The Methodology and Case of Scientific System Engineering Management Process in Defense Space Program

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Abstract

Including 425 Program, which is Korean military surveillance and reconnaissance satellite, there were mostly civil-driven space programs in Korea. However, there are increasing numbers of military demand-driven space program in nowadays. Furthermore, it is positive effects on launch vehicle development in Korea that the termination of Korea-U.S. missile guideline. In this paper, it emphasizes the needs of system engineering(SE) management method which meets both defense system's characteristics and space's characteristics. These characteristics are such as non-fixable after the launch, the security issue in defense system. And it also introduces SE tool, methodology and its philosophy. There are several functions that data management, issue management, risk management, and technical requirement management. Also describing its implications and direction of improvement.

1. Introduction

Space development program including 425 Program, which is Korean military surveillance and reconnaissance satellite, requires both military weapon system development process' characteristic and satellite development program's characteristic in terms of system engineering management method. Furthermore, it is positive effects on launch vehicle development in Korea that the termination of Korea-U.S. missile guideline over 40 years. Although there are many similarities in civil-driven space development program, there are lots of strict requirements and lack of local cases in military space program in Korea. It is the right time that defense space program should be organized. [1]

Therefore, building web-based software fits defense space program in System Engineering(SE) point of view. There are several fields that 1. Data Management, 2. Issue Management, 3. Risk Management, and 4. System Requirement Management. There will be configuration management function which is essential in development process. [2]

Also there is a concept used in system engineering project and software development field. This is v-model and most defense system project following this model. It works from verification to validation as time pass by. In detail, requirement analysis, system design, and integration testing. To check these factors, there are several system design review meetings with users, military, researchers, engineers, and all the other stakeholders to deeply review the current development status. [3], [4]

In this paper, it introduces the scientific system engineering management concept and cases in defense space field. And take a look on implications and direction of development.

2. Cases of Scientific System Engineering Management in Several Points
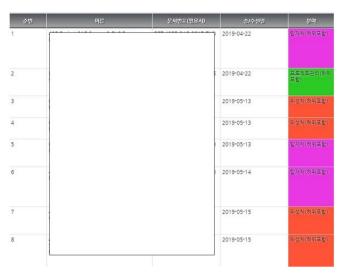
2.1 Data Management

Fig. 1 Data Management Function

Although there is data exchange system in the institution, there are lack of usability such as data search, filing, and traceability.

As Fig. 1 above, each organization based(OBS) or system based(SBS) data management function marked, participant of the program could search data at the same time. Basically, data soring by time, version, and field is more efficient than just sharing with portal or email. It reduces effort on searching by themselves.

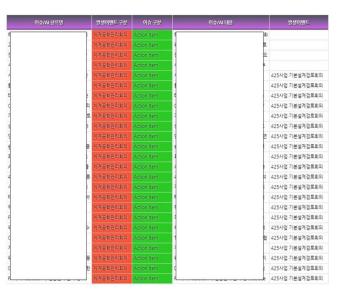## 2.2 Issue Management

Fig. 2 Issue Management Lists

Fig. 3 Issue Management Specific Function

Issue Management is the process that system level meeting's action item and its responses to allocate by organizations and approval by upper level in micro term. On the other hands in macro term of Issue Management is the process that including action items management, issue, feedback, and comments accumulation whole management process. In the development process, there are a lot of meetings in necessary. However, it is good for including these system management process before/after the meeting rather than just meeting oriented.

So, as Fig. 2 shows the lists of system level meetings, and Fig. 3 shows that management is the process including specific name of the meetings, dates, deadline, and the person in charge of the organization. Responder closes the issue by using his/her account to confirm actions by administrative. Accumulative date by such process is the reference for other related meetings, also could be cross-checked a progression by multiple organizations. Also it could be visualization management for before and after the major meetings.

A brief process of issue management is from the certain meeting, organizer put the data including date, the name of the meeting, deadline, assignor, and assignee. After then, that issue task will be done when assignee enter the result with document. We call it as the closing of the issue.

2.3 Risk Management

Fig. 4 Risk Management Function

Risk Management is the process to ease and identify risk factors by review committee periodically. To make this happen, classify risk factors by schedule, cost, and performance and judge its frequency, impact, the level of risk, and period. And also assign a person in charge of each risk factors, manage by periodically relieve activities.

As shown in Fig. 4, coloring and filling the contents by each risk factors to make users tell the difference with. Through the review board for the certain period, collect the expert's feedbacks and neutralize activities. In this process, these kinds of visualization and this systemic engineering management tool are effective.

2.4 System Requirement Management

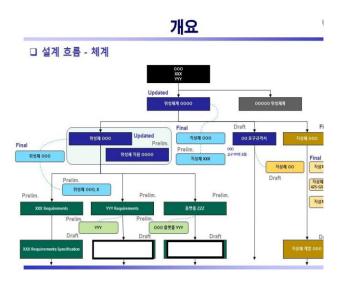**Fig. 5** System Requirement Traceability Management Function

Fig. 6 System Bases Structure(SBS) based Specification, 'Spec Tree'

For the system requirement management, it is the essential for the system engineering(SE) management process. The technical documents driven from each milestone meeting, such as PDR (Preliminary Design Review), CDR (Critical Design Review), series of management matters. Spec-tree, as shown in the Fig. 6, is the structure that document version management and technical contents, linking relationship as traceability management, technically interface between components and specifications meet the requirement from the top-level to the bottom-level structure. [5]

From the users(military) requirements to the system design and sub-system specification for the basis of the production is based on Spec-tree (Fig. 6). It makes technical document's version checking and verification process through scientific systematic engineering management to build efficient model.

3. Implications

So far, the necessity of system engineering management in defense space development program is expressed. Building on the system that multiple users could access simultaneously, for the program's characteristics fitting, participation from the development stage web-based domestic software. By using this, it is useful from the admin level to the working level to meet its own purpose that systemic

management approach.

The enhancements after bringing in this system are following. A visualization of the risk, Data sharing with log, substitution of the minutes of the meeting as this system, and trackable of technical document as a requirement spec. Also there was no system like this in defense space sector. It would lead to the standard of system engineering in this field.

There are further improvements that configuration management which is crucial in system development process, a linkage among working-intranet, and user friendly functions (User Interface, User Experience). To obtain these goals, it should be enhanced its performance, more expertise analysis reporting by using visualization and statistics. Even if functional factors are important, it is more crucial that individual researchers, organization's acceptance, culture, and context to reach the final goal.

4. Conclusion

There are few cases in domestic area in the system engineering point of view. Among them, this field is an intersection of defense and space. And there is a few case in domestic, also limited access in the international cases. Therefore, it should progress by trial and error method. And, it is more important that systematic integration and way of thinking rather than individual capability considering with lots of resource consuming project as defense program.

The contribution of introducing this system into the defense space project is making efficient of project management to meet the goal of the program. Especially, linking the technical requirement from top to bottom shows how each component or technology reflects the requirements. Also configuration management which is important is covered by this system engineering tool to minimize the process.

To sum up, scientific system engineering management should be accompanying as saying above. Deriving the best practice from the current defense space program, and make it as standardization to settle down this system. Also it is needed to discuss deeper and spread for further way ahead by paying attention.

5. Acknowledgement

References

[1] Agency for Defense Development's development data for re-processing to present external usages.

[2] NASA, *Systems Engineering Handbook*

[3] Project Management Institute, "*PMBOK Guide and Standards*"

[4] Kevin Forsberg and Harold Mooz, *"The Relationship of System Engineering to the Project Cycle"*, in Proceedings of the First Annual Symposium of National Council on System Engineering, 57–65p, 1991

[5] *Clarus Concept of Operation*s, Federal Highway Administration (FHWA), 2005