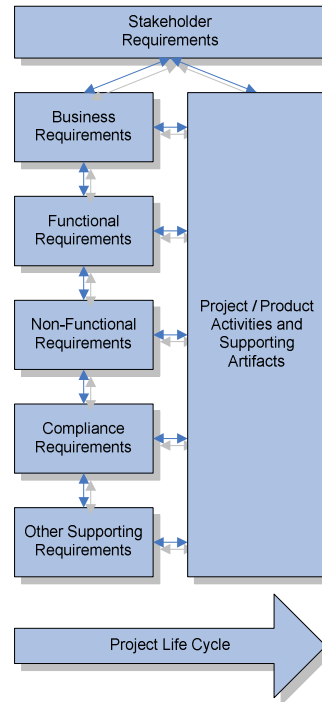# Requirements Tractability

Requirements traceability is an activity that is one part of an overarching requirements management practice and extends from requirements definition through to implementation. Requirements tracing is used to ensure that each step of the product's development process is correct, conforms to the needs of prior and next steps, and conforms to the defined requirements. Requirements tracing is a technique that helps to ensure that the project delivers what stakeholders expect. If applied correctly requirements tracing is a practice that can greatly increase the quality and reliability of a project's final product while minimizing costly rework resulting from requirements errors.

Requirements tracing defines the ability to describe and follow the life of a requirement, in both a forward and backward direction, ideally through each step of the entire product's life cycle. This is done by documenting and tracking traceability relationships between requirements. A traceability relationship is a dependency relationship between project and/or product elements. Similar to the way a dynamic project schedule may react to a change in one task, a change to a requirement element may also have a rippling effect on other elements. A well-documented traceability relationship clearly defines requirement dependencies and allows for analysis of how changes in requirements affect other requirements and the project as a whole.

Regardless of project type, the model used to trace requirements is very similar. The basic structure, for a traceability strategy is relatively common for most projects in that it follows a hierarchy from higher-level needs through detailed requirements and then onto implementation. Activities, such as product development, support requirements that support product features that then all trace to stakeholder needs. These actions provide the capability to track, or "trace", where within the product each requirements is satisfied and also verifies that each defined requirement has been addressed.

Requirements traceability can be considered the backbone of any project and helps ensure correct product delivery that meets the expectations of the client. When verifying project work, using a requirements traceability matrix verifies that the correct functionality is contained within each product module. Tracing requirements through the entire life cycle enables the project team to identify that "D.1.0.1.2.3" compliance requirement satisfies BBB non-functional requirement which enables "C.1.0.1.2" functional requirement to operate thus satisfying "B.1.0.1" business requirements that align with "A.1.0" stakeholder requirements. This type of requirements tracing is illustrated in the image to the right. The tracking of requirements in this way should be performed throughout the project life cycle from scope planning, high-level requirements to detailed design, down through coding, testing, and implementation. It also verified that project work is supporting the overarching goal of meeting the client's needs. Accomplishing this activity is most often done through the use of an automated tool. However, if diligent, requirements traceability can be performed using a spreadsheet or relational database. When configured properly these tools should at a minimum provide:

- Unique ID identifying each requirement to trace
- Bidirectional requirements linking, the ability to trace requirements both forward and backward through the project's life cycle
- Capture of allocation rationale, accountability, and validation
- Identification of inconsistencies

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- Capabilities to view/trace links
- Verification of requirements
- History of requirement changes

However, there is no formal standard for exactly how traceability relationships should be constructed, how it should be represented, what rules to apply to it, and what attributes it should exhibit. Just as each project is unique, characteristics of each traceability relationship will also be unique. Regardless, it should be determined and agreed upon by all stakeholders early in the project's life cycle how requirements will be traced and managed throughout the life of the project. Initially, three important questions need to be answered before embarking on any particular requirements traceability approach:
1. What needs to be traceable?
2. What linkages need to be made?
3. How, when, and who should establish and maintain the resulting database?

Regardless of how requirements tracing is implemented the practice of requirements tracing influences the completeness, consistency, and traceability of the requirements of a system and provides answers to questions such as the following:
- What mission need is addressed by a requirement?
- Where is a requirement implemented?
- Is this requirement necessary?
- How should this requirement be interpreted?
- What design decisions affect the implementation of a requirement?
- Are all requirements allocated?
- Why the design is implemented this way and what were the other alternatives?
- Is this design element necessary?
- Is the implementation compliant with the requirements?
- What acceptance test will be used to verify a requirement?
- Are we done?
- What is the impact of changing a requirement?

Requirements are then traced throughout the development of the product from scope, through high level requirements, detailed requirements, design, and coding. As coding completes, requirements continue to be traced through testing phases including user acceptance testing, ultimately demonstrating that the delivered solution conforms to the defined requirements and meets the needs of the client.

For example, requirement AAA might be identified during the scope management process. Requirement AAA is then decomposed into functional requirements. Each functional requirement is then defined within a design specification document and then coding work is performed. Proper requirements tracing would be able to identify and link the appropriate section(s) of the design specification document to the functional requirement and then to requirement AAA and then follow each requirement through testing and eventually product delivery.

For more information about requirements traceability, the Project Management Community of Practice or the CDC UP please visit the CDC Unified Process website at http://www.cdc.gov/cdcup/. ▮

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The CDC UP offers a short overview presentation to any CDC employee and/or contractor group. Presentations are often performed at your facility, on a day of the week convenient for your group, and typically take place over lunch structured as one hour lunch-and-learn style meeting.

Contact the CDC Unified Process at cdcup@cdc.gov or visit http://www.cdc.gov/cdcup to arrange a short overview presentation for your group. ▮

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