Research on Benefit Evaluation of Equipment Integrated Maintenance Support

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Abstract: Practice shows that equipment integrated maintenance support has become an important factor that restricts and affects the overall combat capability of the institutional units. The scientific and reasonable evaluation of equipment integrated maintenance support capability can find out the deficiencies of equipment integrated maintenance support system in time, so as to give targeted opinions and suggestions to effectively improve the maintenance support ability, and provide decision-making basis for reasonable allocation of maintenance support resources and ensuring the successful completion of maintenance support tasks. This paper demonstrates that the necessity for institutional units to adopt the strategy of equipment integrated maintenance support, carries out a systematic analysis on the connotation of equipment integrated maintenance support and its benefits, and constructs an evaluation index system of equipment integrated maintenance support benefits according to the principles of objectivity, completeness, standardization and operability. Then the evaluation method of equipment integrated maintenance support benefit is given.

Keywords: equipment integrated maintenance support; maintenance support benefit; evaluation index system; method of evaluation

1. Introduction

With the rapid development of science and technology, the technical content and complexity of the equipment of institutional units are increasing day by day. It is difficult to complete the support task by relying on the support ability of institutional units. Integrated support is an inevitable requirement for solving the current equipment support problems of institutional units, and it is also a common measure adopted by countries all over the world [1]. Integrated equipment maintenance support can give full play to various resources, improve the equipment maintenance support capability of institutional units, and maximize the overall efficiency.

2. Equipment integrated maintenance support

In order to comprehensively coordinate the demand for resources for social and economic construction and equipment support construction, effectively allocate and utilize social resources, strive to solve the problem of resource waste caused by the independent and decentralized construction of equipment support forces, integrate technologically advanced and highly efficient support forces into the equipment maintenance support system, and avoid repeated construction of equipment support infrastructure. It is necessary to establish an integrated maintenance support system for equipment, so as to reduce the inventory of equipment and materials, shorten the support period, enhance the ability of equipment maintenance support, and improve the efficiency of equipment maintenance support [2]. To implement the integrated maintenance support strategy of equipment, information is the guarantee, equipment supply is the material basis, technology is the means, talent is the fundamental, and management is the guarantee. The five chains blend and complement each other, and the integrated maintenance support system of equipment is the system network interwoven by the above five chains, jointly promoting the continuous improvement of equipment maintenance support ability [3].

Equipment integrated maintenance support refers to a support mode that takes the support force as the main body and coordinates the equipment maintenance support planning, resource allocation and force application in order to improve the equipment maintenance support capability and benefit. In order to meet the needs of equipment maintenance and support, the organized units and local forces may jointly carry out repair and equipment supply activities. Compared with the complete independence and self-support of organized units, it aims to make full use of various resources and technical advantages of local units to effectively solve the weak timeliness of equipment maintenance caused by the self-support mode of equipment maintenance under the new situation. Equipment maintainability, availability and equipment group completion rate is not high, the timeliness of equipment financing and equipment repair, equipment support low economic benefits. In order to improve the comprehensive benefits of equipment integrated maintenance support, it is necessary to explore more scientific and reasonable ways and methods [4]. In order to promote the development of integrated equipment maintenance and support work, it is necessary to include the equipment research and development units,

equipment production units, equipment repair units, third-party logistics enterprises and market suppliers in the local force system.

3. Benefits of equipment integrated maintenance and support

At present, there are many types of equipment, various models, maintenance support and equipment supply demand. In order to implement the integrated development strategy, the convenience of equipment maintenance and equipment supply can be further improved. The particularity of equipment integrated maintenance and support activities requires that the primary purpose of equipment integrated maintenance and support activities be to improve the use efficiency. Therefore, to study the use benefit of integrated equipment maintenance support activities, we should focus on the objective requirements of integrated equipment maintenance support, fully consider the main factors that affect the use benefit of integrated equipment maintenance support, such as timeliness, maintainability and availability of equipment, and conduct in-depth analysis of various factors [5-6]. Only by continuously improving the efficiency of equipment integrated maintenance support activities can we ensure the completion of diversified tasks with high quality.

In equipment integrated maintenance support activities, the economic benefit of equipment maintenance support and the use benefit of equipment maintenance support are dialectically unified. Improving the use benefit of equipment maintenance support is the purpose, and its economic benefit should serve the use benefit, but the use benefit of equipment maintenance support depends on the economic input, which requires the equipment integrated maintenance support activities must be conducive to improving the economic benefit of support. The improvement of the use efficiency of equipment maintenance support depends on its economic benefits. Especially in the case of resource shortage and tight support funds, it is not feasible to ignore the economic benefits of equipment maintenance support and unilaterally pursue the maximization of the use efficiency of equipment maintenance support. Therefore, to study the economic benefits of equipment integrated maintenance support activities, we should focus on the objectives and requirements of equipment integrated maintenance support activities, fully consider the main factors that affect the economic benefits of equipment integrated maintenance support, such as the total cost of equipment group maintenance and repair, the total cost of maintenance equipment support, and conduct in-depth analysis of various factors.

4. Evaluation index system of equipment integrated maintenance support benefit

Construct the evaluation index system of equipment integrated maintenance support benefit, as shown in Table 1. The index layer is divided into two first-level indexes, namely use benefit and economic benefit, and seven second-level indexes.

Table 1. Evaluation index system of equipment integrated maintenance support benefit

Name	Level-1 Indicator	Level-2 Indicator
Efficiency evaluation index system of equipment integrated maintenance support	Useness benefits	Equipment maintenance timeliness U_1
		Timeliness of spare parts supply U_2
		Maintainability of equipment U_3
		Availability of equipment U_4
		Equipment group completion rate U_5
	Economic benefits	Total cost of maintenance and repair of the equipment cluster in one year U_6
		Total maintenance cost of the equipment group in one year U_7

Among them, the stronger the equipment maintenance timeliness, timeliness of spare parts supply, maintainability of equipment, availability of equipment, equipment group completion rate, the higher the use efficiency is; The lower the total cost of maintenance and repair in one year and the total maintenance cost of the equipment group in one year, the higher the economic benefit is. The overall benefit of equipment integrated maintenance support is determined by the use benefit and economic benefit.

5. Evaluation method of equipment Integrated maintenance support benefit

Firstly, the weights of two first-level indicators are determined, namely the weights of use benefit and economic benefit. The method is relatively simple and can be calculated by using analytic hierarchy process (AHP) to obtain the weights of use benefit and economy respectively, which are denoated as λ_1 and λ_2.

Then, the weights of seven secondary indexes, such as equipment maintenance timeliness U_1, timeliness of spare parts supply U_2, maintainability of equipment U_3, availability of equipment U_4, equipment group completion rate U_5, total cost of maintenance and repair of the equipment cluster in one year U_6, and total maintenance cost of the equipment group in one year U_7, are determined.

The weight of the secondary index is calculated by using the analytic hierarchy process, denoted as

$$A=\{\alpha_1,\alpha_2,\alpha_3,\alpha_4,\alpha_5,\alpha_6,\alpha_7\}$$

The entropy weight method was used to calculate the weight of the secondary index, denoted as

$$B=\{\beta_1,\beta_2,\beta_3,\beta_4,\beta_5,\beta_6,\beta_7\}$$

Give full play to the advantages of analytic hierarchy process (AHP) and entropy weight method [7], further normalize the weights α_i obtained by analytic hierarchy process (AHP) and the weights β_i obtained by entropy weight method to obtain the combined weights of the evaluation indexes of integrated maintenance support for equipment [8-10]:

$$\omega_i = \frac{\alpha_i \beta_i}{\sum_{i=1}^{7} \alpha_i \beta_i}$$

The following is a score for various indicators that affect the use benefit and economic benefit of equipment integrated maintenance support. Seven indicators that affect economic benefit can be scored together, and the scoring values of various indicators can range from 0 to 10.

The scoring format of equipment integrated maintenance support benefit is shown in Table 2.

Table 2. Efficiency score of equipment integrated maintenance support

Name	U_1	U_2	U_3	U_4	U_5	U_6	U_7
Expert 1	s_{11}	s_{12}	s_{13}	s_{14}	s_{15}	s_{16}	s_{17}
Expert 2	s_{21}	s_{22}	s_{23}	s_{24}	s_{25}	s_{26}	s_{27}
Expert 3	s_{31}	s_{32}	s_{33}	s_{34}	s_{35}	s_{36}	s_{37}
Expert 4	s_{41}	s_{42}	s_{43}	s_{44}	s_{45}	s_{46}	s_{47}
Expert 5	s_{51}	s_{52}	s_{53}	s_{54}	s_{55}	s_{56}	s_{57}
Expert 6	s_{61}	s_{62}	s_{63}	s_{64}	s_{65}	s_{66}	s_{67}
Expert 7	s_{71}	s_{72}	s_{73}	s_{74}	s_{75}	s_{76}	s_{77}
Expert 8	s_{81}	s_{82}	s_{83}	s_{84}	s_{85}	s_{86}	s_{87}
Expert 9	s_{91}	s_{92}	s_{93}	s_{94}	s_{95}	s_{96}	s_{97}
Expert 10	s_{101}	s_{102}	s_{103}	s_{104}	s_{105}	s_{106}	s_{107}

Based on specific cases, when evaluating the support benefit of equipment integrated maintenance, the specific value of the support benefit score should be determined according to the format given in Table 2, and the benefit evaluation conclusion of the support scheme should be given. Its calculation formula is as follows:

$$\begin{aligned} P = {} & 0.01\left(\lambda_1\omega_1 \sum_{i=1}^{10} s_{i1} + \lambda_1\omega_2 \sum_{i=1}^{10} s_{i2} + \lambda_1\omega_3 \sum_{i=1}^{10} s_{i3} \right) \\ & + 0.01\left(\lambda_1\omega_4 \sum_{i=1}^{10} s_{i4} + \lambda_1\omega_5 \sum_{i=1}^{10} s_{i5} \right) \\ & + 0.01\left(\lambda_2\omega_6 \sum_{i=1}^{10} s_{i6} + \lambda_2\omega_7 \sum_{i=1}^{10} s_{i7} \right) \\ = {} & 0.01\lambda_1 \sum_{j=1}^{5} \sum_{i=1}^{10} \omega_j s_{ij} + 0.01\lambda_2 \sum_{j=6}^{7} \sum_{i=1}^{10} \omega_j s_{ij} \end{aligned}$$

6. Conclusion

By analyzing the characteristics of equipment integrated maintenance support, the utility and economic benefits of first-level equipment integrated maintenance support are further constructed, and the evaluation index system of equipment integrated maintenance support is further established. Including Then, the weights of seven secondary indexes, such as equipment maintenance timeliness, timeliness of spare parts supply, maintainability of equipment, availability of equipment, equipment group completion rate, total cost of maintenance and repair of the equipment cluster in one year, and total maintenance cost of the equipment group in one year, the evaluation model of equipment integrated maintenance support benefit was established, which provided a scientific method for the evaluation of equipment integrated maintenance support benefit.

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