

## A Relation Oriented System Analysis Method

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**Abstract**—System analysis is a main part of military system simulation. Six-element analysis method is integrated the advantage of system analysis method for function and system analysis method for entity. This method analyses the system through its connotation, category, structure, function, state and operation. It provides an operable way to describe static character and dynamic character.

**Keywords**- system analysis method; simulation; system six-element; description framework

### I. INTRODUCTION

System simulation is to build the model of the system, and test with the model [1]. At the present time, system simulation has been an important means and methods to analyze and study the operation behavior of system, bring to light the dynamic process of system and open out the system movement rules [2]. System analysis is the first step of system simulation, and it is the most crucial step. It directly affects the quality of subsequent steps of system simulation and the availability of the simulation results.

System analysis is to observe and analyze the system, and through it, the system and all the influencing factors can be abstracted into some system elements which are interrelated. System analysis is the premise of system modeling, and is a base step of system simulation, plays a key role in system simulation [3]. There are two system analysis methods: function oriented system analysis method and entity oriented system analysis method.

The function oriented system analysis method focuses on the system phenomena and function analysis, but, can not hold the dynamic change of the system, and lack the applicability for larger systems. The entity oriented system analysis method considers the dynamic system operation process, but fall short of holding the system static structure and features, lack of entity selection criteria and backtracking mechanism. In the practice, the entities are left frequently. The two methods are not seize the essence of system analysis, and have great one-sidedness because they research and analysis system from one side of system. In fact, when we research and analysis system, we must base on the system theory, particularly to the general system theory.

### II. MAIN THOUGHT OF SYSTEMATIC SIX-ELEMENT ANALYSIS METHOD

The general system theory deems that the system is made up of a number of interactivity and interdependent components, which are combined an organic having specific

functions. As a general rule, a system includes five essential factors, such as component element, structure, function, state and operation. The five essential factors form a system. The relationship between system and the factors of it can be described Equation (1).

$$\text{System} = \{\text{element, structure, function, state, operation}\} \quad (1)$$

System, moreover, exists in the environment, and is a part of the environment. The environment directly influences the system. So, when the system is analyzed, the direct environmental factor must be taken into account. In another words, the six elements must be taken into account when the system is analyzed. The six elements are the component element, structure, function, state, operation and environmental factor respectively. The relationships between the system and its environment are shown as Figure 1.

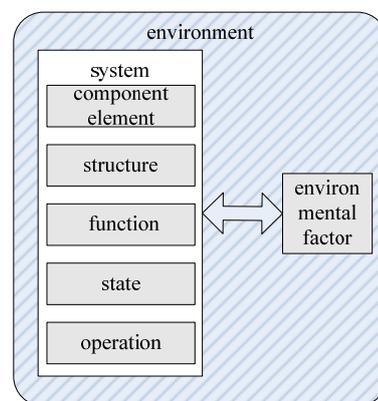


Figure 1. Relationships between System and Environment

The system is stable. It included a large number of relations between the components. This relation reflects the system feature which does not change with time change. At the same time, the system is also constantly in motion and development. The development and motion of the system reflects the relation between system and the external environment. This relation reflects the characteristic that the system changes with time. The system inside relations and outside relations behave the static state characteristic and dynamic state characteristic of system through the part, function, structure, and operation of the system. We research and analysis the system, we must investigate its static state characteristic, and still pay attention to its dynamic state characteristic at the same time. In other words, we should

analysis the system from studying the system both inside and outside relation.

The relation of system can be expressed as:

$$R=\{R_i, R_e\} \quad (2)$$

Where R means the relations of the system; R<sub>i</sub> and R<sub>e</sub> means the inside relations and outside relations of the system respectively.

The five essential factors and environmental factor give expression to the relations of the system. The five essential factors and environmental factor can be mapped six elements. The six elements named systematic six-element are intro-element, ex-element, structure, function, state and operation. We can think that the six elements constitute a new system. The new system is a separate, closed system. The system and the parts of it have no connection with other thing. The mapping between systematic six-element and the factors of the original can be depicted as Figure 2.

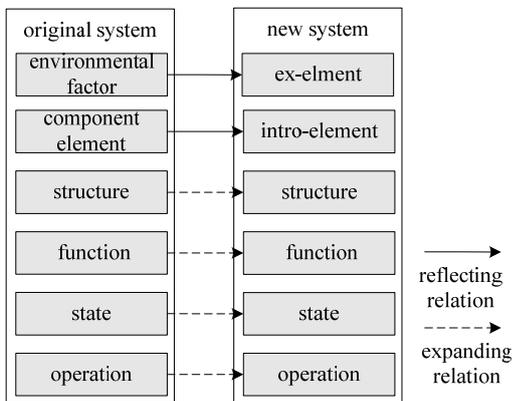


Figure 2. Mapping Relation between Original System and New System

Systematic six-element analysis method is a kind of analysis method which faces to the relation. With this method, the system is analyzed and described through its intro-element, ex-element, structure, function, state and operation. The system static state characteristic is described through its intro-element, ex-element, structure, and function. The system dynamic state characteristic is described through its state and operation. The systematic static state characteristic has contained the systematic dynamic characteristic, and the systematic dynamic characteristic has been to have promoted system static state characteristic keeping as shown in Figure 3.

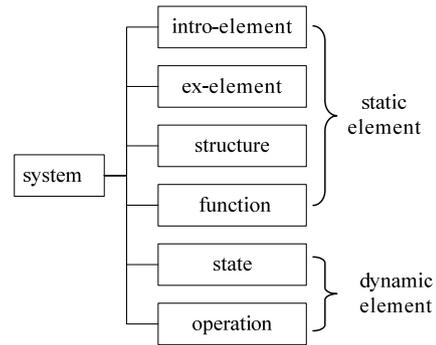


Figure 3. Constitution of the Systematic Six-element

### III. MEANINGS OF SYSTEMATIC SIX-ELEMENT

#### A. Systematic Intro-element

The system is composed of different components that constitute the whole. Each component is the constituent elements of the system. However, the various components of the system elements to the function of the system are different. Some elements function is bigger, and other elements are much smaller. In the system research process, all system elements will not be considered. In general, those elements that play an important role in the system should be considered, and those elements that play a small role in the system should be ignored. The systematic intro-element is those of the system play an important role in the system elements. The systematic intro-element is the embodiment of system static state.

#### B. Systematic Ex-element

System exists in the certain environment. Environment plays an important role in system existence and development. The difference of the connection between different things in the environment and the system is very big in nature and the close degree. For a specific system, the external environment that is inexhaustible. When the system is studied, all the external environment things should be considered. But, it is not possible and nor necessary to consider all the external environment things, and the environment things that are no great importance should be ignored. The external environment things that impact the system badly are only considered. The systematic ex-element is the environmental factors that play a decisive role and can not be ignored in the system developing. The systematic ex-element is the embodiment of the systems and the external environment association.

In the study of specific object system, the systematic ex-element and the systematic intro-element should be treated equally, and that they form a new larger system in which they are the new system components. So, the new system becomes a closed system that has no external factors. To avoid confusion, below, the original system is called an object system, called the new system as system.

### C. System Structure

The system structure is the summation both the relation and the interactivity between the components of the system. It constituted the organized form and the relatively stable combine way of the internal system. They make a whole organization. The space distribution and the coherence of the system components form the order of the sub-systems. And it is the system structure. The relation of system components includes combination relation and class relation mainly. The combination relation means that the some main factor is the sum of other some several factors, namely that this main factor constitutes from other a few main factors. The class relation means the subordinate of the factors, that is to say that some factors belong to another factor which is the taller gradation. The system structure illustrates the interrelation between the system factors, and makes clear that the steady state of system.

### D. System Function

The system function is concept which characterizes the relation [5]. It embodies the whole emergence of the system. The system function includes two aspects. One is the system's external function, and it is the influence from system to environment, and reflects the overall system external ability. Another is internal function of system, and it is interactivity and interdependent of the internal components of the system, and reflects capacity of system internal elements. With the systematic Six-element Analysis Method, the systematic ex-element is as the component elements of a new larger system, so the system function is only considering the system internal functions, without considering the system's external function. The system function is a synchronization concept [6]. It is the embodiment of system static characteristics, namely, the elements of the system relation.

### E. System State

The system is evolving. In different times, the system may appear in different conditions. System state refers to the characterization of the system and system elements in a moment's position, and it puts up the given moment characteristics of the system. A system will produce a series of state in its development process. The state constitutes a collection, known as the system state interval. Systems convert in various states, and that reflects the dynamic process of the system.

### F. System Operation

System operation refers to the changing process of the system state with the passage of time and reflects the dynamic characteristics of the system. System operation makes the system state change ceaselessly, and embodies the interaction of system elements. System operation accompanied the system elements additions, changes and system adjustment and the system function can be shown. System operation is mainly reflected in the change of the system elements.

## IV. GENERAL STEP TO DRAWING SYSTEMATIC SIX-ELEMENT

The key of Systematic six-element analysis method is to draw the six factors of the system. The general step is firstly to draw the static features, next to draw the dynamic state characteristic. The earlier drawing element is the base of the later drawing element, and the later drawing element can test and verify validity and full-scale of the earlier drawing elements. The procedure of drawing the Systematic six-element is as shown in figure 2.

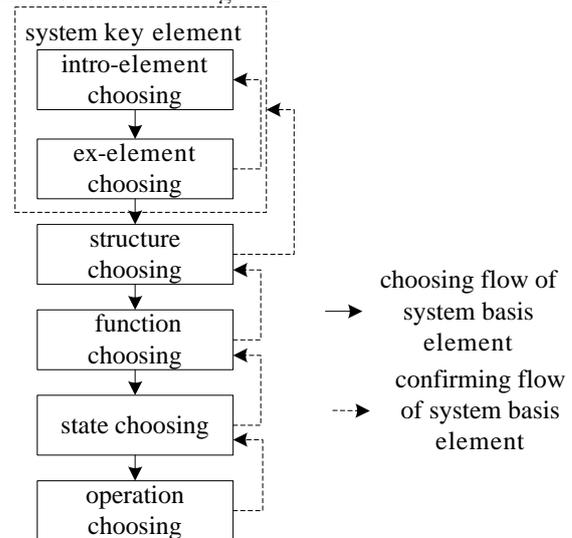


Figure 4. Procedure of Drawing the Systematic Six-element

### A. Confirming System Intro-element

When studying on a particular object system, we should firstly clear what is the object system, what is its intro-element. For example, when we study on a factory, we should confirm our object of study is to the whole factory, or to the producing departments, or the executive, or the marketing department. The object of study is different, and the intro-element is not as same. When confirming the system intro-element, we should decompose the object system through multidimensional manner. After the system is decomposed to diverse element, the elements that belong to different sort should be assembled. The results of assemblies are the system intro-element.

### B. Confirming System Ex-element

There is a target to research the system. If the research targets are different, the external environmental factors considered are not the same. Therefore, when you analysis the system, you must closely around the system target. You should weightily research the external environmental factors that greatly influence the system target, and the external environmental factors are the ex-element. The external environmental factors can be ignored that less influences the system target. The ex-elements and the object are assembled a new system.

### C. *Confirming System Structure*

Between the system elements exist each connections. Structure is the sums of the connections between elements. The interaction existences of the elements are structure, and they should be considered when the system is analyzed. But in the practical application, it is neither possible nor necessary to identify all possible connections, and the essence, the main, and the stable connections only are found out, and the secondary connections are negligible. A system structure often included within the manifold element, need from multiple perspectives to examine. The system is studied generally from different perspective such as hierarchy, space, action to examine the structure.

### D. *Confirming System Function*

The system elements in a certain structure can produce the interaction. Through the interaction, the elements formed the service and serviced relations, support and supported relations. These relations reflect the system function. The system function is the external performance for interactions between the intro-element and ex-element. The function is embodied from multiple directions. Some system functions system on the target plays an important role, and some functions of the system on the system to study takes a very small role. In the course of system analysis, the functions paying an important role must be selected, and the functions paying small role should be ignored.

Need to be advertent that some system function exists, but the lack of the necessary elements and structure in the system function clear process. At this point, we should analyze these functions important function is it right?. If the function system is important, and closely with the system studying target, you should consider adding elements, building structure again.

### E. *Confirming System State*

Elements in the interaction, not only shows the static function, but also changes with the passage of time. These changes may be embodied as a factor in the amount of increase and decrease, may manifest as elements in the qualitative change, but also may be elements of movement in space. No matter what kind of change, are likely to influence

the state of system. Therefore, in the full study system static attributes while, also should review the factors of the system change, according to the change of element, judges the state of system of different.

### F. *Confirming System Operation*

Each system has a number of states. The state of the transformation process embodies the system trajectory. System from one state to another state, resulting in the elements of the system during the interaction may be seen in the space transformation, quality change and so on, so as to promote the system development. Investigation of the dynamic characteristics of the system, we should seize the system state changes between associations, clear system trajectory. System is system dynamic characteristics of important characterization.

## V. CONCLUSIONS

Used the systematic six-element analysis method, both the static and dynamic feature of system can be confirmed. The method makes up for the deficiency of the function oriented system analysis method and entity oriented system analysis method.

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