

Structural Analysis of Equipment Maintenance Support Task Based on Hall 3D Structure

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Abstract

The scientific analysis of equipment maintenance and support task is important guarantee of high quality and efficient implementation of equipment maintenance and support. The paper discusses the important value of equipment maintenance support task analysis. Then, the paper made a structured, systematic analysis mainly from the time, elements and knowledge dimensions of equipment maintenance support task based on Hall 3D Structure method. The research results provide a more comprehensive and standardized theoretical analysis basis for the calculation, planning and implementation of equipment maintenance and support task.

Keywords

Equipment Maintenance Support; Task Structural Analysis; Hall 3D Structure.

1. INTRODUCTION

At present, with the rapid development of science and technology and the constant change of war patterns, the combat types and styles of troops become more complex, and the maintenance and improvement of their combat capabilities increasingly depend on the performance of equipment maintenance and support. However, the types, quantity, time, space and maintenance requirements of wartime equipment damage change accordingly, and equipment maintenance support faces higher requirements and severe challenges. First, the task of equipment maintenance is larger. In the future, the combat system of the battlefield will be more intense and three-dimensional, and the troops' combat equipment system will be complex, with a large span of time and space and a lot of equipment damage. However, the maintenance and support of equipment will run through the whole process of combat, which has the characteristics of "start first, end later and all accompany", making the task of equipment maintenance in wartime increase sharply. Second, equipment maintenance is more technical. Due to the high technical content of the equipment itself, the reasons for failure and damage are diverse and the integration of multiple technologies of important components makes the equipment damage mode more complicated and repair more difficult under the information condition. Third, the timeliness of equipment maintenance is stronger. In order to occupy the advantageous situation on the battlefield, the troops should not only maintain the effectiveness advantage of equipment damage attack, but also quickly recover the damaged equipment.

The scientific analysis of equipment maintenance and support task is the key premise to solve these problems and the important guarantee of high quality and efficient implementation of equipment maintenance and support. In this paper, Hall 3D Structure method is used to make structural analysis of equipment maintenance support task, which lays a theoretical foundation

for the calculation, planning and implementation of subsequent equipment maintenance support task.

2. OVERVIEW OF HALL 3D STRUCTURE

In 1969, Hall (A.D Hall), an American expert dedicated to systems engineering research, proposed Hall three-dimensional structure methodology, which comprehensively and clearly explained the management process of systems engineering [1-4]. Hall 3D Structure mainly divides system engineering into time dimension, logic dimension and knowledge dimension. Among them, the time dimension corresponds to each stage of the system implementation process at the time level, the logical dimension corresponds to each procedural step of analyzing and solving problems at the logical level, and the knowledge dimension corresponds to the professional knowledge and technology required to complete the work at each time and step.

Hall 3D Structure has the advantages of standardization, programming and integration, and can systematically and normatively solve the problems of analysis, planning, management and organization of complex systems. Its form is relatively simple and intuitive, so it has been highly valued and widely used by scholars all over the world.

3. EQUIPMENT MAINTENANCE SUPPORT TASK ANALYSIS BASED ON HALL 3D STRUCTURE

In wartime, fixed-point support and accompanying support are adopted to complete equipment command, equipment emergency repair, equipment rescue, equipment evacuation, equipment maintenance, maintenance equipment support and information communication support tasks. This paper focuses on equipment emergency repair as an example to carry out research, from the demand side consideration, mainly studies the wartime damaged equipment repair workload, which includes not only the “combat damage” of equipment damaged by the enemy, but also “non-combat damage” on the battlefield leading to the loss or decline of equipment function; Considering from the supply side, the main research is the support force and resources required by the army to complete the maintenance support. Therefore, it is necessary to carry out system analysis of equipment maintenance support task by taking combat task as traction, equipment damage condition as basis and equipment maintenance support demand as target.

Considering that the analysis process of wartime equipment maintenance and support task is relatively complex, hall three-dimensional structure can solve the problems of confusion of thinking and unclear hierarchy in the analysis process. Based on hall three-dimensional structure, this paper makes a comprehensive, systematic and more intuitive analysis of wartime equipment maintenance and support task. Taking offensive combat as an example, this paper mainly discusses from three dimensions of time dimension, element dimension and knowledge dimension. Its Hall 3D Structure model is shown in Figure 1.

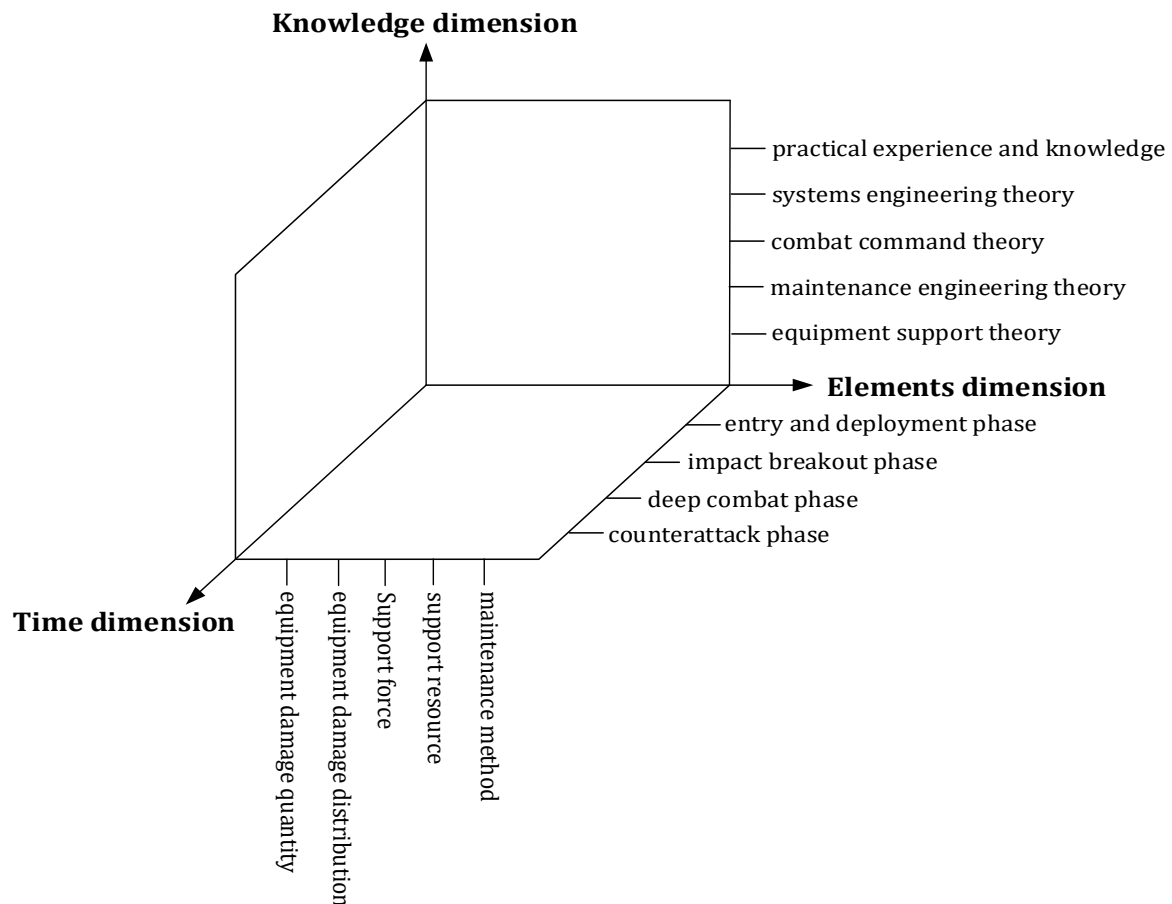


Figure 1. Analysis of wartime equipment maintenance support task based on Hall 3D Structure

3.1. Time Dimension

According to the principle of combat traction, the damage situation of equipment in each stage of combat is quite different, and the corresponding maintenance and support tasks of equipment are also quite different. Therefore, the time dimension is mainly analyzed from four stages: entry and deployment, impact breakout, deep combat and counterattack.

In the entry and deployment phase, troops move from the assembly area to the attack starting position. The main tasks of its equipment maintenance and support are: support forces rescue and repair the equipment hit by the enemy on the way into the country, and send the equipment that is difficult to maintain to the higher support forces.

In the impact breakout phase, the battle process is the most intense, the equipment damage is more concentrated, and the maintenance task is large. The main tasks of equipment maintenance and support are: on-site rescue and repair of war-damaged equipment, summary and report war-damaged information, and send the hard-to-maintain equipment to the superior support force.

In the deep combat phase, the attack team divides and encircles the enemy. The main tasks of its equipment maintenance and support are: to carry out maintenance and support by distinguishing support forces and accompanying main combat units, and to use attack to adjust the gap to quickly rescue and repair equipment.

In counterattack phase, the equipment is seriously damaged. Its equipment maintenance and support mission is mainly: support forces to carry out anti-enemy counter-impact units focus on the implementation of support, timely send repair equipment to the front.

3.2. Elements Dimension

The maintenance and support task of wartime equipment is closely related to the factors such as participation rate, damage rate and degree of equipment, strength and resources needed for repair, combat task and combat environment. The mission of wartime equipment maintenance and support originates from equipment damage and aims to quickly restore equipment performance. Based on the operation process of maintenance support, B Liu et al. [5] divided it into five tasks: mobility, deployment, repair, withdrawal and restoration. When calculating the maintenance support task of equipment, the author can focus on the repair task and describe it simply as: how much support force and support resources are used, how many sets of a certain type of equipment are repaired, how the damage degree is distributed, and what maintenance methods are adopted. Therefore, the elements dimension is mainly analyzed from the equipment damage quantity, equipment damage distribution, support force, support resource, maintenance method. The quantity of equipment damage represents the decline degree of the military equipment combat effectiveness index, which is an important basis for the combat command department to comprehensively plan the battlefield situation and flexibly adjust the combat strategy, and is also the core benchmark for the equipment support department to plan and implement maintenance support. Since the quantity of equipment is known, the damage rate is often used to indicate the damage amount. Equipment damage distribution indicates the proportion of equipment damage degree. The degree of damage corresponds to the degree of functional impact and repair difficulty of equipment, which is often represented by the degree of damage. There are great differences in support force, resources and repair time for equipment with different damage degrees. As the main body of maintenance activities, support force is the most active element in maintenance support system. Support force here mainly refers to support personnel. Reasonable allocation of support force is the basis and key to complete the support task. Support force is generally described by professional posts, technical ranks and the number of personnel. Support resource mainly include equipment, facilities, equipment, etc., which is an important object of maintenance support operations. Among them, equipment refers to the assembly, parts, components, accessories and materials used for maintenance, and is closely related to the number of damaged equipment, fault conditions, etc. Equipment refers to machinery, instruments and electrical appliances used for maintenance, and facilities refer to workshops, warehouses and other places, lifting and power stations and other facilities used for maintenance. Maintenance method is also one of the elements of maintenance support task, refers to the implementation of maintenance methods, including original repair, replacement repair, disassembly repair, etc., in wartime replacement repair is the main.

3.3. Knowledge Dimension

Knowledge dimension refers to the knowledge, experience and professional skills required to complete the above equipment maintenance support task from various stages and elements. The battlefield environment is changeable, the equipment damage is random, the support strategy is flexible, the support demand is uncertain, so the analysis of the equipment maintenance support task is relatively complicated. To be specific, maintenance support task analysis needs certain knowledge reserve, such as equipment support theory, maintenance engineering theory, battle command theory, systems engineering theory, and certain practical experience and knowledge.

4. CONCLUSION

First, the paper discusses the important value of equipment maintenance support task analysis. Then, the paper makes a structured, systematic analysis mainly from the time, elements and knowledge dimensions of equipment maintenance support task based on Hall 3D

Structure method. The research results provide a more comprehensive and standardized theoretical analysis basis for the calculation, planning and implementation of equipment maintenance and support task.

REFERENCES

- [1] M. Zhao, Y.J. Ruan: Building Combat-oriented Training Subjects in Army's Equipment Support Drills on the Base on Hall Three-dimensional Structure, Journal of Military Transportation, Vol. 1 (2022) No.1, p.75-80.
- [2] Y.B. Li, H. Tang: A New Method of Haixinsha Project Management Based on Hall 3D Structure, Construction Economy, (2011) No.6, p.16-17.
- [3] L.H. Xia: Research on Construction of Emergency Logistics Management System Based on Hall Three-Dimensional Structure, Value Engineering, Vol. 41 (2022) No.13, p. 32-34.
- [4] Y. Yang, Y.C. Zhao and Y.C. Ma: The Research of Project Risk Dynamic Management Based on Hall's three-Dimensional Structure, Science and Technology Management Research, Vol. 30 (2010) No.13, p. 281-282.
- [5] B. Liu, D. Mi and X.M. Du. et al: Research on Task-Oriented Modeling of Equipment Maintenance Support Process in Wartime, Fire Control & Command Control, Vol. 36 (2011) No.12, p. 103-106.