Technical Note

Establishment of Railway Safety Management System Using Systems Engineering Management Plan

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Abstract: *In this paper, the processes which are currently under development in South Korea, concerning railway safety management system are introduced. Railway safety management system in South Korea is briefly presented, making particular attentions to Systems Engineering Management Plan (SEMP). To make huge national R&D projects successful, systematic management process is essential. In this respect, detailed applying SEMP on railway safety management system of South Korea is discussed including Systems Engineering process and Verification and Validation procedures. Furthermore, a computer-aided systems engineering tool (Cradle) is used in order to make the management process more easily controllable.*

Keywords: *Systems Engineering Management Plan (SEMP), Requirements, Railway Safety Management System, Verification and Validation Process*

1. Introduction

Safety securing technology is one of the most important factors for ensuring operational safety of high-speed trains. Since Korea dose currently have a weak technological basis for safety evaluation and traceability of the accident causes, there are demands for a definition and procedure development of safety regulation system, organization of safety case system, establishment of detailed safety standard, evaluation technology development for safety, construction of test assessment basis, technology development for a prevention of critical accidents and construction of safety information management system, etc, then the developed technologies need to be incorporated into the overall system, in order to prepare an efficient enforcement basis of the railway law already taken effect.

2. Body

2.1 Systems Engineering Management Plan (SEMP)

The Systems Engineering Management Plan (SEMP) is the primary, top level technical management document for the integration of all engineering activities within the context of, and as an expansion of, the project plan [1]. A SEMP should be prepared for each project and regularly updated as development progresses.

The SEMP is not necessarily a long document. For some projects, it could be a page long, for others it could be hundreds of pages long. The plan needs to be specific to the needs of that project. It needs to be a "living" document, updated as often as needed as new information becomes available. The most important function of the SEMP is to ensure that all of the many active participants know their responsibilities to one another.

The figure 1 shows us the place of the SEMP in the system management planning.

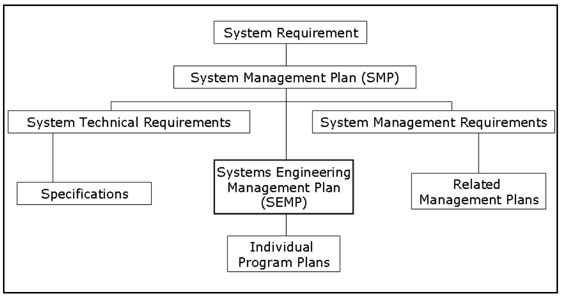

Fig. 1. Place of SEMP in system management plans

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2.2 Systems Engineering Process for the National Safety R&D Project

Systems engineering process should begin during the new business development and pre-proposal phases of a project, and should continue throughout the system life cycle [2]. The process is critical in responding to a request for proposal (RFP). Early application of the systems engineering process ensures that a company's proposal is responsive to all the customer's requirements.

From requirements analysis, functional and physical solutions should be developed. Functional solutions are a set of activities or functions arranged in a specified order that, when activated, achieves a defined requirement. Physical solutions are capable of carrying out processes and the interconnection between components indicates that a directed flow is possible.

Decision making from functional and physical solutions should be considered after effectiveness analysis. Generally, effectiveness analysis includes production engineering analysis, test and verification analysis, deployment and installation analysis, operational analyses, supportability analyses, training analysis, disposal analysis, environmental analysis, life cycle cost analysis [3].

System specification is a guide line document for developing railroad safety system product. A system requirements document, operational requirement document or draft system specification form the customer will have to be completed or transformed into a system specification to the mutual satisfaction of the customer and contractor. All of the requirements in all of the lower tier product requirements documents should be traceable from and to system specification. All of the requirements in the system specification should be traceable to the customer's need through a logical process of functional decomposition, allocation, and requirements analysis.

2.3. Detailed Verification and Validation Process

Validation and verification are tasks associated with activities within the systems engineering process. Validation ensures that the requirements are consistent and complete with respect to higher level requirements. Verification ensures that the selected solution meets its specified technical requirements and properly integrates with interfacing products.

In verification process, project teams should make verification plan documents referred from requirements, functional and physical architectures, railroad safety system products.

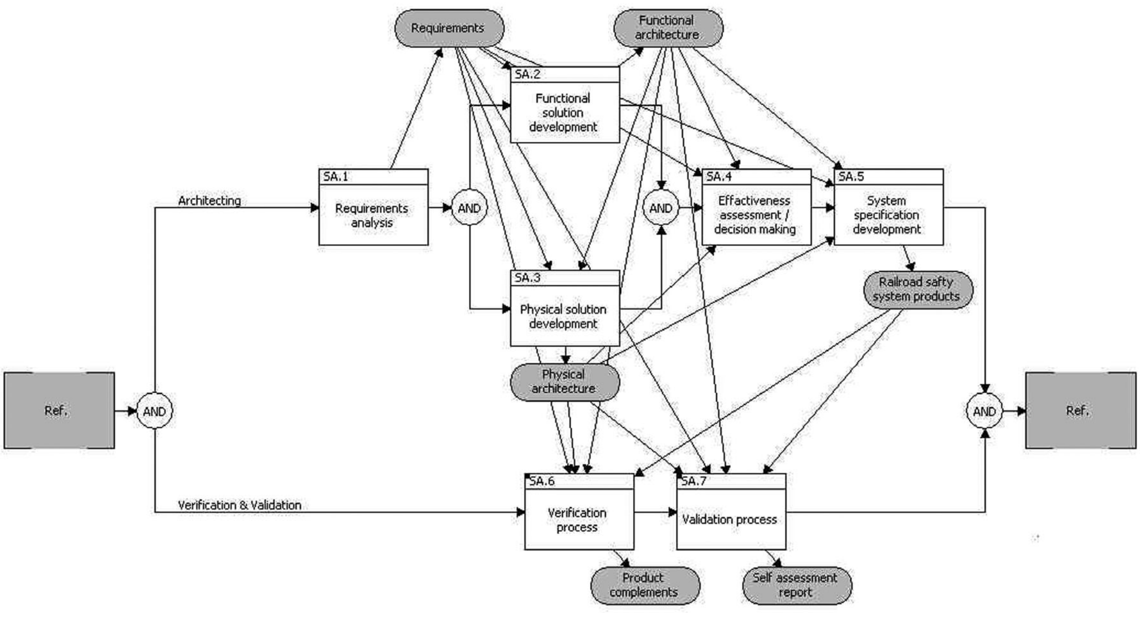

Fig. 2. Tailored SE process for national safety program

Table 1. Verification and validation check lists

Statements Verificati	Grades
What is our systems engineering project for this process ?	
What are the methods that we will task for each SE apply ?	
What are the tools we will use to hod these supportmet ?	
How will we control configuration development?	
When/conduct we lwil How review technical?	
How will we esatblish the need for trade manage and-studies off ?	
Who has authorization for technical control change?	
ll we manage How wi? requirement	

These verification documents should be approved by SE management teams. The project teams make VRTM documents and the SE teams approve them after investigation. Based on Approved VRTM by the SE teams, project teams perform verification and make verification reports. These reports are reviewed by management teams.

In validation process, firstly architectures derived from requirements should be reviewed by SE teams. After reviewing architectures, consistency and completeness should be validated. Even though our SE management teams are consisted with multidisciplinary experts, expert reviews are sometimes necessary for perfect validation. We made validation check lists as shown table 1.

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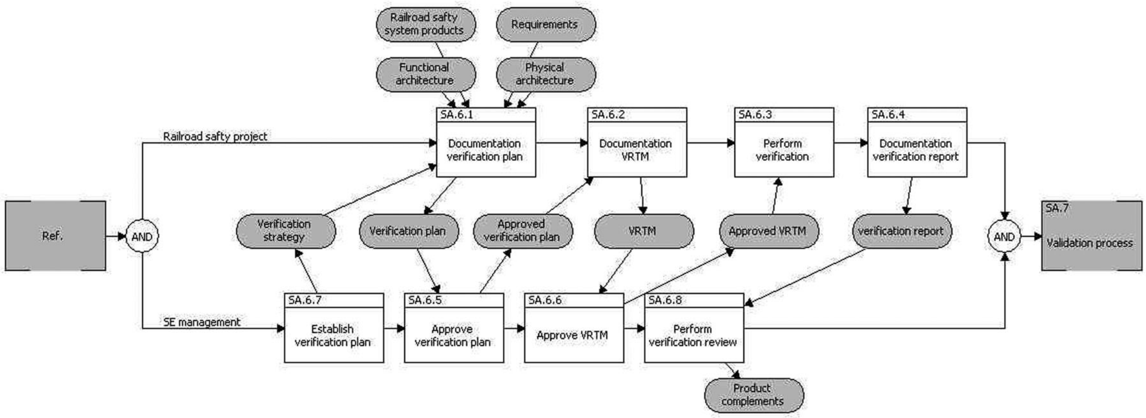

Fig.3. Detailed verification process

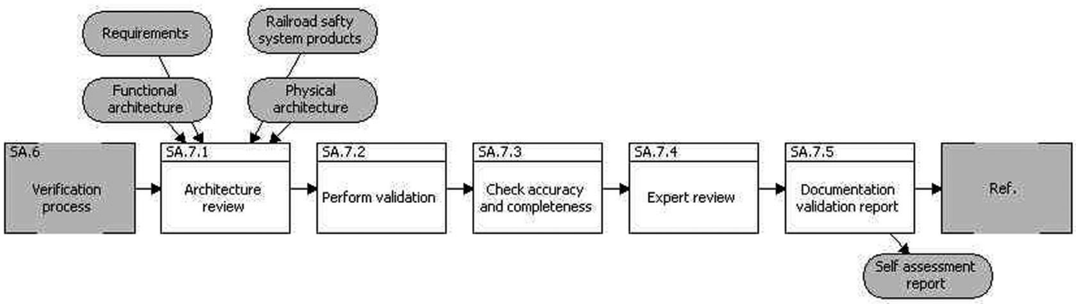

Fig.4. Detailed validation process

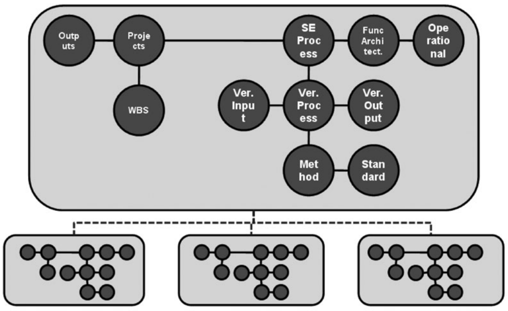

Fig.5. Tracibility of SE Architecutre.

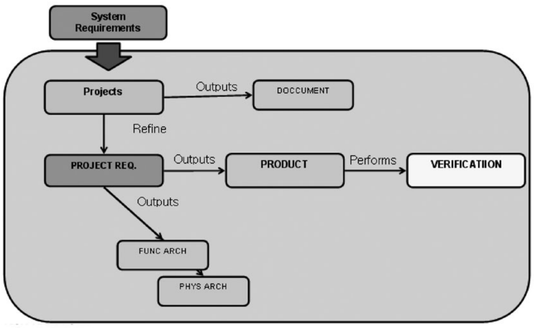

Fig.6. Process of SEMP

available. It is often best if the SEMP references existing organizational policies and procedures. There is no need to duplicate what already exists.

The SEMP forms the foundation for all engineering activities during the entire project and is the means for documenting the tailored SE approach to be used for a specific project. The development of the SEMP is a systems engineering management responsibility, but it must reflect the combined, coordinated inputs of the Project Manager and all other participants in the project.

The contents of the SEMP are described in EIA 632 and many include three parts as depicted as follows:

Part 1, Technical Program Planning and Control, describes the proposed process for planning and control of the engineering efforts for the system's design, development, test and evaluation.

Part 2, Systems Engineering Process, includes specific tailoring of the SE process, implementation procedures, trade study

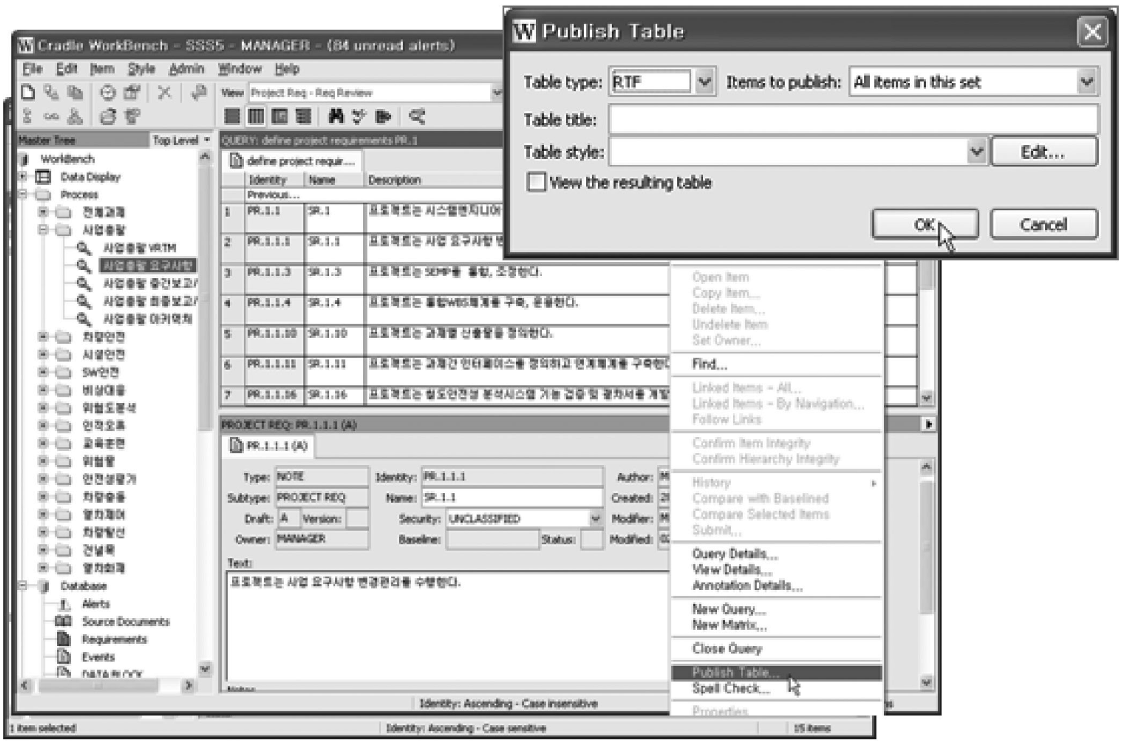

Fig.7. Requirements Inputs

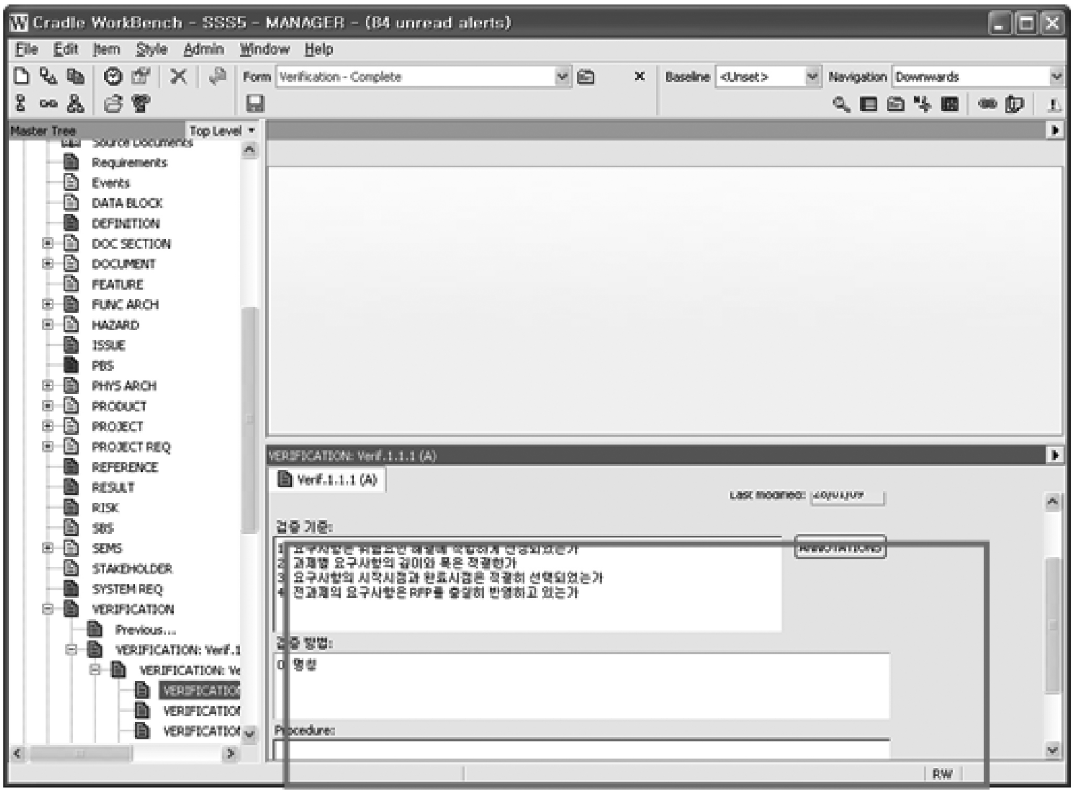

Fig.8. Verification and Validation Inputs

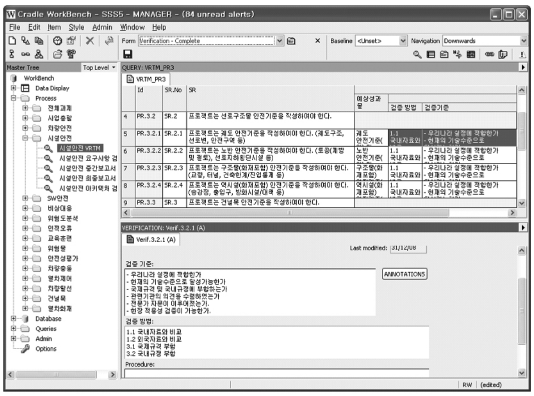

Fig.9. VRTM Checks

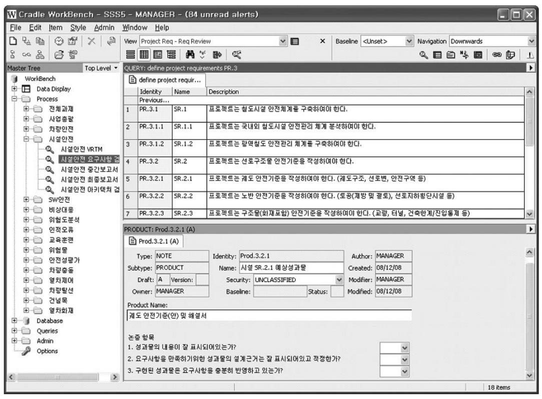

Fig.10. Project evaluation

methodology, types of models to be used for system and cost effectiveness evaluation, generation of applicable documentation and specifications.

Part 3, Engineering Specialty Integration, describes the integration of technical discipline efforts with a cross reference to the specific plan.

2.4 Computer-Aided Systems Engineering

Computer-Aided Systems Engineering Tool (Cradle) is used to manage various programs more practical. Cradle is a beneficial and powerful for modification of requirements, verification assessment and validation management.

Outputs of this program are requirement table, VRTM (Verification Requirement Traceability Matrix), SEMP (System Engineering Management Plan).

3. Conclusion

Establishment of processes of railway safety management system in South Korea was attempted in this research. These processes were introduced with particular attention to Systems Engineering Management Plan (SEMP). For this purpose, railway safety management system in South Korea was briefly discussed and systematic management process was considered that ensures the success of national R&D projects. In this respect, detailed applying SEMP on railway safety management system of South Korea was discussed including Systems Engineering process and Verification and Validation procedure. In order to make the management process more easily controllable, a computer-aided systems engineering tool (Cradle) was used.

References

[1] Alexander Kossiakoff, William N.Sweet, “Systems Engineering Principle and Practice”, pp31-33, Wiley-Interscience, 2003.

[2] James, N., Martin, “Systems Engineering Guidebook” ,CRC press, pp21-22,1997.

[3] Jeffrey O.Grandy, “System Integration”, pp171-174, CRC press.