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Analysis of Capability Requirements for Equipment Maintenance Support Police Troops Based on GQFD

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Abstract: In order to accurately analyze the key capability requirements of the equipment maintenance and support police team, and facilitate targeted improvement of the maintenance and support capabilities of the police team. This article provides an explanatory description of the task and capability requirements of the equipment maintenance and support police force through the GQFD method, and constructs a mapping matrix between them. Through relevant calculations, the importance of the capability indicators of the equipment maintenance and support police force was ranked, and key capability indicators were obtained. Then, verification and analysis were conducted based on the actual situation of grassroots troops, providing some basic data support for studying the competency model of the equipment maintenance and support police force.

Keywords: GQFD, Equipment Maintenance Support Police, Capability Requirements.

1. Introduction

With the adjustment and reform of the organizational system, the mission and tasks undertaken by the military have been further expanded, and the variety and quantity of equipment allocated have become increasingly diverse. At the same time, the various types of equipment distributed by the military in previous years have gradually become outdated, and the frequency of malfunctions has also increased, which puts higher requirements on the ability of equipment maintenance and support teams. The equipment maintenance and support team mainly consists of a police officer team, a police sergeant team, and a civilian personnel team. Among them, the number of police officers in the equipment maintenance and support team accounts for the largest proportion, and they are the main personnel responsible for equipment maintenance and support tasks. The level of their abilities and the performance of their roles directly affect the maintenance of equipment performance and the generation of combat effectiveness of the troops. A detailed analysis of their ability requirements is a prerequisite for improving the overall quality of the equipment maintenance and support police force, and has significant research significance and value.

There is a lot of research on the equipment maintenance support system and equipment maintenance support effectiveness evaluation in China, but there is still relatively little research on the talent team of equipment maintenance support. References [1-2] used the GQFD analysis method to analyze the capability requirements of the synthetic brigade equipment maintenance support team and intelligent equipment support respectively; Reference [3] analyzed and studied the selection of maintenance support modes for complex equipment and the optimization of human resource allocation using simulation methods; Reference [4] uses the Grey Analytic Hierarchy Process to analyze and evaluate the indicator system of equipment maintenance support capability. Overall, their research subjects are relatively broad, and their research content is relatively macro. There are relatively few studies specifically targeting the ability of equipment maintenance and support police officers under the new system.

This article provides an explanatory description of the task requirements and capability requirements of the equipment maintenance and support police team. The grey correlation method is used to establish a mapping matrix between them, and the importance ranking of capability requirement indicators is calculated. This provides some reference value in data for improving the overall quality of the equipment maintenance and support police team in the next step.

2. Relevant Indicators for Determining the Task Requirements of The Equipment Maintenance Support Police Force

The task requirements of the equipment maintenance and support police team basically correspond to the actual needs of the military for equipment maintenance and support activities. According to the management methods for equipment construction classification, the equipment system based on functions can be divided into 12 categories: command and control communication, reconnaissance intelligence, general fire strike, engineering rescue, chemical prevention and rescue, aviation, comprehensive support, confidential information, general vehicles, non lethal disposal, counter-terrorism and stability maintenance, and sea (water) vessels. Therefore, the task requirements of the equipment maintenance and support police team can be specifically expressed as the maintenance and support task requirements for the 12 major categories of equipment mentioned above, respectively numbered as E1, E2, E3, E4, E5, E6, E7, E8, E9, E10, E11, E12, as shown in Table 1.

Table 1. Task Requirements for Equipment Maintenance Support Police Troops

Number	Task requirements
E_1	Accusation communication equipment
E_2	Investigation intelligence equipment
E_3	Universal fire strike equipment
E_4	Engineering emergency equipment
E_5	Chemical prevention and rescue equipment
E_6	Aviation equipment
E_7	Comprehensive support equipment
E_8	Confidential equipment
E_9	General vehicle equipment
E_{10}	Non lethal disposal equipment
E_{11}	Anti terrorism and stability maintenance equipment
E_{12}	Marine (Water) ship equipment

3. Relevant Indicators for Determining the Capability Requirements of The Equipment Maintenance Support Police Force

At present, our army mainly implements a two-level maintenance system for various types of equipment at the unit and base levels. The equipment maintenance support police team mainly corresponds to the unit level maintenance. Therefore, their main tasks are to maintain, inspect, and repair various types of equipment. Based on the main tasks they undertake, the maintenance and support tasks of the 12 major categories of equipment are further divided into specific task requirements, and the mapping relationship of capability requirements such as "many to one", "one to one", and "one to many" will be displayed, as shown in Table 2.

Table 2. Mapping of Equipment Maintenance Capability Requirements

Capability requirements	Mission
Regular maintenance support Maintenance Information identification	Equipment integrity inspection Daily maintenance and upkeep of equipment Equipment general troubleshooting Equipment replacement and repair Equipment parts repair
Maintenance support for suixing tasks Command and management Rescue and repair	Equipment suixing task rescue Equipment suixing task emergency repair Equipment for mission evacuation
Teaching, training, maintenance and support Teaching and training Service support	Equipment maintenance operations Selection of equipment maintenance support personnel Training for equipment maintenance and support personnel Assessment of equipment maintenance and support personnel Equipment maintenance materials and equipment support

By reading literature, conducting telephone interviews, and conducting on-site research, we have summarized and analyzed the mapping of equipment maintenance and support capability requirements in Table 2. The capability requirements of the maintenance and support police force can be summarized into four aspects: ① receiving tasks. The main task is to inspect and master the basic performance and faults of the equipment it belongs to, and promptly request reports to accurately receive maintenance tasks; ② Coordination and docking. On the basis of standardized management of equipment, actively coordinate and coordinate work with professional police officers and relevant maintenance and support personnel to ensure the smooth completion of maintenance and support tasks; ③ Repair and maintenance. The central task of the equipment maintenance and support police team of the Inner Guard Corps is to carry out daily maintenance and upkeep of the equipment, check the integrity of the equipment, and eliminate general faults Lessons learned guarantee. Mainly responsible for daily training of equipment and related teaching activities, providing material and equipment support to ensure that teaching and training can be carried out normally. The four maintenance support capability requirements summarized above can be classified as F1, F2, F3, and F4, as shown in Table 3.

Table 3. Capability Requirements for Equipment Maintenance Support Police Troops

Number	F_1	F_2	F_3	F_4
Capability requirements	Accept tasks	Coordination and docking	Maintenance	Lessons Learned Guarantee

4. Analysis of Support Capability Requirements for Equipment Maintenance Support Police Troop

According to the requirements of equipment support capability indicators, 15 experts with rich experience and specialized knowledge reserves in equipment maintenance and support work in the army were selected from the equipment cadres of the headquarters and branches, as well as the main officers of the battalion and squadron, as well as some middle and senior police officers engaged in equipment maintenance and support. Through on-site visits, telephone interviews, and questionnaire surveys, The indicators for the capability requirements and task requirements of the equipment support police force are scored, calculated, and analyzed using the 9-level scale method. 12 task requirement indicators have been identified $E_i = (e_i(1), e_i(2), \text{B}\ e_i(12))$, $(i = 1,2,3,\text{B}\ ,12)$, 4 capability requirement indicators $F_j = (f_j(1), f_j(2), f_j(3), f_j(4),), (j = 1,2,3,4)$, that is to say $n = 15$, $e = 12$, $f = 4$, Rate their importance separately (see Table 4).

Table 4. Expert scoring of task requirements and capability requirements for equipment maintenance and support police teams

Requirement type	Expert scoring														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
E_1	9	6	8	7	6	8	6	5	7	8	6	8	5	8	7
E_2	5	8	7	7	6	8	4	7	4	8	7	9	7	7	6
E_3	8	7	7	8	8	7	6	9	6	4	8	8	9	6	6
E_4	7	8	6	9	7	7	5	6	9	6	7	5	8	3	5
E_5	4	6	8	5	6	6	7	4	8	3	8	6	6	7	9
E_6	5	6	3	7	9	6	5	6	7	8	6	7	7	8	6
E_7	7	7	8	6	8	5	6	7	5	9	7	5	6	8	8
E_8	9	7	6	8	6	8	9	5	7	3	9	7	6	8	7
E_9	9	8	6	9	6	9	8	7	7	9	6	8	6	7	9
E_{10}	8	9	6	8	7	8	6	8	7	5	9	7	6	8	9
E_{11}	9	7	8	9	9	8	8	7	9	5	7	8	8	9	7
E_{12}	5	6	4	4	5	7	6	6	5	7	7	6	5	7	5
F_1	7	6	8	4	7	9	6	3	6	6	6	8	3	7	6
F_2	3	5	9	7	8	8	7	6	4	6	8	5	6	9	7
F_3	9	8	8	7	9	7	7	8	9	6	9	9	8	7	7
F_4	4	6	5	6	3	7	5	6	6	7	4	6	5	6	6

According to the scoring situation in Table 4, based on the relevant formulas of the GQFD method and calculated using Matlab software, the grey comprehensive correlation matrix for the task requirements and capability requirements of the equipment maintenance police support team can be obtained, and the sum of the grey comprehensive correlation matrix is as follows:

$$\psi = \begin{pmatrix} 0.7556 & 0.5075 & 0.7838 & 0.5162 \\ 0.5207 & 0.6985 & 0.5205 & 0.9498 \\ 0.9591 & 0.5085 & 0.9089 & 0.5210 \\ 0.7734 & 0.5090 & 0.7474 & 0.5235 \\ 0.5155 & 0.7665 & 0.5153 & 0.8503 \\ 0.5233 & 0.6676 & 0.5230 & 0.9442 \\ 0.6863 & 0.5092 & 0.6704 & 0.5250 \\ 0.7637 & 0.5076 & 0.7928 & 0.5164 \\ 0.8528 & 0.5080 & 0.8928 & 0.5184 \\ 0.8769 & 0.5087 & 0.8367 & 0.5220 \\ 0.9461 & 0.5083 & 1.0000 & 0.5199 \\ 0.5346 & 0.5867 & 0.5339 & 0.7308 \end{pmatrix}$$

$$\sum_{j=1}^{4} \rho_{ij} = \begin{pmatrix} 2.5631 \\ 2.6895 \\ 2.8976 \\ 2.5533 \\ 2.6476 \\ 2.6581 \\ 2.3908 \\ 2.5805 \\ 2.7721 \\ 2.7444 \\ 2.9744 \\ 2.3860 \end{pmatrix}$$

It can be seen that $\sum_{j=1}^{4}\rho_{11i} > \sum_{j=1}^{4}\rho_{3i} > \sum_{j=1}^{4}\rho_{9i} > \sum_{j=1}^{4}\rho_{10i} > \sum_{j=1}^{4}\rho_{2i} > \sum_{j=1}^{4}\rho_{6i} > \sum_{j=1}^{4}\rho_{5i} > \sum_{j=1}^{4}\rho_{8i} > \sum_{j=1}^{4}\rho_{1i} > \sum_{j=1}^{4}\rho_{4i} > \sum_{j=1}^{4}\rho_{7i} > \sum_{j=1}^{4}\rho_{12i}$.

Thus, it can be concluded that $E_{11} > E_3 > E_9 > E_{10} > E_2 > E_6 > E_5 > E_8 > E_1 > E_4 > E_7 > E_{12}$.

According to the formula $\lambda_{il} = n - l + \mu$, $(0 \le \mu \le 1)$, Generally, $\mu = 0.5$, The absolute weight λ_i of E_i is obtained as: $(\lambda_1, \lambda_2, \lambda_3, \lambda_4, \lambda_5, \lambda_6, \lambda_7, \lambda_8, \lambda_9, \lambda_{10}, \lambda_{11}, \lambda_{12})$ =(3.5，7.5，10.5，2.5，5.5，6.5,1.5,4.5,9.5,8.5,11.5,0.5),Fill the absolute weight E_i of grey comprehensive incidence

matrix Ψ and into the House of Quality,By using the traditional QFD method for calculation, the importance of the support capability requirement indicator F_j for the equipment maintenance and support police officers of the Inner Guard Corps can be obtained, as shown in Table 5.

Table 5. Equipment Maintenance Support Police Force "Task Requirements Capability Requirements" Quality House

		Capability requirements				
Task requirements	Importance	F_1	F_2	F_3	F_4	
E_1	3.5	0.7556	0.5075	0.7837	0.5162	
E_2	7.5	0.5207	0.6985	0.5205	0.9498	
E_3	10.5	0.9591	0.5085	0.9089	0.5210	
E_4	2.5	0.7734	0.5090	0.7474	0.5235	
E_5	5.5	0.5155	0.7665	0.5153	0.8503	
E_6	6.5	0.5233	0.6676	0.5230	0.9442	
E_7	1.5	0.6863	0.5092	0.6704	0.5250	
E_8	4.5	0.7637	0.5076	0.7928	0.5164	
E_9	9.5	0.8528	0.5080	0.8928	0.5184	
E_{10}	8.5	0.8769	0.5087	0.8367	0.5220	
E_{11}	11.5	0.9461	0.5083	1.0000	0.5199	
E_{12}	0.5	0.5346	0.5867	0.5339	0.7308	
		55.9603	40.5209	56.2266	45.3411	Importance of capability requirements
		28.26%	20.46%	28.39%	22.89%	percentage
		2	4	1	3	sort

Comparing the data obtained from the House of Quality, it can be concluded that $F_3 > F_1 > F_4 > F_2$,In the capacity requirements of the equipment maintenance and support police force, the maintenance and repair ability of the equipment is the most critical indicator, followed by the ability to receive tasks, coordination and docking ability, and the demand for lesson support ability is the weakest. This provides some useful reference value for the ability cultivation of the equipment maintenance support police team and their later growth path planning, and provides basic data for the analysis of the ability model of the equipment maintenance support police team.

Based on the four key capability indicators of the equipment maintenance and support police team calculated above, the four branches A, B, C, and D under a certain headquarters are quantitatively scored according to the "percentage system" assessment rules for the ability of the equipment maintenance and support police team to receive tasks, coordinate and connect, maintain equipment, and provide lesson support during the mission and normal equipment maintenance and support periods, The specific scoring situation is shown in Table 6.

Table 6. Equipment Maintenance Support Capability Scoring of the Equipment Maintenance Support Police Force

Examined unit	Evaluation indicators			
	Accept tasks	Docking coordination	Equipment maintenance and repair	Lessons Learned Guarantee
Detachment A	80	77	83	75
Detachment B	86	84	87	82
Detachment C	88	86	90	84
Detachment D	82	78	84	76

From the evaluation score, the evaluation score values of the equipment maintenance and support capabilities of the equipment maintenance and support police teams of the A, B, C, and D detachments all showed equipment maintenance and support capabilities>task acceptance capabilities>coordination and docking capabilities>lesson support capabilities. This is consistent with the weight of the capability requirement indicators for the equipment maintenance and support police force calculated in the previous text, indicating that the results calculated by the GQFD method in this article are true and reliable. It is worth noting that there is one First Class Sergeant and one Third Class Sergeant in the equipment maintenance and support police officers of Brigade B and C, respectively. Both of them have work experience in detachment agencies and have served for a relatively long time, with rich work experience. However, the equipment maintenance and support police officers of Brigades A and D do not have officers at or above the first rank sergeant level. Therefore, overall, the scores of various indicators for the equipment maintenance and support police officers of Brigades B and C are higher than those of Brigades A and D.

5. Summary

This article first constructs a relationship matrix between the task requirements and equipment maintenance and support capability requirements of the Equipment Maintenance and Support Police Force of the Internal Defense Corps. Then, the GQFD method is used to further

establish the grey correlation matrix between them. Traditional calculations are conducted using the House of Quality based on grey correlation, and each capability requirement is ranked in importance. Finally, analysis and verification are conducted based on the actual situation of the military, This has laid the foundation for building a capability model of equipment maintenance police officers in the Inner Guard Corps, and provides certain reference value for studying the construction, cultivation, and growth path planning of the equipment maintenance support police officers in the Inner Guard Corps.

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