Risk Analysis of Military Logistics Outsourcing Under The Background of Informatization And Big Data of Logistics

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Abstract: With the rapid development of domestic logistics enterprises and networks, military logistics outsourcing has gradually become an important means of China's military material transportation, delivery and comprehensive support, however its risks are everywhere, especially the Third-Party Logistics (TPL) managed by novel information technologies and mobile management systems is prone to potential risks of loss and disclosure in military information collection, transmission, tracking, mining and analysis. The paper systematically combs and analyzes the risk of military logistics outsourcing under the background of informatization and Big Data of logistics by using the methods of literature investigation, field investigation and expert consultation, and analyzes the connotation of each risk factor in detail; Based on this, each risk factor is quantitatively analyzed and measured by the Applet of analytic hierarchy process (AHP) and expert scoring. The research show that: in terms of primary indicators, the biggest risk factor is the risk from TPL enterprises, followed by the risk of process management of logistics transportation; In terms of secondary indicators, the biggest risk is the asset specificity risk from TPL, the second is the legal environment risk, and the third is military information leakage via Internet, which provides a certain guidance for the risk management of military logistics outsourcing.

Keywords: Military logistics outsourcing; Risk analysis; Logistics informatization; Big Data of logistics; Quantitative measurement

1   Introduction

In recent years, the rapid development of domestic logistics industry and the in-depth promotion of the military-civilian integration strategy have promoted the rapid rise of China's military logistics outsourcing mode [9] [12]. Due to the complexity and variability of the market environment, the profitability of outsourcing enterprises, the uncertainty of the natural environment, changes in military policies and other factors, military logistics outsourcing not only brings great benefits to both military and local sides, but also hides a lot of risks [10], such as the loss, damage, theft of materials and equipment, and even the exposure of camp location, troop establishment, personnel information, etc. in the processes of outsourcing services [6]. There is a great possibility of loss and disclosure. These risks may come from the internal and

external environment of the army, or from the transportation links of TPL enterprises, or in the weak supervision of them [11]; Especially the modern logistics management informatization supported by the new generation of information technologies (Big Data, Cloud computing, Internet of things, Artificial intelligence, etc.) poses a challenge to the security and confidentiality of military materials. It is inevitable to come into contact with sensitive information such as military location, staffing, material category and delivery location; When the TPL enterprises collect, analyze, store and mine logistics data information, once there is a problem in one link, it will inevitably lead to the disclosure of military information and cause immeasurable harm. Addition, in the context of the normalization of the current epidemic, the transport capacity, timeliness and other service quality of TPL enterprises have decreased significantly. Therefore, it is of great significance to identify and measure the potential risks of military logistics outsourcing in the new era.

Foreign countries have studied military logistics outsourcing earlier, especially the western countries led by the US military have formed a complete sets of military logistics outsourcing theories based on modern science and technologies [3], and have good practical experience, which is worthy of our army to learn from. The researches on the risk of military logistics outsourcing in our army started relatively late, and there is a big gap compared with foreign countries in terms of achievements and time [4], which still needs to be broken through and innovated. Many studies are biased towards qualitative research. A few scholars have summarized the quantitative evaluation methods of military logistics outsourcing risk, such as the fuzzy comprehensive evaluation method [1], analytic hierarchy process (AHP) [7], structural entropy weight method [8], etc; However, from the perspective of risk influencing factors, on the one hand, the analysis is not comprehensive and reasonable, such as outsourcing subject risk, outsourcing object risk, outsourcing environment risk, etc. [2] but does not include others; on the other hand, the existing research is not detailed enough, and there are few specific, practical and quantitative studies. The paper systematically combs and identifies the risk factors of military logistics outsourcing, and then analyzes the risk influencing factors in detail from the perspective of micro dimension, practicability and operability. Based on this, the influence of risk factors is quantitatively analyzed and measured by the AHP and expert scoring method. The results have certain reference value and guiding significance.

2   Basic knowledge

2.1 Concept

Military logistics outsourcing refers to the behavior that the army, in order to fully ensure military training and military modernization, concentrates resources and forces to improve the combat effectiveness of the army, separates non core logistics businesses that consume more resources in the field of military logistics, such as transportation, delivery and support, and is not very good at themselves, and contracts them to a local TPL enterprise in the form of contract [3]. Outsourcing can effectively reduce the logistics and transportation cost of the army, improve transportation efficiency and military economic benefits, free up human, material and financial resources, focus on military training and preparation, and improve the combat effectiveness and management benefits of the army [5].

2.2 Significance of Research

The significance of the study is as follows: (1) It can find the hidden dangers in time, so as to formulate measures to effectively avoid risks and reduce the degree of loss; (2) It can provide powerful and efficient supply guarantee of materials and equipment for various military activities; (3) It is conducive to concentrating the limited resources, strength and energy of the troops to improve their combat effectiveness; (4) It has promoted the standardization and institutionalization of military logistics outsourcing project management and improved the level of logistics outsourcing project management.

3 Risk identification and analysis

3.1 Risk identification

The paper adopts the methods of literature investigation and field investigation to identify the risk factors of military logistics outsourcing for the first time from the external and internal environmental risks of the army, the risks of TPL enterprises and the risks of process management, and obtains the preliminary risk factors (as shown in Table 1); Then, by consulting experts in the field and relevant military experts, the preliminary risk factors are ranked in three rounds, as shown on the right side of table 1 (15 experts are invited to score). The scoring criteria for the first round are as follows: give 100 points to "maximum possibility", and then compare with other risk factors, and give 70 points to "more likely"; 50 points for "generally possible", 30 points for "less likely",0 point for "impossible". If there are other possibilities compared with each other, the experts can score between the above standards. The scoring standard of the second round is the same as that of the first round, but the experts shall be informed of the scoring results of the first round. The scoring criteria for the third round are as follows: inform all experts of the scoring results of the second round, and invite experts to score again: give 1 point to those who agree with the scoring results of all risk factors in the second round and 0 point to those who disagree; and calculate the proportion of agreeing with the scoring results of the second round, and multiply the obtained proportion by the average scores of the second round of investigation to obtain the final expert scoring results of each risk factor (as shown on the right side of Table 1).

It can be seen that natural environment risk and political environment risk are less likely to affect military logistics outsourcing. In fact, the current domestic logistics transportation network is generally safe and reliable, the road network is in good condition, and the railway and air transportation are relatively safe. Even the internal logistics transportation in the military will face natural risks; The state also vigorously advocates the development strategy of modern logistics industry and military civilian integration. Therefore, these two risk sources are deleted.

Table 1: Risk identification and scoring of military logistics outsourcing

Initial risk factors	1st	2st	Approval ratio	Final
Natural environment	18.3	15	100%	15
Political environment	40	40	100%	40
Market environment	50	50	100%	50

Legal environment	53.3	56.7	100%	56.7
Risk of service performance evaluation	66.7	66.7	100%	66.7
Monitoring risk of TPL	73.3	73.3	100%	73.3
Asset specificity risk of TPL	63.3	66.7	100%	66.7
Enterprise capability risk of TPL	53.3	53.3	100%	53.3
Opportunistic risk of TPL enterprises	43.3	43.3	100%	43.3
Risk of logistics service quality	51.7	50	100%	50
Risk of information asymmetry	63.3	60	100%	60
Target conflict risk	56.7	60	100%	60
Risk of information disclosure	56.7	60	100%	60

3.2 Risk analysis

■ External environmental risk

It refers to the risk factors that only exist in the external environment of the military and are not controlled by the military. ① Market environment risk. The fierce competition in the logistics industry will have a serious impact on military logistics outsourcing. The maturity of the outsourcing market determines the possibility of successful implementation of military logistics outsourcing to a certain extent. At the same time, the operation efficiency of logistics industry will also bring some risks to military logistics outsourcing activities. ② Legal environment risk. Before the army and logistics enterprises formed a cooperative relationship, it was expressed in the form of contract. When the army and logistics enterprises sign the contract, if the laws and regulations involved are imperfect, there will be loopholes in the legal provisions in the future operation, which will also make it possible for local logistics enterprises to drill legal loopholes.

■ Internal environmental risk

①Risk of service performance evaluation. At present, when the army cooperates with TPL enterprises, it lacks a scientific and effective evaluation mechanism of service quality and benefit, and has too much trust in TPL's services. In the long run, the TPL enterprises will be blindly arrogant and leave their duties without permission. From the perspective of service performance evaluation, on the one hand, if the requirements of the army are too high and divorced from the current development reality of the logistics industry, local TPL enterprises may not be willing to cooperate with the army, resulting in the failure of military logistics outsourcing activities; On the other hand, if the requirements of the army are too low, the service quality will be reduced and the outsourcing effect will not be achieved. ②Monitoring risk of TPL enterprises. Since the army and the local TPL enterprises belong to two systems, it is difficult to supervise. If there is a lack of supervision or the supervision is not timely and in place, it is easy to breed hidden dangers and bring uncertainty to the logistics support and military operations of the army.

■ Enterprise risk of TPL

The main risks are: ① Asset specificity risk. In recent years, local logistics has developed rapidly, and the logistics infrastructure such as storage system, distribution network and distribution personnel are relatively perfect, which makes local logistics enterprises form a

strong specificity for their own assets, which will make the army more dependent on local logistics enterprises. It does not rule out the "rip off" of logistics enterprises at the critical moment, so that the army has a disadvantage in cooperation and negotiation. ② Enterprise capability risk. Due to the asymmetry of information, local logistics enterprises will consciously show their advantages and hide their disadvantages; Once a cooperative relationship is formed, its service disadvantages will be exposed. It is uncertain whether it can meet the requirements of military logistics. If it cannot complete the support task, it will seriously affect the task of the army. ③ Opportunistic risk. Due to the asymmetry of information, the specificity of enterprise assets and the difficulty of the army in supervising logistics enterprises in an all-round way, it is easy for TPL enterprises not to act in accordance with or completely in accordance with the terms of the contract, and seek their own private interests through means of information deception and concealment.

■ Process management risk

It mainly includes: ①Logistics service quality risk. On the one hand, if the management and technical level of the TPL enterprise is low, it will lead to the untimely support and the loss and damage of military materials and equipment; On the other hand, the army lacks the monitoring of TPL enterprises, which makes it difficult to monitor the whole processes of military logistics outsourcing at all times. Logistics contracting enterprises may have opportunistic behaviors, resulting in the reduction of service quality. ②Information asymmetry risk. Every link of military logistics outsourcing contains the flow of information and the army is inferior to local logistics enterprises in controlling information; the asymmetry will increase many uncertainties and risks will arise. ③Risk of target conflict. Military logistics outsourcing cooperation to achieve the army and the TPL enterprise "win-win", with each purpose and each need; However, with the changes of market environment, the uncertainty of policy, the emergence of emergencies and the increase of operating costs, once the profits of TPL decline, the degree of taking what they need and the disharmony of win-win will occur. It is possible to renegotiate or cancel cooperation, which is faced with increasing costs or selecting suppliers again. ④Risk of information disclosure. Military logistics activities have different confidentiality requirements from ordinary logistics; At present, the form of inter defense confidentiality work is severe, when local logistics enterprises participate in logistics transportation, they are bound to obtain specific information from the army; if the confidentiality work is not done in place, some core important information may be mastered by local logistics enterprises, so there will be the risk of information disclosure. For example, first, TPL enterprises store military customer data in the cloud, which may be stolen by hackers; Secondly, it is easy to disclose the secrets of logistics flow records, receiving and shipping addresses, order information, etc; Moreover, through the association mining analysis of big data, it is not difficult to analyze military secrets such as military strength, personnel information, task content and location.

4 Quantitative risk measurement

4.1 Risk hierarchy model

Based on the above identification and analysis of risk factors, a three-level hierarchical structure model of military logistics outsourcing risk is constructed, as shown in Figure 1. In this model,

the top layer is the target layer, which represents the target of military logistics outsourcing risk; The middle layer of the model is criterion layer 1, which represents four first-class indicators of military logistics outsourcing risk; The bottom layer of the model is criterion layer 2, which represents 11 secondary indicators of military logistics outsourcing risk to be measured by decision-makers.

4.2 Risk measurement based on AHP

The reasons for using the AHP method [7] for risk measurement in the paper are as follows: (1) AHP is a scientific method combining qualitative and quantitative methods, which is suitable for some evaluation and trade-offs without structural characteristics; (2) The structure of AHP method is highly similar to the hierarchical model structure of military logistics outsourcing risk; (3) AHP is mature, easy to operate and easy to obtain data.

The calculation formula and processes involved in adopting AHP are as follows:

(1) Normalize each column of the judgment matrix, $i, j = 1, 2, 3 ..... n$

$$b_{ij} = \frac{a_{ij}}{\sum\limits_{k=1}^{n} a_{kj}} \tag{1}$$

(2) Add each row of the normalized judgment matrix of each column

$$U_i = \sum\limits_{j=1}^{n} b_{ij} \tag{2}$$

(3) Normalize the vector $U = (U_1, U_2, ..., U_n)$, the obtained vector $(W_1, W_2, ..., W_n)^T$ is the weight vector.

$$W_i = \frac{U_i}{\sum\limits_{j=1}^{n} U_j} \tag{3}$$

(4) Calculate the maximum eigenvalue. The assignment of A_i is shown in Table 3.

$$\lambda_{max} = \frac{1}{n} \sum\limits_{i=1}^{n} \frac{(A_i W_i)}{W_i} \tag{4}$$

(5) Calculate the consistency index CI

$$CI = \frac{\lambda_{\max} - n}{n - 1} \tag{5}$$

(6) Find the corresponding random consistency index RI in Table 2, When $n = 2$, $RI = 0$.

Table 2: RI value with matrix order n of 3-10

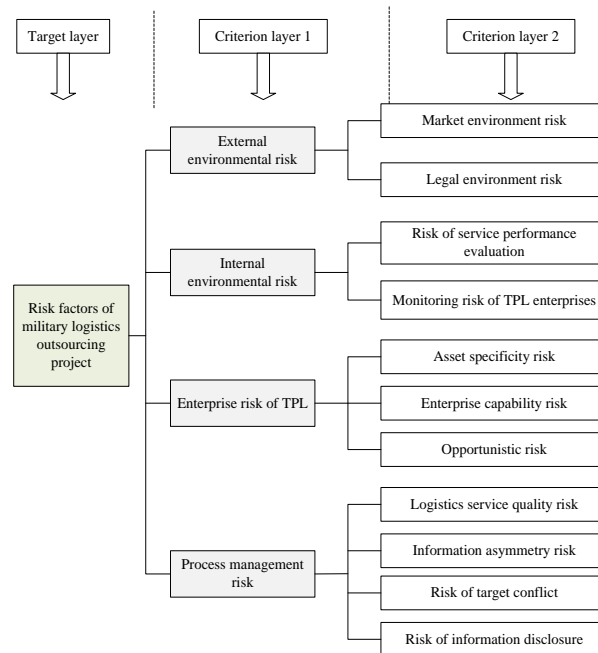| n	3	4	5	6	7	8	9	10
RI	0.58	0.89	1.12	1.24	1.32	1.41	1.45	1.49

Figure 1: Hierarchical structure model of military logistics outsourcing risk

The processes and results of evaluating and calculating the risks of military logistics outsourcing by the AHP method and developed applet are as follows: (1) firstly, build the risk judgment matrix of each criterion level, invite 15 field experts to compare and score the corresponding risk indicators of each criterion level, so as to obtain a series of judgment matrices; (2) then, the judgment matrix is calculated to obtain the maximum eigenvector values and the corresponding weight vector; (3) based on this, the random consistency index CR is obtained, and the consistency test is carried out. It is calculated that the relative vector W_1 of each risk factor under criterion layer 1 to the risk of military logistics outsourcing is (0.1528,0.0480,0.4149, 0.3844);

(4) then, using the same calculation method, calculate the relative vector of criterion layer 2 to criterion layer 1; (5) multiply the influence value W_1 of each risk factor under criterion layer 1 by the weight corresponding to criterion layer 2 to obtain: (0.0382, 0.1146, 0.012, 0.036, 0.2628, 0.1081, 0.0441, 0.0384, 0.1153, 0.1153, 0.1153). That is, the relative risk value of each risk factor in criterion layer 2 is obtained, as shown in Table 4, where "1" represents the maximum risk and "9" represents the minimum risk. The risk histogram of secondary indicators is shown in Figure 2.

Table 3: Importance level and its assignment of elements in pairwise comparison

No	Importance level	A_{ij}
1	i and j are equally important	1
2	Element i is slightly more important than element j	3
3	i is more important than j	5
4	i is obviously more important than j	7
5	i is very more important than j	9
6	i is slightly less important than j	1/3
7	i is obviously less important than j	1/5
8	i is strongly less important than j	1/7
9	i is very less important than j	1/9

4.3 Analysis of risk measurement results

In terms of primary indicators, the TPL enterprise has the greatest risk, and the second is the process management risk, and these two risk factors are much larger than the other two risk factors. The reason is that when the army cooperates with local logistics enterprises, the internal and external environmental factors of the army are easier for the army to predict and take preventive measures to avoid, while the implementation processes of TPL enterprises and outsourcing is not under the control of the army.

In terms of secondary indicators, the biggest risk is the TPL's asset specificity risk, and the second is the legal environment risk; the three risks of information asymmetry, target conflict and information leakage ranked third in parallel; the TPL capability risk ranks fourth, and other risk factors have less impact on military logistics outsourcing than these risk indicators. The main reasons are as follows: (1) the rapid development of local logistics industry makes it master a large number of resources and form a certain asset specificity, which will produce strong dependence when the army cooperates with it; (2) As a contractual activity, military logistics outsourcing must be carried out in a good legal environment, but the military does not understand the laws and regulations related to logistics, so it is easy to mine; (3) In the logistics cooperation between the army and local logistics enterprises, the local logistics enterprises, as the implementers, have much more control over the information of all links of logistics activities than the army; (4) The conflict of interest between the two sides will also bring the risk of target

conflict. Military logistics activities have strong military confidentiality, and there will inevitably be the risk of information disclosure when the two sides cooperate.

Table 4: Risk scoring of military logistics outsourcing

Secondary risk indicators	Risk values	Risk ranking
Market environment risk	0.0382	7
Legal environment risk	0.1146	2
Risk of service performance evaluation	0.012	9
Monitoring risk of TPL	0.036	8
Asset specificity risk of TPL	0.2628	1
Enterprise capability risk of TPL	0.1081	4
Opportunistic risk of TPL enterprises	0.0441	5
Risk of logistics service quality	0.0384	6
Risk of information asymmetry	0.1153	3
Target conflict risk	0.1153	3
Risk of information disclosure	0.1153	3

Therefore, when managing the risks of military logistics outsourcing, the military logistics departments should focus on the control of these main risk factors, focus on the general, and the control of other risk factors should also be followed up, and corresponding risk prevention measures should be taken.
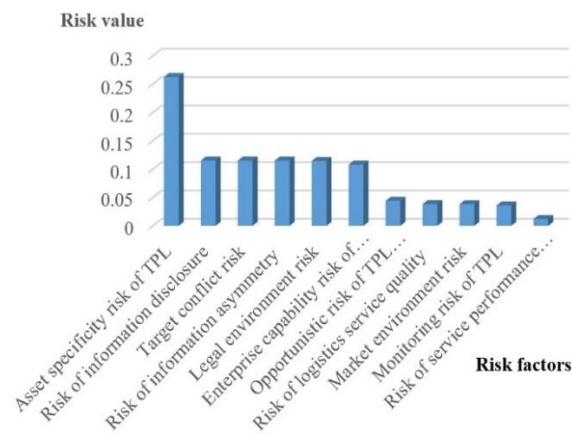

Figure 2: The risk histogram of secondary indicators

5   Conclusions

Close to the current reality of military logistics innovation and development, the paper studies the risk analysis and risk measurement of military logistics outsourcing projects under the background of informatization and Big Data of logistics, which provides a good reference for improving the risk management ability and level of military logistics outsourcing projects, and has strong theoretical and practical guiding significance. As a TPL enterprise, it should strictly perform the contract, abide by the confidentiality provisions, do a good job in security management from the aspects of information technology means, the formulation and implementation of security management rules, personnel ideological education and so on, and ensure the security and controllability of logistics management information systems, logistics personnel, carrier materials and big data analysis and mining platform of logistics, so as to ensure that military information is not leaked.

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