

Discussion on the Way of Top Level Design in the Field of Equipment Maintenance

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Abstract: The top-level design research in the field of equipment maintenance assurance is of great significance to improve the planning, scientific and predictability of maintenance assurance of troops under the new system. Firstly, the paper analyzes the characteristics and structure of the equipment maintenance assurance system, clarifies the relationship between the components within the system, analyzes the forecasting method of equipment maintenance assurance resource demand and the specific strategy of resource allocation. Secondly, based on the actual demand of the troops for the equipment maintenance support force, this paper explores how to use and control the equipment support force system. Finally, based on the above analysis, the thought of the framework of the efficiency evaluation system and the general requirements and specific principles of the index system are given, with a view to innovating the construction of equipment maintenance support force and promoting the development of equipment maintenance support field.

1. Introduction

Equipment maintenance support is an important means to maintain the combat effectiveness of the troops. With the continuous improvement of the informatization level of weapons and equipment, we rely more and more on maintenance and support resources during combat [1]. In order to give full play to the operational capability of existing equipment, it is necessary to establish a supporting equipment support system. The top-level design research in the field of equipment maintenance assurance is the starting point and end point for the construction of equipment assurance system and the use of equipment assurance force.

In recent years, researchers at home and abroad have conducted extensive research in the field of equipment support, focusing on the following four aspects: First, the construction and application of maintenance support force for a certain type of weapons and equipment; The second is to carry out maintenance support research for different task directions; Third, research on maintenance resources, maintenance capacity and maintenance effect; The fourth is the research on equipment maintenance and guarantee around military-civilian integration and military-civilian integration. However, more research has been made to highlight the use of equipment maintenance support. Under the new system, it is necessary to follow the system-wide maintenance management requirements. starting from the development trend of equipment maintenance support, the top-level design and evaluation is carried out around the important issues of future development planning and weapons and equipment system. In order to optimize equipment maintenance support resources and make rational use of equipment maintenance support forces.

2. Analysis of Equipment Maintenance Supports System

2.1. Characteristic Description of Equipment Maintenance Support System

The equipment maintenance support system has the characteristics of integrity, relevance, level, purpose and adaptability, among which the integrity, relevance and level are the basic attributes.

2.1.1. Integrity

Components of equipment maintenance support system are interrelated and each element should obey the whole function of the system. Each element carries out activities on the basis of the overall function, and this activity will accumulate continuously to form the equipment maintenance support behaviour [2].

2.1.2. Relevance

Equipment maintenance support system consists of 9 components, including maintenance support scheme, human resources, supply support, equipment, technical data, training, information support and support facilities [3]. During equipment maintenance and support activities, each element is interrelated and has a strong correlation.

2.1.3. Hierarchy

Equipment maintenance support system is a collection of many elements, it can be decomposed into multiple subsystems, each subsystem has a certain hierarchy structure. It is through this hierarchical structure that the equipment maintenance support system can coordinate the work of each element and complete the specified function [4].

2.2. Structural Analysis of Equipment Maintenance Support System

The purpose and complexity of equipment are different. Therefore, there are differences in the maintenance support systems of different equipment, mainly reflected in the role of each support element.

2.2.1. System Composition

The system is mainly composed of three aspects: The first is the theory of equipment maintenance support, including basic theory, professional basic theory and application theory. The second is equipment maintenance support resources, which are the material basis for implementing equipment maintenance support, specifically referring to some equipment, facilities, spare accessories, tools, instruments, etc [5]. The efficiency of equipment maintenance support is affected by equipment maintenance support resources, combat mode and equipment maintenance support demand. The third is the system of equipment maintenance support, which is an important link in the construction of equipment maintenance support system. It is of great significance to establish an equipment maintenance support system with reasonable structure, clear responsibilities, overall optimization, coordination and high efficiency to exert the efficiency of equipment maintenance support.

2.2.2. Interrelation

The relationship between the above three can be described specifically as: equipment maintenance support theory is the basis. It is the most active factor of the three, it determines the quantity and quality of equipment maintenance. Equipment maintenance assurance system is the organizational assurance, which plays a restrictive role in equipment maintenance. The equipment maintenance system is closely related to the military strategy, the specific maintenance assurance level, which changes with the military strategic thinking [6].

3. Ways to Optimize the Allocation of Equipment Maintenance Support Resources

The configuration of maintenance support resources needs to be considered from a global perspective so that the elements can be matched to ensure the operational use of equipment.

3.1. Research Objects and Decision Goals

The research object is equipment maintenance support resources. The decision-making goal is to maximize the maintenance of weapon performance. We need to repair and maintain our equipment in peacetime, but also in wartime [7].

3.2. Forecasting Method of Equipment Maintenance Resource Requirements

3.2.1. Influencing Factors

There are two factors that influence the forecast results of maintenance resource requirements: the first is the future situation of equipment maintenance, and the second is passed resource consumption. Generally, estimates of equipment maintenance rely primarily on the inferences of military experts. The consumption of maintenance resources can be estimated by equipment parameters, user use parameters and spare parts parameters.

3.2.2. Method of Prediction

The first is the quantitative prediction method. This prediction method generally needs to be based on data and can be divided into time sequence method, structure analysis method and system analysis method according to different data processing methods [8].

The second is the evaluation criteria of the prediction method. Any prediction method has applicable conditions and environment. Only the selected prediction method can guarantee certain prediction accuracy.

The third is the predictive model. It includes non-repairable equipment demand prediction model and repairable equipment demand prediction model. Among them, non-repairable equipment means that when the equipment fails, it can only be solved by replacing the parts, and the parts that are replaced need to be scrapped, and the parts consumption rate of the non-repairable equipment is related to the failure rate. Restorable equipment refers to equipment that can be repaired by a repair mechanism and can be reused. For fixable equipment, there is a certain chance of repair for the failed part depending on the degree of failure.

3.3. Optimal Allocation of Equipment Maintenance Resources

3.3.1. Policy Introduction to Equipment Maintenance Resource Configuration

Equipment maintenance resource allocation is carried out on the basis of demand forecast. The rationality of the configuration affects the maintenance support task can be completed. Our army now uses the secondary maintenance support model, adopts the strategy of multi-level allocation of maintenance resources, in all levels of warehouses are equipped with spare parts. Maintenance resources are stored in the central warehouse and the regional warehouse respectively. Regional warehouses are responsible for supplying spare parts to maintenance agencies on the ground floor and central warehouses are responsible for supplying spare parts to regional warehouses. If in a state of war, some important spare parts are normally supplied directly from the central warehouse to the maintenance site.

3.3.2. Influencing Factors of Equipment Maintenance Resource Allocation

The ultimate goal of optimizing the allocation of equipment maintenance resources is to ensure the integration of spare parts reserve, supply and maintenance requirements. The rational distribution of spare parts can improve the force's equipment support capability. But parts configurations are affected by a variety of factors, such as ease of purchase, being critical and being cheap. Because of its many factors, some of them are easily overlooked, thus increasing the difficulty of resource allocation. Therefore, qualitative and quantitative analysis can be combined to improve the efficiency of parts configuration.

3.3.3. Configuration Scheme for Equipment Maintenance Components

The ultimate objective of equipment maintenance resourcing is to maximize the need to replace equipment components by sending spare parts to their destinations in the shortest possible time, with minimal funding in exchange for the highest equipment integrity rate. First of all, we need to determine the parts that can be replaced according to equipment usage requirements, equipment failure cause, equipment failure hazard, equipment repair time and other factors. Secondly, we need to consider the possibility of parts for replacement during the service life of the equipment and determine whether the equipment needs to be replaced.

4. Application and Control of the Power System of Equipment Maintenance Support

4.1. Development of Equipment Maintenance Support Force

The logical starting point for the use of equipment support forces is the study of demand. With the continuous advancement of science and technology, the future war presents the characteristics of intelligence and informatization, the equipment support task emerges more, the task becomes more difficult, whether the existing equipment support force can complete these tasks within the specified time is worth exploring. Specifically, there is a need for procedural treatment of preparedness support requirements, thus solving the problem of excessive qualitative description and low normalization of traditional equipment support requirements. The development of complexity science provides us with a standardized thinking, and also provides preconditions for the construction of equipment support force system and the generation of equipment support capability.

4.2. Application of Equipment Maintenance Support Force System

In the context of informatization and intelligent warfare, the concept of system has been extended to many dimensions, which further broadens the interaction between equipment support behavior in multidimensional space, deepens the mutual coordination of equipment support action, and emphasizes the rapid response capability of equipment support force system in the countermeasure environment. Based on this, how to use the existing organizational system to integrate equipment support resources and build equipment support force system with strong battlefield adaptability and obvious advantages is the end of equipment support work. The application of equipment support force system includes the transformation of the existing system and the construction of a new system. At this stage, we should consider how to make it adapt to the complex requirements of equipment support on the basis of the existing mature equipment support force system. We can use advanced theoretical methods to guide the transformation of the existing system forces, build a "mesh" equipment support force system, and realize the leap from point-line guarantee to system guarantee.

4.3. Evolution and Control of Equipment Maintenance Support Force System

The fundamental purpose of the evolution of the equipment support force system is to improve the stability of the system and its adaptability to complex operational tasks. Specifically, the evolutionary mechanism of the system can be designed for equipment support needs. put forward the strategy of evolution, control the behavior of evolution, Solving the problem of how to control the adaptive behavior of the equipment support force in the face of changes in the external environment, Strengthen the monitoring of the equipment support force system and the dispatch of the force unit, so as to improve the adaptability of the system.

5. Evaluation of the Effectiveness of Equipment Maintenance Support System

The performance evaluation of equipment maintenance assurance system is a complex problem. Its complexity is manifested in three aspects: First, there are many types of evaluation indicators; Second, system performance requires an overall assessment methodology; Third, the complexity of comprehensive evaluation of equipment maintenance assurance system. Only by viewing it as a complex system can be the performance of the equipment maintenance assurance system be evaluated as a whole [9].

5.1. System Framework Analysis for Performance Assessment

5.1.1. Specific Description

Accurate description of equipment maintenance assurance system is the basis of efficiency evaluation. Equipment maintenance support system is a typical complex system which can be regarded as a control system and information system. It is also a dynamic system whose performance is influenced by tasks, time, environment, etc. In this paper, equipment maintenance

support system can be described from the perspective of information system and control system, taking into account the task, time and environment.

5.1.2. Methodological Study on Simplifying Guarantee Elements and Evaluation Indicators

Equipment maintenance assurance system is a multi-level, multi-element, multi-directional complex system. In different maintenance tasks, the elements and characteristic indexes in the equipment maintenance assurance system play a different role in the evaluation of system performance. We study the corresponding method, which is of great significance to reduce the complexity of the evaluation model and optimize the index system.

5.2. Establishment of an Indicator System for Performance Assessment

5.2.1. The Overall Requirements for the Establishment of the Indicator

The overall purpose of the Equipment Maintenance Assurance System Evaluation is to assess the function of the system. Thereby identifying problems, correcting them and ensuring their proper operation. Maintenance assurance systems can be evaluated from top to bottom or from a lower level up [10]. Prior to the assessment, the methodology for determining the assessment is the basis for all work, and we can identify specific assessment methods by establishing an assessment model that can reduce the impact of other external factors and make the assessment more scientific.

5.2.2. Specific Principles for the Establishment of the Indicator System

In the information age, the technical content of weapons and equipment is higher and higher, the types are more and more. The operational application is more and more flexible. The following principles should be followed when establishing an indicator system. The first is the principle of completeness. The establishment of performance indicators should start from maintaining the continuous combat effectiveness of the supporting forces, based on specific mission tasks, combined with the military requirements in the process of equipment support development, analyze the various links of equipment support, and fully reflect the characteristics of equipment support. This was followed by the principle of scientifically. There are many factors affecting the effectiveness of equipment support. Therefore, it is necessary to clarify the subordinate relationship when constructing the index system, analyze the main factors affecting the effectiveness of equipment support, and simplify the index system. Finally, there are systemic principles. The establishment of the indicator system should be based on the system theory, the indicator system should be regarded as a system, reflecting the characteristics of the troops performing equipment support tasks from different levels and perspectives, showing the overall logic of the equipment support structure of the troops, reflecting the changing trend and development of equipment support.

6. Conclusion

In this paper, the mismatch between the leapfrog development of equipment and the existing maintenance support capability is discussed as the starting point of the research. From qualitative analysis and quantitative analysis, the macroscopic strategies and micro-methods of problem solving are studied in depth.

References

- [1] Yang, X., Hongxing, W. (2005) Status and Development of Equipment Maintenance Assurance Technology in the US military. *Aviation Maintenance and Engineering*, 3, 19-21.
- [2] Nuobei, W. (2010) Research on the Logistics Support of Foreign Army and Its Reference Value to Our Army. Wuhan University.
- [3] Changqing, L., Shining, M. (2013) A Preliminary Study on Equipment Maintenance Technology system. *China Surface Engineering*, 5, 111-116.

- [4] Wei, W. (2014) Design of Communication Quality Detector for On-Board Network. Nanjing University of science.
- [5] Ruizhou, F., Kai, G. (2019) Thinking on the Basic Problem of Unmanned Intelligent Equipment Guarantee. Journal of the Military Transportation Academy, 7, 37-40.
- [6] Shigang, S., Hang, Y., Li, J. (2021) Research on Development Trend of Intelligent Assurance Technology of Equipment. Flying missile, 4, 90-94.
- [7] Fei, L. (2021) Clarify the Development Focus of Intelligent Combat Forces. People's Liberation Army Daily, 7.
- [8] Xishan, Z., Guangyao, L., Huijie, L. (2020) Development and Application of Intelligent Unsupervised Equipment. National Defense science and Technology, 2, 10-14.
- [9] Ming, Z., Shizhen, G.,Minghao, G.(2010) Risk of Maintenance and Control of Military-Civilian Integration Equipment. Journal of the Institute of Equipment Command Technology, 6, 23-26.
- [10] Xiaoan, L., Bing, J., Guo, Y. (2020) Exploration on the Development Trend of Equipment Security under the Condition of Intelligent War in the Future. Flying missile, 4, 22-25.