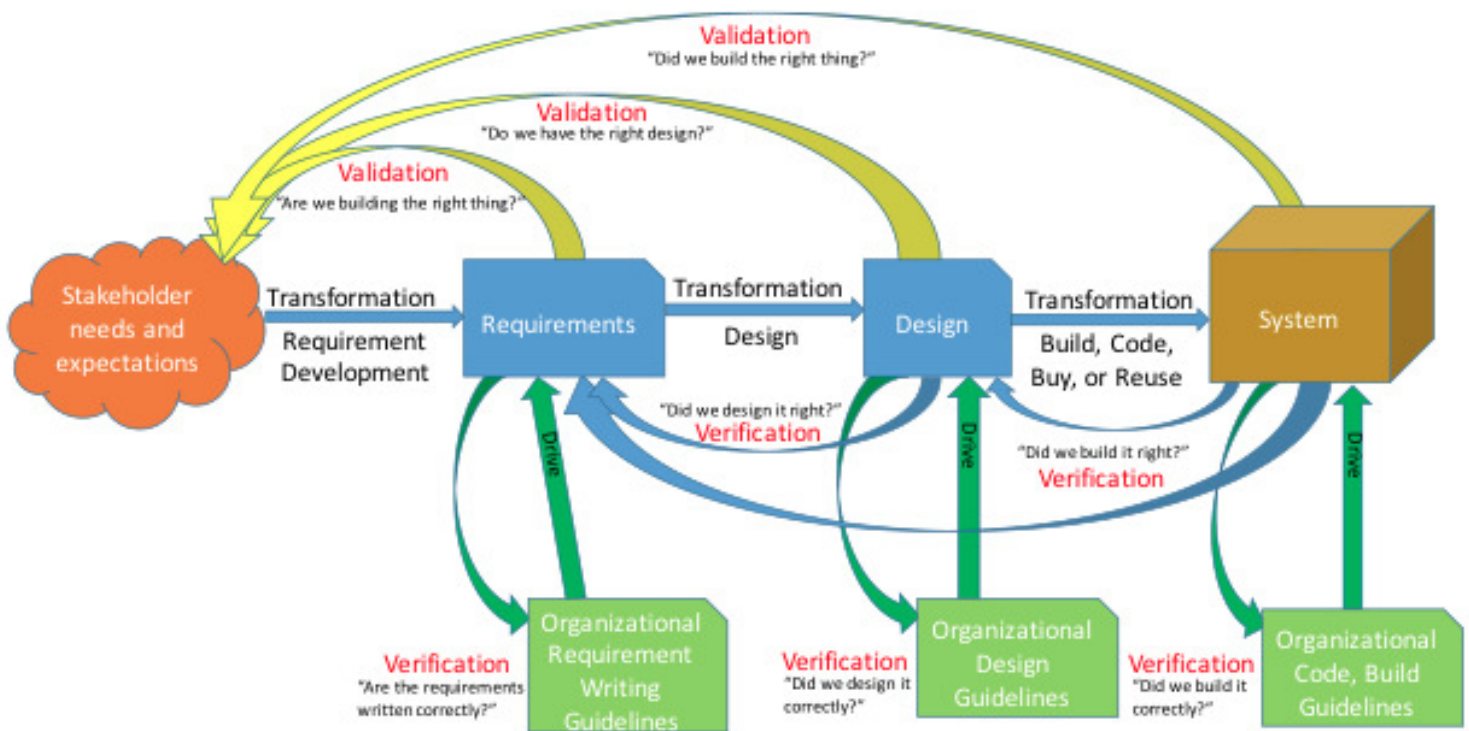
Acceptance - A process, under the control of the Acceptance Authority (cli, confirming that the user's needs have been met by the systems supplied

² A recognised issue is the same acronyms can have different meanings and different acronyms can define essentially the same process – providing a clear definition of the acronyms used in a project plan is essential to avoid unnecessary confusion. Some of the more common are:

- V&V - Verification and Validation
- IV&V - Integrated Verification and Validation
- IV&V - Independent Verification and Validation
- ISVV - Independent Software Verification and Validation
- SQA - Software Quality Assurance
- T&E - Test and Evaluation
- ITEA - Integrated Test, Evaluation and Acceptance



typical 'PMBOK Project' the requirements are gathered³, the scope is defined (a design process) and then the required 'system' is built and tested. This process is basically the same for a building new hotel or developing a software upgrade using the 'waterfall approach'. However, regardless of the deliverable being created, to be sure of receiving the final acceptance of the delivered system at the end of the project verification and validation need to be planned functions undertaken at regular/appropriate intervals with the validation element involving the customer and other key stakeholders. These 'review points' may represent phase boundaries, contractual hold points and/or gateway review points⁴ in the overall project lifecycle, or they may simply be 'sensible' points to check work is progressing correctly in the development of the product.



Requirements Stage Review

Requirement Verification is the process of ensuring the documented requirements comply with the rules and characteristics defined for writing good requirements.

Requirement Validation confirms by inspection and analysis that the resulting requirement set:

1. Clearly communicates the baselined stakeholder needs and expectations
2. Are in a language understood by the project team; and
3. If the intended project deliverables fulfil the requirements they will meet the intent and needs of the stakeholders.

³ For more on **requirements gathering** see: http://www.mosaicprojects.com.au/WhitePapers/WP1071_Requirements.pdf

⁴ For more on **gateway reviews** see: http://www.mosaicprojects.com.au/WhitePapers/WP1092_Gateways-Scorecards.pdf

Design Stage Review

Design Verification has two elements:

1. Verifying the design process followed the appropriate guidelines for doing the design correctly.
2. Ensuring the design implements the requirements correctly.

Design Validation confirms that the design will result in a system that meets its intended purpose in its operational environment; and will fulfil the stakeholder needs and expectations that were baselined in the requirements.

System Review

System Verification asks two questions, did we build the right thing, and did we build it right? Methods used for system verification include: test, simulation, demonstration, inspection, and analysis of quality assurance information. The first consideration is to verify that the built deliverable clearly represents the requirements that drove the design (requirements traceability⁵), the second is focused on the processes and components used in the build to verify they meet specifications.

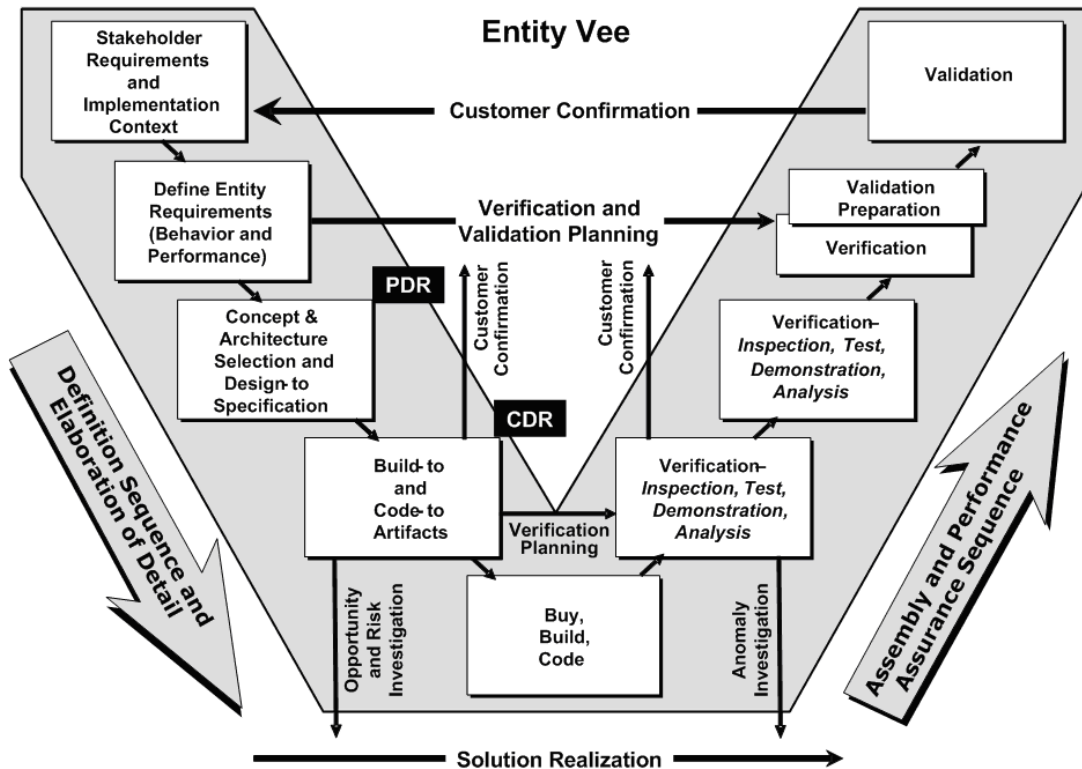
System Validation occurs after verification to make sure the designed, built, and verified system meets its intended purpose in its operational environment. The focus is on the completed system and how well it meets the baselined stakeholder needs and expectations that were defined and baselined during the scope definition phase.

This final validation is much easier to obtain if the client has been involved, or informed, of the flow of V&V processes throughout the project lifecycle. This is a key stakeholder engagement and communication processes that needs planning into the flow of the work.

⁵ For more on **requirements traceability** see:
http://www.mosaicprojects.com.au/WhitePapers/WP1029_Requirements_Traceability_Matrix.pdf



Test Planning



Verification requires testing and good testing is planned into the design of a process! Effective planning for V&V early in the lifecycle will provide many benefits to every project. Although it costs a little more up front, discovering errors early saves problems later in the project lifecycle or once the system is deployed. Various forms of ‘Vee Diagram’ such as the one above demonstrate these concepts.

Subsystems and Agile

For each subsystem, iteration or ‘sprint’, the above cycle is repeated with the definition of stakeholder needs, expectations, and requirements, transformed into subsystem requirements, which are baselined via requirements verification and requirements validation. Once the subsystem requirements are baselined, design results in a subsystem architecture in which the units/components are defined. This design is baselined via the design verification and design validation process. The required components are then bought or built and the verification and validation accomplished. Particularly in projects using the ‘Scrum’ approach with a short ‘sprint’ cycle, these V&V functions should be quick and ‘light’; but should not be ignored. This is one of the reasons an experienced ‘customer representative’ should be part of the team.

Summary

This White Paper is a very brief overview of verification and validation (V&V); many industries and organisations have very specific and rigorous V&V requirements that are frequently imposed as part of a contract. However, regardless of contractual V&V requirements, every project should think through its V&V



obligations and practical requirements and then plan to use V&V as a mechanism for delivering a quality product that is fit for its intended purpose – the contractual requirements may not be sufficient!

Effective V&V starts at the requirements stage and flows through to final delivery. While this may appear to a much broader concept than the one suggested in the *PMBOK® Guide*, the opening paragraph in process 5.5 *Validate Scope* has the clear statement *'This process is performed periodically through the project as needed'*. The outline above shows one example of points in the project lifecycle where V&V is *'needed'*. There may be more or different needs for V&V depending on the nature of the project, the development approach used, and the degree of rigour warranted.

W. Edwards Deming concept *'Quality is planned in, not inspected in'* is absolutely true of the primary work processes of the project and is equally true of the supporting V&V processes. In addition to the quality support function of confirming quality has been achieved, verification and validation serve an additional purposes which is to confirm to your stakeholders that the product will, and continues to, fulfil the client's needs and expectations. Effective V&V is as much a communication and stakeholder engagement process as a technical one.

Finally, V&V has an important risk mitigation function with the potential to avoid very heavy failure costs. All product failures occurring after release can be traced to a defective verification and validation processes. By taking the formal V&V activities outlined above seriously during product development, the number of issues that occur after the product is released for use will be significantly reduced; avoiding the negative *'informal'* system validation associated with *'unhappy users'*, its associated costs, and the reputational damage we frequently observe in social media and other public forums. These days delivering a quality product is mandatory! V&V is one of the tools to ensure this happens.

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