Research on C4ISR Requirement Demonstrating Method Based on System Configuration

Li Jinfeng, Sun Bingcheng, Dai zheng
Academy of Information & Communication National University of Defense Technology, Wuhan, 430010, China.
*Corresponding author: jinfeng_li@nudt.edu.cn

Abstract. Requirement demonstrating is an important link of C4ISR construction. The paper design a requirement demonstrating architecture framework of C4ISR based on the research on DOD2.0. The paper describe how to design capability requirement view, information requirement view, services requirement view, systems requirement view, project requirement view and standards requirement view emphatically. Project viewpoints have great significance in the field of C4ISR requirement demonstrating.

1. Introduction
Demand demonstration is an important link in the construction of information system. It is not only the main stage to guide developers to understand users' needs, but also directly affects the progress and budget of later projects, and even the main basis for system evaluation and acceptance. Therefore, it is more and more important to study the description method of requirements of information system.

In the past construction, the demand demonstration was mainly qualitative demonstration, supplemented by quantitative analysis. In many cases, the necessity demonstration of project construction was regarded as demand demonstration, ignoring the multi-level and multi-subjectivity of demand, and the results of demand demonstration were not quantified, detailed and concrete enough, leaving disadvantages for system design and development. Using the architecture method to demonstrate requirements can accurately refine the system construction requirements, provide a standardized common language that can be understood by technical personnel, build a communication bridge between different fields and different personnel, and make it easy to put for work comprehensive requirements analysis results that meet the needs of users in different fields and different categories.

2. Framework of requirement demonstration
According to the theory of multi-view, the architecture framework can divide the problem into manageable views. Combining with the theory of multi-view in the existing architecture framework, drawing on the multi-view description framework of DoDAF2.0, it demonstrates the key problems to be solved according to the requirements of information system construction. Then, from six angles, such as capability demand, information demand, service demand, system demand, procurement demand and technical standard demand, the demonstration framework of demand of information system is put for work.
The framework mainly includes capability requirement view, information requirement view, service requirement view, system requirement view, procurement requirement view and technical standard requirement view, as shown in Figure 1.

**Figure 1.** demand demonstration framework of information system

Six views reflect the requirements of information system from different aspects. The capability demand view, from the perspective of planning, describes the capability and the process of capability formation, and puts forward the system capability demand. Information requirements view, from the perspective of information users, describes information process, relationship and background, and puts forward system information requirements. Service demand view, from the perspective of information resource planning, describes service composition and function, and puts forward system service demand. System requirements view, from the perspective of system construction, describes the system functions and interconnection, and puts forward system construction requirements. Procurement requirements view describes the relationship, time arrangement and DLOD status of the procurement project from the perspective of the project purchaser, and puts forward the system procurement requirements. Technical standard requirements view, from the perspective of technical support, describes data, information services and system design standards, and puts forward system technical standard requirements.

**3. Requirement demonstration process**

The requirements of information system can be divided into six types: capability requirements, information use requirements, information service requirements, research and development requirements, project acquisition requirements and information support requirements. Using the framework of demand demonstration in this paper, we can accurately demonstrate these six types of needs, and the process of demand demonstration is shown in Figure 2. Demand demonstration is divided into eight steps, which are background analysis, capability demand analysis, information demand analysis, service demand analysis, system demand analysis, procurement demand analysis, technical standard demand analysis and comprehensive demand.
3.1. Background analysis
Background analysis is the starting point of demand demonstration of information system. Through background analysis, the following contents of information system should be made clear.

① Information task list, which forms a task list according to objectives, threats and environment, opponents’ main intentions and other factors.

② Information conception analysis: based on the task list, the information environment, information style, information objects and information forces are analyzed to form information conception.

3.2. Capability requirements
The purpose of information system construction is to apply it to actual information, complete certain tasks and missions, and achieve certain strategic goals. These tasks, missions and strategic objectives can be transformed into specific capability requirements for the information system.

The demonstration process of capability requirements is shown in Figure 3: The first step is to put forwork the capability concept of information system according to information tasks and information concepts, so as to provide strategic background and high-level vision for capability requirements. The second step is to show the current and future capabilities, and define the goal of capacity building. The third step is to plan the stages and steps of capability formation, and to deploy the scheme of capability formation.
3.3. Information requirements

Information requirements directly reflect information user requirements. How to work the war in the future, what kind of system there is, how the information flows, and how the information system should support the work are all urgent problems to be solved. The information requirements demonstration process is shown in Figure 4.

1. System analysis, based on information tasks and information concepts, analyzes the organization and information organization in peacetime and wartime, and rationalizes the relationship. Relationship diagram is usually used to describe relationship, which can visually describe system.

2. Activity analysis, information activity model is the core of the whole model, and also the key to information requirements. The IDEF0 method is used to decompose the information tasks layer by layer, and the information resource flow is connected with the information tasks, information eras, information actors and information systems. activity model describes the information flow needed to complete information tasks from different angles.

3. In the analysis of information resource flow, the description and matrix of information resource flow are usually used to describe the exchange demand of information resources between information nodes concerned by system designers and system users, and to show the relationship among information activities, information elements and information resource flow.

3.4. Service demand

Infrastructure as a service, platform as a service, software as a service. The concept of large services has been widely used in system design. Users of information systems are increasingly concerned about what services the information system can provide, how to provide services, and how service resources are managed. The service demand demonstration process is shown in Figure 5.

1. Service function description, based on the information missions to be completed and the capabilities provided, analyze which service functions resources need to provide. The service function description generally adopts a hierarchical structure to visually show the various service functions of
the system. The service function description is the basis of the service demand view, and other products depend on the content of the service function description.

② Service composition description, according to the service function description, determine the service of the information system, generally one service provides one service function.

③ Service relationship description, usually using service interface description, service resource flow description and service resource flow matrix to analyze the interaction relationship between services and the resource flow between services.

**Figure 5.** Demonstration process of information system service requirements

### 3.5. System requirements

System requirement view is the foothold of system construction. Through the system requirement view, the system composition, system function, system connection relationship and information interaction relationship of information system are mainly described. The system requirement process is shown in Figure 6. According to the information tasks to be completed and the capabilities provided, the functions, subsystems, connection relations and information exchange relations of the system are determined in turn.

**Figure 6.** System requirements demonstration process of information system
3.6. Acquisition requirements
The procurement demand view provides the basis for purchasing managers to make decisions in advance. The procurement demand view determines the interaction between projects, and plans procurement activities in system construction, service construction and capacity building to ensure maximum benefits. The procurement demand process is shown in Figure 7.

① Description of project portfolio: according to capability, service construction and system construction, determine procurement projects, clarify the relationship between procurement projects, and classify and manage procurement projects. Mainly show the composition of the project and the main information of the project.

② The corresponding relationship between project and ability, the gap between reality and ability is demand, and the measure to achieve ability is project. This view product reflects the project's ability to meet and support the project, to ensure that the project can form a capacity, to ensure that there are no redundant projects, and to ensure that the largest benefits can be obtained with the smallest investment.

③ The project time baseline, the project is carried out around the completion of the ability, and the schedule of the acquisition project is determined according to the ability formation process.

3.7. Technical standard requirements
Technical standard demand view, from the perspective of system implementation, describes the standards and specifications that should be followed in data, information construction and system construction. Through the view of technical standard requirements, it can be ensured that the interoperability between internal systems and external systems can be realized from the beginning of system design.

Technical standard demand view has three main purposes. First, unify the technical system of the information system, and lay a technical foundation for the interconnection and interoperability of the systems. The second is to provide a unified standard for the integrated construction of information system of all people, support and realize the joint operation of all people, and improve the overall information efficiency. The third is to provide technical guidance for system development and project acquisition to ensure the comprehensive integration of new and old systems.

**Figure 7.** The process of information system procurement requirements demonstration

3.8. Comprehensive demand demonstration
The requirements of information system are demonstrated from different aspects by capability requirements, information requirements, service requirements, system requirements, procurement requirements and technical standard requirements. Based on the analysis of the above steps, the requirements of the system are comprehensively demonstrated.
4. Conclusions
Demonstration of needs is an important and hot issue in the research of information system construction. This article uses the thought of system structure and the DOD2.0 framework to conduct a systematic demand demonstration for the information system. The requirement demonstration method described in this paper clearly and completely expresses the capability requirements, information requirements, service requirements, system requirements, procurement requirements and technical standard requirements of information system through formatted graphics, tables and texts, and establishes a complete set of requirements demonstration specifications, providing reference for the capability formation, detailed design and system implementation of information system.

By adopting the method of architecture requirement demonstration, we can accurately demonstrate how the system functions support the needs such as information activities and how the system construction supports the formation of capabilities. Therefore, the design of system performance index has a quantitative basis, which provides reference for the decision-making of user departments and leading organs, thus improving the top-level design level of the system and the success probability of development.

References
[1] Zhang Xiaoxue, Liao Liangcai, Yang Kewei. Product design and development of equipment architecture project view [J]. Industry Automation, 2011, 30(7): 9-13.
[2] Xu Bin, Xu Jianfeng, Shen Yanli. New developments in the architecture of the US Department of Defense [J]. Ordnance Industry Automation, 2010, 29 (7): 54-56.
[3] Shu Zhen, Chen Honghui, Luo Xueshan. SOA-based electronic information system architecture development method [J]. Modern Defense Technology, 2010, 38 (3): 45-52.
[4] He Feng. Research on Requirements Engineering of Implementing Network-centric Warfare [D]. Master's Thesis of National University of Defense Technology, 2009.5.