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Conceptual Modeling and Simulation Application Analysis of In-service Assessment

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Abstract: Firstly, this paper expounds the conceptual connotation of in-service assessment in the new system, then applies modeling and Simulation in the field of in-service assessment, establishes the conceptual model of in-service assessment and its process, and finally analyzes the application of modeling and simulation in the specific links of in-service assessment.

Keywords: Modeling and simulation; In service assessment; conceptual model

1 Introduction

In 2016, with the whole army's adjustment and reform of the leadership management system in China, major adjustments and changes took place in the field of equipment test and evaluation. A new equipment test and evaluation management system was established, which defined a closed loop of "performance test-operational test-in-service assessment" [1–3]. In the new management system, the formation of combat effectiveness has been emphasized, so the new equipment test concept and link of "in-service assessment" came into being.

The key link of "in-service assessment" has solved the disadvantages of the way of "one trial determines life" equipment finalization in the past [4]. It is mainly organized and implemented by relying on the equipped troops and relevant colleges and universities, in combination with tasks such as normal combat readiness training, joint exercise training and teaching. It focuses on mastering the use, support and maintenance of equipped troops and investigates the equipment operation and support function in the environment of equipment system and personnel system.

Starting from the current situation that the concept of in-service a sessment is relatively new and less studied, this paper puts forward to learn from the basic idea of 5W2H analysis method, constructs the conceptual model of in-service assessment, clarifies the purpose, process and specific content of in-service assessment, and provides reference for the concept understanding and practice of in-service assessment.

2 Connotation of In-service Assessment

2.1 Basic Concepts

Combined with normal combat readiness training, joint exercise training and teaching, in-service assessment is mainly organized and implemented by relying on the equipped troops and relevant colleges and universities [5]. It focuses on tracking and mastering the use, support and maintenance of military equipment, verifies the combat and support effectiveness of equipment, finds problems and defects, and assesses the adaptability of equipment with deployed troops and the economy of service period, and some indicators that are difficult to assess in the stage of performance test and operational test.

2.2 Assessment Content

The purpose of in-service assessment is to find out the problems in the process of personnel equipment integration and war training integration in the actual staffing system during its service period, and feed back the problems so as to solve them in time. Therefore, the content of the assessment index system of in-service assessment should reflect the key factors affecting the exertion of equipment combat effectiveness [6]. Clarifying the assessment contents and standards is conducive to the implementation of quantitative and qualitative assessment.

The latest clear main assessment indicators: first, the applicability of equipment with the army, which mainly investigates the degree to which the equipment meets the daily training use and maintenance, mainly including use availability, mission reliability, maintenance adaptability and support adaptability; The second is the stability of equipment quality, which mainly investigates whether the equipment quality characteristics of all aspects specified and promised are guaranteed, mainly including the difference of quality level and the variation rate of quality level; Third, the economy of equipment, which mainly examines whether the equipment can be used and whether the efficiency cost ratio is reasonable, including average maintenance cost and utilization cost [7,8]; Fourth, equipment adaptability, that is, whether the equipment allocation is compatible with the current force establishment, including task adaptability, quantity adaptability and personnel adaptability; Fifth, Equipment suitability, which mainly investigates the matching degree between the constituent elements of the equipment system, including mobility synchronization, firepower coordination, information connectivity and war support coordination [9].

The specific assessment index system is shown in Fig. 1.

2.3 Main Features

In the new system, as a separate implementation process and link, in-service assessment plays an irreplaceable role contrast performance test and operational test, and the process organization is obviously different from the former ones.

There are three main characteristics: first, the assessment contents are diverse. As a supplementary verification means for identification and finalization, it is necessary to set different assessment requirements according to different mission requirements and combat training environment. And it's necessary to verify the indications that are difficult to test in the previous verification link and solve the previous remaining problems [10]. Second, the test cycle is long. The long-term applicability and economy assessment shall be conducted throughout the service period after the equipment is equipped in the army, and the assessment data, conclusions and suggestions shall be reported regularly every year. Third, there are high requirements for coordination. The in-service assessment requires systematic and organic experimental investigation. Combined with the unit's daily training

and teaching tasks, it involves many units and departments, which makes the coordination is relatively difficult.

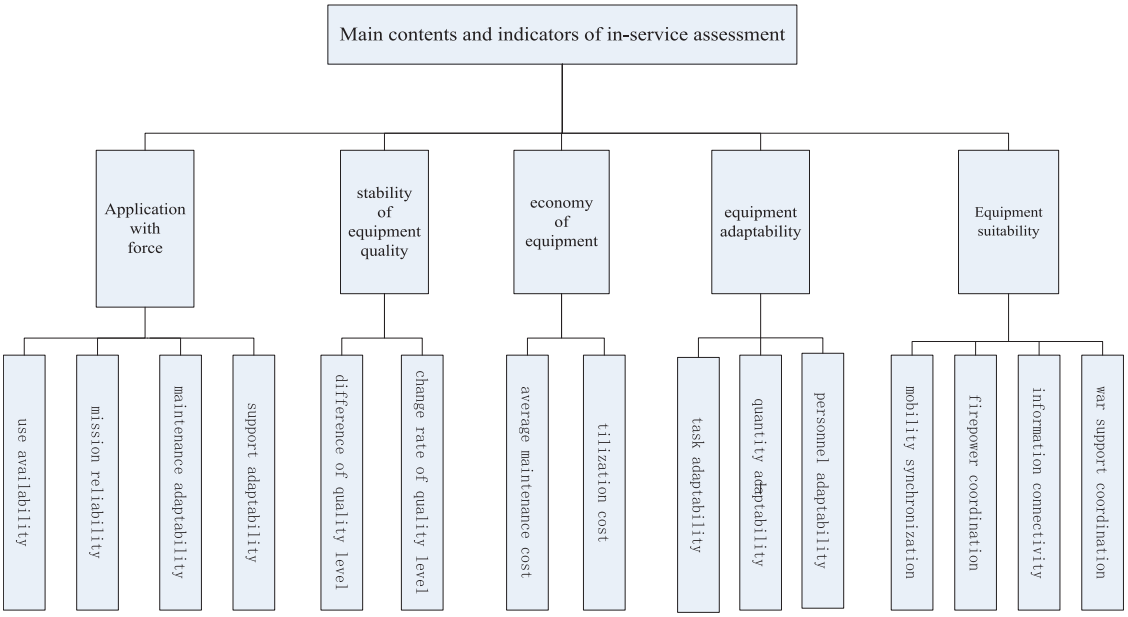

Figure 1: Assessment index system

2.4 Classification of In-service Assessment

According to the scale of in-service assessment objects, in-service assessment can be divided into three types: single equipment, arms equipment system and integrated joint in-service assessment. These different types of in-service assessment have their own emphasis, as shown in Tab. 1.

Table 1: Classification of in-service assessment

Type	Specific object	Evaluation focus
Single equipment	Single equipment and weapon system	Application with force Stability of equipment quality
		Equipment economy
Arms equipment system	Equipment system or multiple similar equipment	Equipment adaptability
		Equipment suitability
Integrated joint assessment	Multi arms equipment system	Comprehensive index

3 Conceptual Modeling of In-service Assessment

The so-called "modeling" is the abbreviation of "model building", and the so-called "model" is the abstraction of the actual system. Abstract models are divided into conceptual models, mathematical models and simulation models. In the abstract model, the conceptual model is not only the first abstraction of the real world in the simulation world, but also the basic basis for the construction of mathematical model and simulation model. Its designing level directly determines the quality of mathematical model and simulation model.

As a new concept under the new system, the conceptual model of in-service assessment can be established to simplify its concept and make its process more intuitive and visual.

3.1 5W2H

In order to describe the concept of in-service assessment under the new system more systematically and comprehensively, this paper uses the basic principle of 5W2H analysis method to establish the conceptual model of in-service assessment. 5W2H: What; Why; When; Where; Who; How; How much [11].

In the field of in-service assessment, the specific mapping of 5W2H is shown in Tab. 2:

Table 2: Conceptual model of in service assessment

5W2H items	In service assessment concept	Content
What	Test content	Force applicability Quality stability Equipment economy Equipment adaptability
Why	Experimental purpose	Promote equipment iterative development Optimize equipment organization structure Deepen the actual combat application of equipment
When	Equipment life cycle	Equipment service period
Where	Main places	Actual combat environment
Who	Participants	Overall technical unit Task force Test evaluation organization Equipment manufacturer Expert consulting team
How	Test method	Task combined in-service assessment Special in-service assessment
How much	Test effect and benefit	Promote equipment improvement and upgrading Help force combat effectiveness generation

3.2 Dynamic Process

The dynamic process of in-service assessment takes the whole process of equipment life cycle as the timeline, involving multiple stages, multiple units and various work tasks, with complex forms and contents. In this section, the complex and diverse equipment in-service assessment work is presented

in the multi-dimensional chart of the time axis to realize the dynamic visualization of the process. The detailed flow chart is shown in Fig. 2.

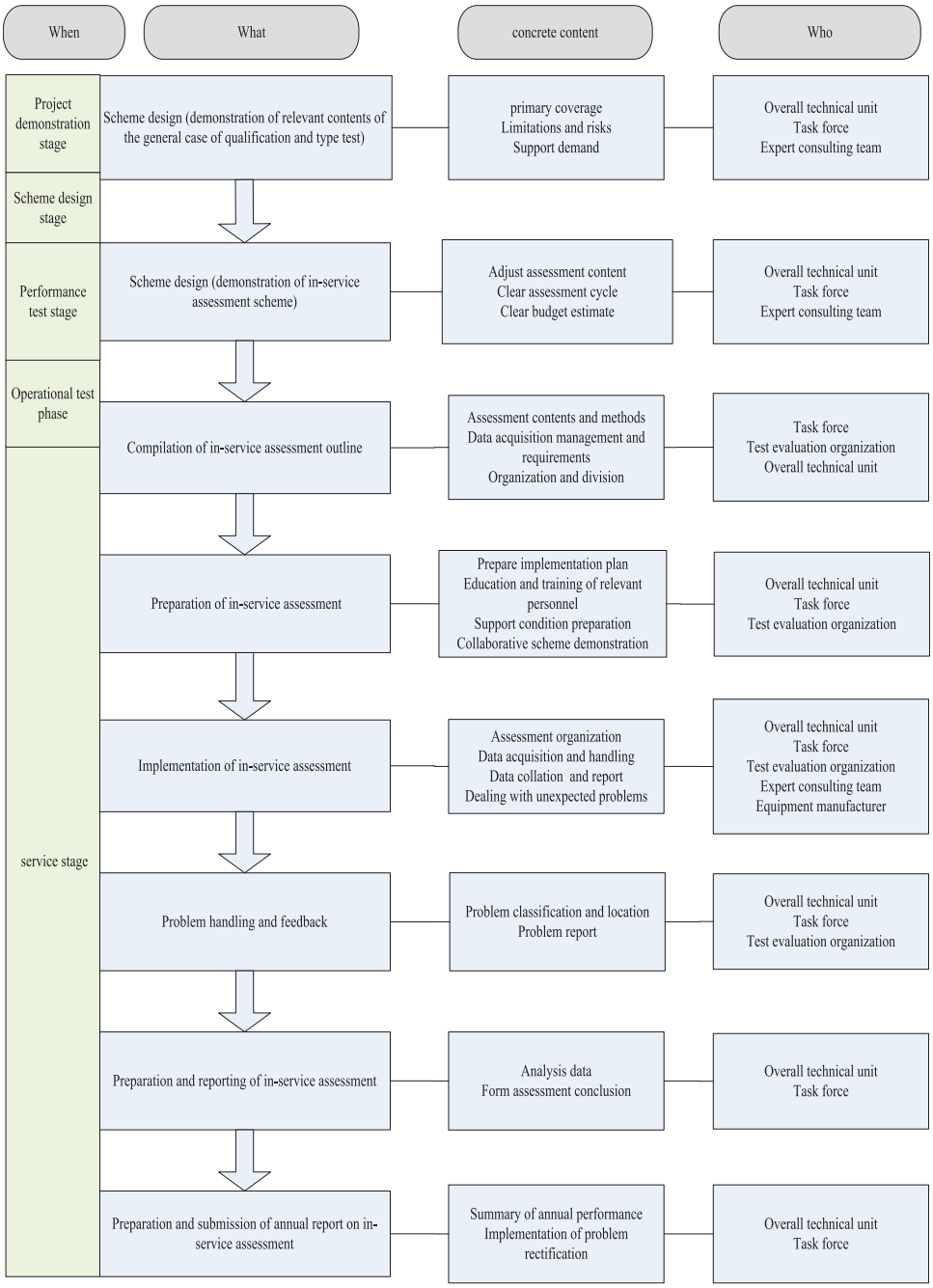

Figure 2: Dynamic process of in-service assessment

4 Application Analysis of In-service Assessment Simulation

According to the connotation, characteristics and process of the above in-service assessment, this section discusses the application of simulation means in the in-service assessment process so as to simplify the test operation and achieve the test purpose.

4.1 Optimize the Design Scheme of In-service Assessment

By constructing a simulation system for specific assessment tasks and using the simulation deduction method, it provides effective theoretical and advance data support for the preliminary scheme demonstration and design. It helps to form a scientific combat scenario, systematic evaluation index and reasonable composition of the test force. It can compares and tests the compliance of the assessment data acquisition elements and the completeness of the whole assessment implementation scheme so as to evaluate whether the implementation plan is scientific and reasonable and optimize the in-service assessment outline and collaborative processes [12].

4.2 Structure the Assessment Environment

During the implementation of in-service assessment, more and more emphasis is placed on the construction of practical environment in the new system. It is proved during the practise that the closer the test condition environment is to the reality, the higher the credibility of the test effect is. In the design stage of in-service assessment scheme, simulation technology can be applied to battlefield environment configuration and virtual confrontation environment simulation [13]. Besides, it can build an intelligent test field and a logical confrontation range. Through the research on simulation technologies such as simulated battlefield electromagnetic combat and firepower combat, it can establish test targets and virtual scenes based on target characteristics, combine hardware in the loop simulation with real countermeasure environment, and constructs an assessment environment system with simulated countermeasure, approximate real combat and realistic state, to form an LVC simulation environment structure [14]. It provides a reference for the environmental selection and structure of in-service assessment test. Combined with the actual military tasks and training conditions, the terrain, climate, electromagnetic environment and other simulated combat test elements can be added to the test environment system in virtual form through simulation technology.

4.3 Auxiliary In-service Assessment and Comprehensive Evaluation

In service assessment and evaluation shall be conducted after completing the phased or annual tasks. At this stage, all kinds of data need to be used to comprehensively evaluate the adaptability and economy of equipment in service. According to the technical documents, software and preliminary performance test and operational test data provided by the manufacturer, a comprehensive evaluation means combining virtual simulation and real equipment can be established by means of simulation, and an in-service evaluation index system can be formed [15]. Since the operational applicability and system contribution rate change with the changes of different actual combat backgrounds, it is necessary to clarify the specific operational requirements and objectives, and analyze the evaluation levels. According to the determined evaluation indexes and evaluation methods, evaluation models and evaluation systems can be established by conducting system simulation modeling for equipment in-service assessment to assist in the comprehensive evaluation of in-service assessment. Combined real equipment in-service test, simulation means provides a reference for equipment service evaluation, improvement and upgrading.

5 Summary

As an important means to understand, analyze and solve problems, modeling and simulation plays a more and more important role in the implementation of equipment test under the new system. Under this new system, the independent link of in-service assessment is added, the equipment test cycle is prolonged, and the assessment of combat effectiveness and system of equipment under the background of actual combat after equipment service is strengthened. By establishing a conceptual model, this paper analyzes the concept and specific work flow of in-service assessment, and discusses the application of modeling and Simulation in specific processes. In the future development of in-service assessment, we should make full use of the development achievements of simulation technology, carry out research on in-service assessment modeling and simulation technology, accelerate the landing application of in-service assessment simulation evaluation means, optimize and improve assessment benefits. Modeling and simulation provide new ideas for promoting the implementation of in-service assessment and the upgrading of equipment, and then accelerate the improvement of combat effectiveness of the army.

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