
Architecture Description Approach of Information Systems to System Optimization

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Abstract

The comprehensive electronic information systems architecture is an important part of arming information-based construction, so the architecture description approach is needed to be studied with the system optimization simultaneously. In order to support system optimization, an architecture description approach of information systems is studied with the multi-perspective point's method. Based on the data of the architecture description models, this article will analysis the data form of the description model and the logic relation of the data therefore the architecture description models can be used to optimize information systems architecture.

Keywords: information systems; architecture description; system optimization, comprehensive evaluation method

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1. Introduction

The architecture of comprehensive electronic information system ("Architecture" in the following part of this paper) refers to the construction, property and the relationship of the sub-systems in the information system, is the foundation of structure of the architecture, determines the ability of the information system. The most important work in the designing of information system development and construction scheme is the analysis of the architecture and the designation and optimization of the scheme. At present, most of the design methodologies of architecture draw on the DoDAF that are limited to the description of the architecture. In the architecture scheme, the perspective products generated are used to propose the result, but the architecture design and the optimization process are not combined.

In the designation and optimization of the architecture, the ability evaluation is the foundation of the analysis and optimization of the architecture. The two facets should be combined to ensure the scientific of the architecture scheme. From the perspective of system optimization, with the data in the architecture description models as the medium, an architecture description methodology fit for the comprehensive electronic information system architecture optimization is designed.

2. The Principle of Architecture Description

The architecture of comprehensive electronic information system is the description and a static attribution of the state of the information system itself, which affects the ability of the information system architecture. In the DoDAF 2.0 and MODAF 1.2, the usage of the data-centre ideology and the result of the description of architecture are emphasized. Based on the main ideology of DoDAF 2.0 and MODAF 1.2, with the data of the architecture as the motif, this paper describes the architecture scheme from several viewpoints.

The architecture description model is the standardized expression of the architecture. The architecture data is the data storage form of the architecture description model. In the optimized relationship of the architecture description model supporting system, the architecture data is not only the input argument but also the output result.

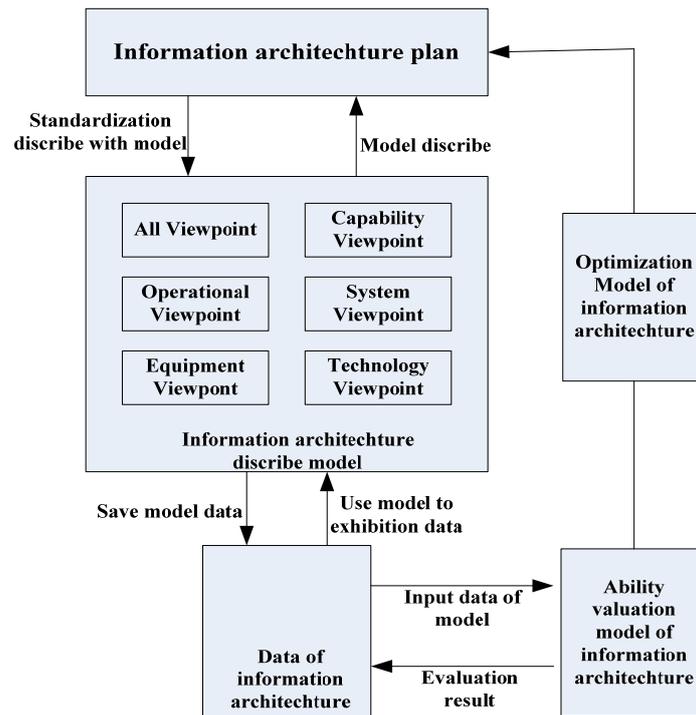


Figure 1. The relationship of the architecture description and the system optimization

3. Architecture Description Methodologies

Different results are generated when the architecture is described from different perspectives, and researcher of different fields pay attention to different parts of the system. The architecture description methodology is studied from the point of perspective of support information system optimization in this paper.

3.1. Architecture Description

In the construction process of the comprehensive electronic information system, the designation of architecture usually analyzes the system composition and the relationship of the architecture based on the military task or the demand of the stratagem. To guarantee the availability of the architecture scheme and the intercommunication of the system, the criterions and technologies in the construction process should be considered. Based on the DoDAF, MoDAF and the architecture research achievements of PLA, the comprehensive electronic information system is described in 5 viewpoints, i.e., capability viewpoint, operational viewpoint, all viewpoint, equipment viewpoint and technology viewpoint.

In Figure 2, the goal, scope and the background of the architecture is determined by the 5 viewpoints, and the comprehensive dictionary of the product is unified. The support ability requirements of the comprehensive electronic information system are proposed in the capability viewpoint, which reflect the main tactical indexes. The military conception, process, tasks of system, typical battle style, army elements and their relationship are represented in the operational viewpoint. The configuration and information relationship of the elements in the battle process is reflected in this viewpoint. The equipment viewpoint describes the components of the comprehensive electronic information system equipments, the support relation of the equipment and the military task, the development trend of the equipments, hence, this perspective should be corresponds to the military equipment development and construction plan. The system viewpoint represents the relationship of the components of the comprehensive electronic information system which meets the demand of military application. The technology viewpoint represents the technical system and criterion of the comprehensive electronic information system.

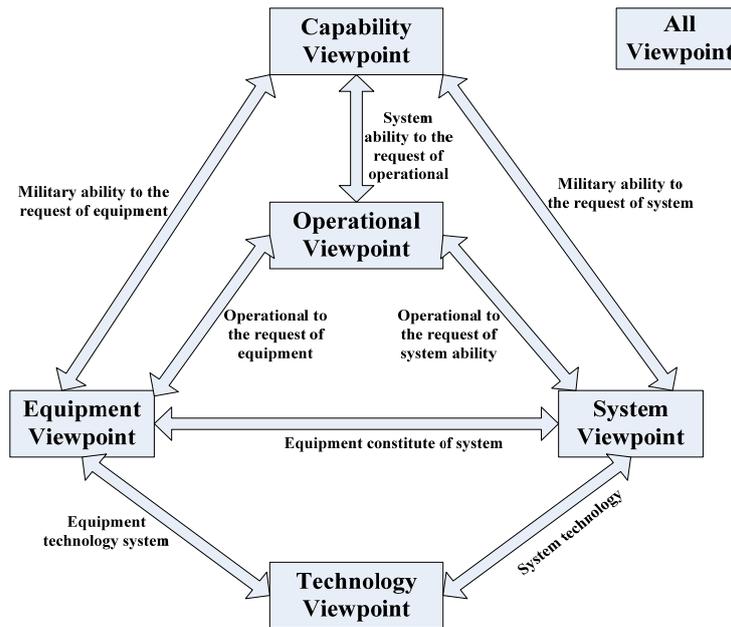


Figure 2. The relationship of viewpoints of the information system architecture

In the 5 viewpoints, the military members interested in the operational viewpoint and the capability viewpoint, while the equipment researchers mainly pay attention to the equipment viewpoint, capability viewpoint and the operational viewpoint; the system demonstrators interested in the capability viewpoint, equipment viewpoint; Technique researchers and equipment developers care about the technical viewpoint and the criterion viewpoint.

3.2. Categories of the Architecture Description Models

Several description models are proposed in every view in order to illustrate the relationship of architectures of different dimension. The all view represents the designation scheme analysis, the design background and the public terminology of the weapon equipment architecture.

Table 1. Architecture description models

Perspective Name	Frame Products	General Description
All Viewpoint	AV-1, AV-2	Represents the goal, scope, background and related terms of the architecture development
Capability Viewpoint	CV-1, CV-2, CV-3, CV-4	Representing the tactic conception, ability components, ability relationship and the corresponding relationship of the military affairs
Operational Viewpoint	OV-1, OV-2, ..., OV-7	Representing the military conception, military nodes and their link relationship, exchange relationship of military information, organization, military affairs, military rules, and logical data models
Equipment Viewpoint	EV-1, EV-2, ..., EV-5	Representing the equipment structure, relationship of equipment and ability, relationship of equipment and military task, the main tactical indexes, the development trend of the equipment
System Viewpoint	SV-1, SV-2, ..., SV-11	Representing the relationship of components of the comprehensive electronic information system which meet the demand of the military requirements
Technology Viewpoint	TV-1, TV-2	Representing the system of technical criterion and its development plan

The ability requirement is represented by the tactic conception, ability component, ability relationship and the relationship with military tasks of the support ability requirements of the comprehensive electronic information system.

Military application is the relationship of the elements and the information relationships in the military affairs. In the military application, the military conception, military nodes and their link relationship, exchange relationship of military information, organization, military affairs, military rules and logical data models are illustrated.

Equipment structure represents the equipment component of comprehensive electronic information system, the support relationship of equipment and military task and the development trend of the equipment. EV-1, EV-2, ..., EV-5 illustrates the equipment components, the relationship of equipment and ability, the relationship of equipment and military task, the main technical and tactic indexes and the development trend of the equipment, respectively.

The technical criterion refers to the technical criterion system, in which TV-1 and TV-2 represents the criterion system and the development plan respectively.

Other than the 5 viewpoints, the system also illustrates the goal, scope, background and related terms of the comprehensive electronic information architecture by all viewpoints AV-1 and AV-2.

4. Logical Relationship of the Architecture Data

The viewpoints of the architecture are composed of models that illustrate the characteristics of the system. The steps in the models perform in certain order; hence, the logical relationship between models also exists. Besides, the description models often expressed in the form of data, hence, the description data of the models is also related with each other. The correspondence and support relationship of the content of each architecture description is one of the most important foundations to optimize the system.

4.1. The Relationship of Data

The architecture perspectives express in the form of charts, texts and tables, including conception chart, component chart, relationship chart, active chart, sequence chart, data flow chart, the relationship table, mapping table, property table, definition table, text description, and so on. The storage of the architecture description products is in the form of description data. Instead of storing a model description produce as one data, the model divides the description content into several data units (so called "basic model object") on the basis of the model object, and store data in the form of data unit. The description data of each model description product is composed of the data unit, hence, when the content of the data unit changes, the related description products are also affected.

4.2. Logical Relationship

Instead of isolated entities, the architecture perspective description products combine the ability perspective products, military perspective products, system perspective products, equipment perspective products, technical criterion perspective products, and generate an all-round architecture perspective.

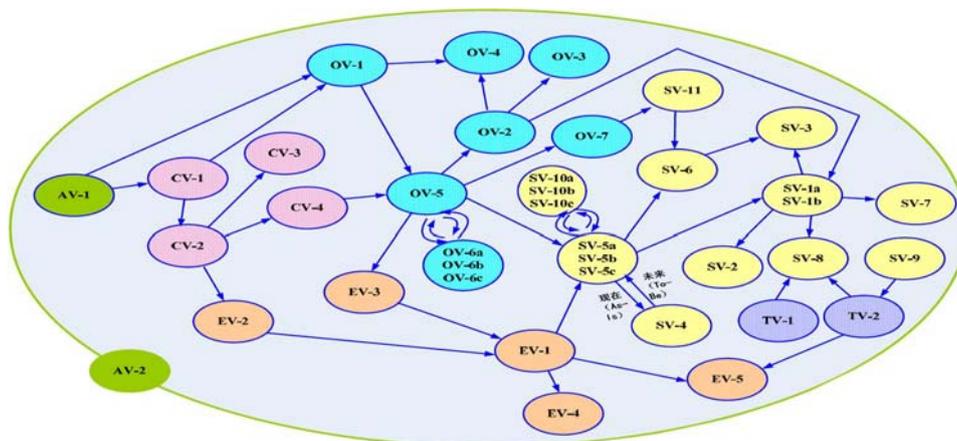


Figure 3. The logical relation of the description data of the information architecture

In the figure, the one-way arrows represent the data flow, and product at the end of the arrow is generated from the product at the start of the arrow. The two-way arrows in the graph represent the consistency of the data, i.e., the description data of the products at the endpoints of the arrow are consistent.

The relationship products and the products of the architecture perspectives restrained by the AV-2, the support, restrain and dependent relationship of the capability viewpoint, equipment viewpoint, system viewpoint and technology viewpoint are realized. Hence, the logicity, integrality and robustness are achieved, and the consistency, rationality and availability of the architecture are enhanced, which provide a product basis for the integration of the products and the enhancement of the co-operation ability.

5. Optimization Method

5.1. The Consideration of System Optimization

The comprehensive electronic information system is a complex system. The main content of the optimization of the system is the optimization of the architecture of the information system, the optimization of the configuration of the weapon equipments, the optimization process of the components, proportion, technical level, quantity and the deployment of the information system. In the optimization process, the architecture description, model, mass data statistics, analysis and management of the information should be considered, which is difficult to complete.

In the optimization process of the comprehensive electronic information system, the primary work is the estimation of the ability of the system. The basis of the estimation is the degree at which the architecture meets the ability requirements. Through the compare of the ability level and the ability requirement, the ability difference and the degree at which the system can meet the requirements of the task is obtained. In the architecture data of information system, equipment kind, interactive relationship of information, command relationship, deployment relationship are the basis of the estimation process. The equipment amount and the technical capability is the input arguments of the estimation model. The ability data gained is part of the architecture data.

The relationship of the related data and models in the optimization process the system is illustrated in the following figure.

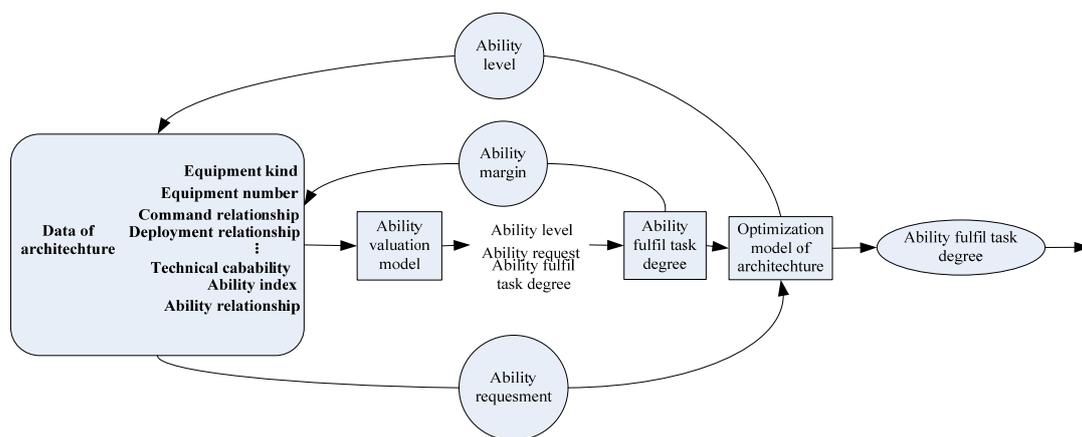


Figure 4. The relationship of the architecture data and the optimization of the system

5.2. Methodology of the Optimization of the Architecture

The common methods of system optimization include Multi-Scheme Optimization Methodology and Simulation Analyze Methodology.

The main idea of the Multi-Scheme Optimization Methodology is comparing several kinds of schemes, and choosing the optimal scheme. In this methodology, the optimal scheme is chosen from all the schemes by professional estimation, simulation and modeling. However,

the “optimal scheme” chosen is meaningless if the Optimization Methodology is not designed properly.

The Simulation Analyze Methodology regards the architecture as a “black box”, the system output as a random function of the system argument. After repeatedly experiment, the optimal scheme is chosen by analyzing the system output.

The advantage of the Simulation Analyze Methodology is that a closed programming optimization model is not necessary to built. The disadvantage of it is the conclusion of the optimization contains only one optimal solution, instead of a satisfied solution region in the uncertain condition. Besides, there is usually mass data in the comprehensive electronic information systems, the simulation and optimization process take a much long time, which is a big lacuna of this methodology.

6. Conclusion

When describe the weapon equipment architecture in a multi-viewpoint style, all viewpoint, operational viewpoint, capability viewpoint, equipment viewpoint, technology viewpoint and the system viewpoint can be chosen to support the decision-making process of the development of the weapon equipments. As the data result of the architecture description model, the architecture data is both input and output in the optimization process of the support architecture.

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