Research on Risk Management Strategy of Direct Supply Support for Maintenance Material Manufacturers

Zhonghua Cheng*, Yangyang Zhang*, Quanyue Ma* and Xuyang Yin*
Army Engineering University, Shijiazhuang, China

*Corresponding author e-mail: 2108007979@qq.com, *ke24668@163.com,
*284380229@qq.com, *376564788@qq.com

Abstract. Direct supply support for maintenance material manufacturers is a new mode of support, which also faces many risks and problems. Aiming at the problem of how to effectively manage and control risks, considering the main risk factors in the support process comprehensively, on the basis of getting the weight of risk factors by using the analytic hierarchy process, the ABC classification method is used to classify and grade the risk factors, and then effective risk countermeasures and reasonable management and control suggestions are put forward respectively to ensure that the direct supply of maintenance material manufacturers can achieve the desired effect.

1. Introduction
Equipment maintenance material is the premise and foundation for the implementation of equipment maintenance support in the army. It is the supply line for the maintenance and guarantee of important machinery and equipment, and the lifeline for the production and operation of major machinery and equipment. With the development and application of high-tech, the original maintenance material support model cannot meet the new task requirements. Based on the above reasons, Ma Quanyue et al. [1] established a decision-making model of direct supply support for maintenance material manufacturers in view of the direct supply support mode of maintenance material manufacturers, which provided a scientific theoretical basis for the optimization of direct supply manufacturers.

At present, the direct supply support mode of maintenance material manufacturers is still in the preliminary stage of exploration, and the related research is relatively few, and there is little risk management for the operation of this mode. And some scholars have certain reference significance for risk-related research of other systems. Fang Jian et al. [2] and others have studied the safeguard risk of equipment, Xu Tao et al. [3] and Wu Yanbin et al. [4] have studied the risk of ship maintenance, Zhao Jianzhong et al. [5] and Wu Yongle et al. [6] have assessed the related risk of equipment System, Wang Kai et al. [7] have assessed the risk of power system. However, these studies lack risk control strategies. In view of this, on the basis of using analytic hierarchy process to get the main risk factors and their index weights [5-7], this paper uses ABC classification method to sort the above risk indicators according to certain rules, so as to classify and grade these risk factors, and then puts forward corresponding strategies and risk control suggestions, in order to provide reference for strengthening the theoretical research and practice of operational risk management of direct supply support system.
2. ABC Classification

ABC classification, also known as Pareto analysis or primary and secondary factor analysis, is a commonly used method of project management. Its main idea is to classify and sort things according to their main characteristics in some specific aspects, to distinguish the main factors, secondary factors and general factors, so as to make the management mode differentiate. Because it usually divides the objects into three categories: A, B and C, it is called ABC classification [8].

ABC classification has a prescribed range of grades. The usual range of values and the values in this paper are shown in Table 1. Category A is the main influencing factor, Category B is the secondary influencing factor, and Category C is the general influencing factor. According to this method, we can realize differentiated management and make the management countermeasures more pertinent.

| Risk Level | Common range of values | The range of values in this paper |
|------------|------------------------|----------------------------------|
| A          | [0, 70~80%]            | [0, 70%]                         |
| B          | [70%, 80~90%]          | [70%, 90%]                       |
| C          | [80~90%, 90~100%]      | [90%, 100%]                      |

3. Risk Classification of Direct Supply Support

In order to take pertinent measures to effectively avoid and control risks, ABC classification method is used to rank the risk factors of direct supply support and determine the risk classification.

Using the analytic hierarchy process, we first get the main risk factors, determine the weight of the indicators, and get the weight proportion, which is summarized in the following table.

| First-level indicators | Code name | Secondary indicators | Code name |
|------------------------|-----------|----------------------|-----------|
| Initial preparation risk | $B_1$ | Demand forecasting risk | $C_1$ |
|                        |         | Recording statistical risks | $C_2$ |
|                        |         | Information exchange risk | $C_3$ |
|                        |         | Leadership decision risk | $C_4$ |
| Medium-term support risk | $B_2$ | Contract signing risk | $C_5$ |
|                        |         | Production supply risk | $C_6$ |
|                        |         | Handover acceptance risk | $C_7$ |
|                        |         | Export transportation risk | $C_8$ |
| Post-management risk   | $B_3$ | Valuation accounting risk | $C_9$ |
|                        |         | Allocation delay risk | $C_{10}$ |
|                        |         | Storage risk | $C_{11}$ |
|                        |         | Inspection and assessment risks | $C_{12}$ |
Table 3. Weights and Weight Ratio of Risk Indicators

| First-level indicators | Weight | Weight Ratio | Secondary indicators | Weight | Weight Ratio |
|------------------------|--------|--------------|----------------------|--------|--------------|
| $B_1$                  | 0.47   | 47%          | $C_1$                | 0.37   | 37%          |
|                        |        |              | $C_2$                | 0.18   | 18%          |
|                        |        |              | $C_3$                | 0.28   | 28%          |
|                        |        |              | $C_4$                | 0.17   | 17%          |
| $B_2$                  | 0.35   | 35%          | $C_5$                | 0.24   | 24%          |
|                        |        |              | $C_6$                | 0.49   | 49%          |
|                        |        |              | $C_7$                | 0.16   | 16%          |
|                        |        |              | $C_8$                | 0.11   | 11%          |
| $B_3$                  | 0.18   | 18%          | $C_9$                | 0.07   | 7%           |
|                        |        |              | $C_{10}$             | 0.28   | 28%          |
|                        |        |              | $C_{11}$             | 0.11   | 11%          |
|                        |        |              | $C_{12}$             | 0.54   | 54%          |

In the table above, the weight proportion of secondary indicators is only relative to the weight proportion of primary indicators, not the proportion in the total risk of direct supply support. Therefore, when the second-level indicators are sorted according to the risk proportion, the proportion of the first-level indicators to the total risk should also be considered. Through calculation, we can get the direct weight proportion of the secondary indicators in the direct supply support risk of the manufacturer, as shown in the table below.

Table 4. Weight Ratio of Secondary Index of Direct Supply Support Risk for Manufacturers

| Secondary indicators | Weight Ratio | Secondary indicators | Weight Ratio |
|----------------------|--------------|----------------------|--------------|
| $C_1$                | 17.4%        | $C_7$                | 5.7%         |
| $C_2$                | 8.5%         | $C_8$                | 3.8%         |
| $C_3$                | 13.1%        | $C_9$                | 1.2%         |
| $C_4$                | 8.0%         | $C_{10}$             | 4.9%         |
| $C_5$                | 8.7%         | $C_{11}$             | 1.9%         |
| $C_6$                | 17.1%        | $C_{12}$             | 9.7%         |

In order to show the main risk factors more clearly, it is more advantageous to use ABC classification method to classify by introducing cumulative weight proportion according to the proportion of cumulative sum in order to total risk.

Let: $a_i$ —— the weight ratio of the secondary index after ranking;

$A_i$ —— the cumulative weight ratio of number $i$;

The steps for calculating the cumulative weight ratio are as follows:

1. Secondary indicators are sorted from large to small according to the proportion of weights;
2. Order $A_i = a_i;$
(3) \( A_i = A_{i-1} + a_i \), in this paper, \( i = 2, 3, \ldots, 12 \);

(4) Finally \( A_{12} = 100\% \).

According to the above steps, the cumulative weight ratio is calculated, and the risk level is determined according to the scope of classification as follows.

| Serial number | Secondary indicators | Weight Ratio | Cumulative weight ratio | Risk Level |
|----------------|----------------------|--------------|------------------------|------------|
| 1              | \( C_1 \)            | 17.4\%       | 17.4\%                 | A          |
| 2              | \( C_6 \)            | 17.1\%       | 34.5\%                 | A          |
| 3              | \( C_3 \)            | 13.1\%       | 47.6\%                 | A          |
| 4              | \( C_{12} \)         | 9.7\%        | 57.3\%                 | A          |
| 5              | \( C_5 \)            | 8.7\%        | 66.0\%                 | A          |
| 6              | \( C_2 \)            | 8.5\%        | 74.5\%                 | B          |
| 7              | \( C_4 \)            | 8.0\%        | 82.5\%                 | B          |
| 8              | \( C_7 \)            | 5.7\%        | 88.2\%                 | B          |
| 9              | \( C_{10} \)         | 4.9\%        | 93.1\%                 | C          |
| 10             | \( C_8 \)            | 3.8\%        | 96.9\%                 | C          |
| 11             | \( C_{11} \)         | 1.9\%        | 98.8\%                 | C          |
| 12             | \( C_9 \)            | 1.2\%        | 100\%                  | C          |

4. Risk Response Strategies for Direct Supply support of Manufacturers

4.1. Category A Risk Countermeasure
The type A risk faced by the direct supply support mode belongs to the risk of relatively large occurrence probability. Once the loss is relatively large, the consequences are relatively serious, and the impact on military and economic benefits is relatively large, it should be highly valued and taken seriously.

In-depth investigation and study of the actual amount of equipment required; use scientific evaluation methods to select the most reliable manufacturers; improve the efficiency and accuracy of information exchange; constantly improve the inspection and evaluation methods; clarify the rights and obligations in the contract.

4.2. Category B Risk Countermeasure
The type B risk faced by the factory direct supply support mode belongs to the risk of relatively general occurrence probability. The loss after occurrence is not very big and the consequence is not very serious. It has a relatively general impact on military and economic benefits, and should be paid attention to and controlled.

Record statistics to ensure that the name, code and substance are consistent; widely absorb opinions and suggestions before making decisions; check and accept in the handover process.

4.3. Category C Risk Countermeasure
The type C risk faced by the direct supply support mode of the manufacturer belongs to the risk with relatively small occurrence probability, and has little or almost no impact on the support effect.
Establish allocation management system; adopt reasonable packaging to reduce damage; classify and store products in different zones; strengthen the construction of financial audit from the management level.

5. Conclusion
This paper uses ABC classification method to establish a risk classification model of direct supply support for manufacturers. According to the weight proportion of risk factors, the main risk factors are classified and graded, and the corresponding and effective countermeasures are put forward for the risk factors belonging to all levels, which has certain reference value for the implementation of direct supply support model for maintenance material manufacturers.

Acknowledgments
This work was financially supported by National Natural Science Foundation (71871219) fund.

References
[1] Q.Y.Ma, Z.H.Cheng, Y.B.Wang, et al. Decision-making model of direct supply support for maintenance equipment manufacturers. J. Journal of Weaponry and Equipment Engineering, 2018,39(8): 138-142.
[2] J.Fang, J.Li, T.L.Song. Research on Risk Identification and Analysis Technology of Equipment Support. J. Fire Control and Command Control, 2008,33(2): 39-41.
[3] T.Xu, J.Gong. Research on Risk Assessment Model of Ship Maintenance Based on Fuzzy Cognitive Map. J. Ship Electronic Engineering, 2015,35(2): 129-132.
[4] Y.B.Wu, Y.Yao and J.Hu. Case-Based Risk Assessment of Ship Equipment Maintenance. J. Journal of Naval University of Engineering, 2016,28(4):59-61.
[5] J.Z.Zhao, L.Zhang and B.G.Li. Study on Fuzzy Comprehensive Evaluation Method for Supply Effect of Weapon Equipment Maintenance Equipment. J. Equipment Environmental Engineering, 2015,2(1):45-50.
[6] Y.G.Wu, T.L.Liu, S.Q.Li, etc. Risk Assessment of Weapon and Equipment System Application Based on Fuzzy Comprehensive Evaluation. J. Fire Control and Command Control, 2018,43(10):74-78.
[7] K.Wang, W.Q.Li and Y.X.Bai. Power system security assessment based on fuzzy comprehensive evaluation method. J. Digital Technology & Application, 2019,37(1):65-67.
[8] G. Li, Z.X.Wang and W.Chai. Research on Inventory Control of Vehicle Maintenance Equipment Based on Fuzzy Judgment-ABC Analysis Method. J. Chinese Market, 2013, 26: 127-128
[9] N. Karimi, H. Davoudpour. A branch and bound method for solving multi-factory supply chain scheduling with batch delivery. J. Expert Systems with Applications, 2015, 42(1):238-245