Requirements Management for Long-Term Nuclear Projects

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1. Introduction

Successful completion of a project means meeting the given requirements. Requirements are functions, performances, and physical characteristics that the system must satisfy. In the development of large complex systems such as the nuclear field, systematic management is required to meet these requirements well. This paper presents a method for effectively managing requirements by dividing projects in the nuclear industry that are carried over a long period of time into two types. One is a project to develop a prototype and develop commercial system in the future, and the other is a project to develop a commercial system.

2. Characteristics of Nuclear Projects

The projects in the nuclear industry targeted in this study are large, long-term, and complex projects such as development of new reactors, waste management facilities, and standard development.

The characteristics of projects in the nuclear field are as follows in terms of requirement management.

First of all, the nuclear power field is not a system for specific individual, but a system development at the national level, and the subject who presents requirements is presented at the user and regulatory agency level, not the general individual. In addition to basic functions and performance, most of the requirements to be satisfied are coded.

3. Overview of Requirements Management Standard

The process for successful development is covered by systems engineering, and requirement management is a very important pert of systems engineering. These systems engineering standards include ISO5288, IEEE1220, and EIA632, but in these standards, requirements management tasks are distributed and presented in several places and are not organized. CMMI(Capability Maturity Model Integration) is similar to the systems engineering standards, which summarizes and presents requirement management tasks. The requirement management tasks presented by CMMI for Development are as follow.

- Understand Requirements
- Obtain Commitment to requirements
- Manage Requirements Change
- Maintain Bidirectional Traceability of Requirements
- Ensure Alignment Between Project Work and Requirements

These tasks can be used as a baseline for managing requirements to suit the characteristics of the project.

4. Requirements Management for Prototype System Development Projects

What is important in a project to develop a prototype is to find a valid solution and enable commercial-scale systems to be developed. The requirements management structure of these project is shows in the figure below.

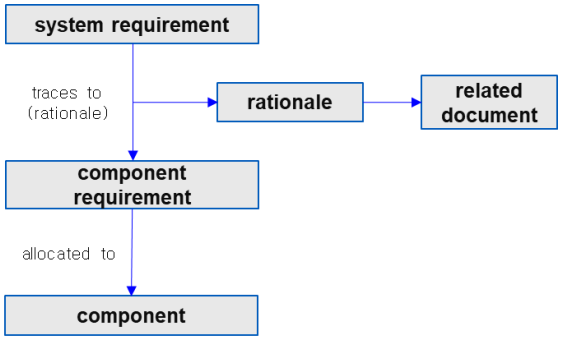

Figure 1. Requirement traceability schema for prototype development projects

Important tasks in managing the requirements of these projects are as follows.

- Manage traceability between system requirements and component requirements
- Manage rationale that describes how system requirements are traced to component requirements
- Manage traceability between rationale and related documents
- Manage traceability between component requirements and component which composes the system.

The most important thing is to manage what decision or analysis has made the system requirements flow down to the component requirements. In other words, it is to organize design knowledge in terms of requirement management.

5. Requirements Management for Operational System Development Project

What is important in project to develop a system that will be used in practice is to meet all requirements.

The requirements management structure of these project is shows in the figure follow.

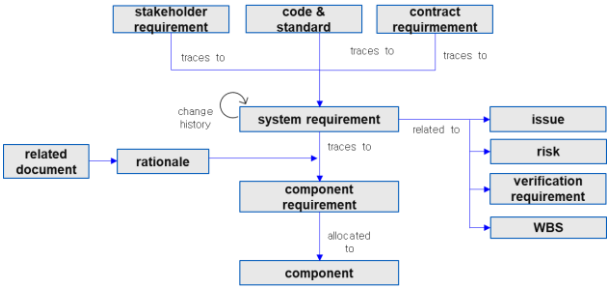

Figure 2. Requirement traceability schema for operational system development projects

Major tasks in managing the requirements of these projects are as follows.

- Manage traceability between system requirements and source of requirements

Source of requirements incudes stakeholder, code&standard and contract document, etc.

- Manage change history of each requirement

It is necessary to manage when, why, how, and by whom the requirements have been changed.

- Manage traceability between system requirement and issues

Requirements issues related to each sentence may include necessity, implementability, ambiguity, verifiability, completeness, and conflict between requirements. It is necessary to manage how these issues related to the requirements have been resolved.

- Manage status of each requirement

Status of requirement can includes accepted, agreed, candidate, closed, disputed, rejected, review, reviewed, suspect, TBD.

- Manage traceability between system requirement and risks

Issue means that the problem and already occurred, but the risk is likely to occur. The risks associated with each requirement should be identified and the response status to these risks should be managed.

- Manage traceability between system requirement and verification requirement

The verification requirement is an expression of how to verify that the requirements are satisfied.

The method of verification include inspection, test, analysis, and demonstration. Verification requirement contains the method of verification and how the verification should be performed.

- Manage traceability between system requirement and WBS(Work Breakdown Structure)

Managing this traceability is to ensure that all requirements are not missed and are all reflected in the design. To this end, a clear output must be defined in each WBS element.

- Manage traceability between system requirements and component requirements.

If the system requirements are not traced to the component requirements, they are not reflected in the design. If component requirements are not traced to system requirements, this is likely to be gold plating.

- Manage rationale that describes how system requirements are traced to component requirements

This rational management is very important for configuration management of the system in the future.

- Manage traceability between rationale and related documents

Decision-making minutes, analysis reports, and related papers to each rationale should be managed.

- Manage traceability between component requirements and component which composes the system.

By allocating component requirements to each component, the specification of the component is defined, and the aforementioned traceability management can show why the specification of the component is defined as such.

6. Results

In this paper, the project in the nuclear industry was divided in a project to develop a prototype and a project to develop a system to be actually operated, and we proposed how to manage the requirements for each type effectively.

Although this paper presents requirement management tasks by dividing the project into two categories, it is recommended to apply them appropriately according to the situation when performing requirements management in an actual project.

Acknowledgement

This work was supported by Korea Institute of Energy Technology Evaluation and Planning (KETEP) grant funded by the Korea government (MOTIE) (No. 20224B10100090).

REFERENCE

[1] Carnegie Mellon, CMMi for Development, version 1.3, pp. 341-347, 2010. pp.612-613, 1999.