

# Risk Assessment of SF Food Cold Chain Logistics Based on Analytic Hierarchy Process

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**Abstract.** In recent years, people's demand for fresh fruits and vegetables for freshness, quality safety, and on-time performance is constantly increasing, and the risk factors existing in each link are also different. The risk of any link may affect the whole process of logistics can not be fully operated, or even directly cause the logistics service can not be completed. Therefore, it is very important to identify and analyze the risks of cold chain logistics from different perspectives. Based on the above considerations, through fully understanding the characteristics of cold chain logistics, this paper takes SF food cold chain logistics as an example, and analyzes the risk factors in cold chain logistics, including warehousing risk, technical risk, distribution risk and information risk. And using the Analytic Hierarchy Process (AHP) to analyze and model the risk factors and calculate, the results show that the weight of warehousing risk factor and distribution risk factor is 0.3597 and 0.3120 respectively, which has the greatest impact on food cold chain logistics. Finally, the four risk factors of the model results are analyzed, and the risk control measures of SF food cold chain logistics are given.

**Keywords:** food cold chain logistics; SF express; risk assessment; analytic hierarchy process.

## 1. Introduction

Cold chain logistics means that in its production, storage, transportation and sales and other links, fresh food that needs low temperature storage is always in a specific low temperature environment, so as to ensure the quality of fresh food and reduce the loss that may be caused by food production and circulation. As a new means of agricultural modernization development, cold chain logistics has great market potential and is also a new trend of agricultural modernization development. From production area to sales area, from farmland to table, it is an important and necessary action to build a cold chain logistics system and avoid related risks, which can improve its own risk management level and improve the risk management mechanism, promote the development of cold chain logistics enterprises themselves and ensure the service satisfaction of consumers.

In recent years, at the same time of economic development, people's material living standards continue to improve, food safety awareness is also constantly strengthening. The development of the Internet of Things has not only promoted the development of the e-commerce industry, but also transformed the domestic agricultural products, cold chain food production areas, processing places and consumer markets, so that people's demand for the cold chain logistics industry is also increasing. On the basis of previous studies, scholars Dong Xiaojun, Ke Zhenhua and Yang Wenjie et al. <sup>[1-3]</sup> studied the development and industry standards of food cold chain logistics. Li Sicong and Ye Jing <sup>[4]</sup> also used the analytic hierarchy process to evaluate and verify the risks of food cold chain logistics. Pan Jiahao et al. <sup>[5]</sup> studied the prevention and control countermeasures of the risks of food cold chain logistics.

Due to the relatively late development of the cold chain logistics transportation industry, theoretical research and practice are difficult to achieve synchronization, and it is difficult to achieve customer satisfaction. Therefore, the research on the risks in the cold chain food circulation process is helpful for the managers of food cold chain logistics enterprises to discover the problems in their own risk management, improve them, and improve the overall level of cold chain logistics. At the same time, it can ensure people's food health and safety, and even promote the rapid and efficient development of agriculture.

## **2. Problems existing in SF food cold chain logistics**

For fresh agricultural products, although SF Express has invested a lot of manpower, material resources and financial resources to develop cold transport business, business income data is also increasing year by year, but there are many cold chain logistics links, high requirements, cold transport business income is always less than 5%, and in the major online complaint platforms have also seen complaints about cold transport logistics cases. Through research, SF food cold chain logistics problems mainly include the following three points:

### **(1) Few types of products involved**

Sf fresh cold chain business has little cooperation with enterprises, because the enterprise cold transport model has not really formed a system. At present, most of the domestic cold chain logistics are still completed by the traditional mode of transport, which is low efficiency and high cost. Enterprises cold transport cooperation B2B customer business involves less product types, resulting in enterprises cold chain profits can not increase. According to the announcement of SF Express, the annual income of cold transport business is increasing year by year, but the proportion of total business income has been unable to increase.

### **(2) Quality control supervision is not in place**

In the logistics industry, SF cold transport has the problem of inadequate quality control and supervision. Sometimes, when the operator does not perform the operation according to the standard program and requirements (such as not according to the regulations to use vehicles with refrigeration function and choose ordinary vehicles, etc.), after complex circulation links, there will be damage to the quality of goods, and the aging is not up to the standard. This kind of problem not only brings great inconvenience to users, but also seriously affects the economic benefits of enterprises.

### **(3) Lack of cold chain logistics personnel**

The construction and operation of cold chain logistics system have high requirements for specialization, and human resources are the most important and core factors. In the enterprise human resource management, how to attract excellent cold chain talents, improve the quality of cold transport service is an important topic, but also the key to cost control. Although some management talents of SF Cold Transport have learned and mastered relevant knowledge and technology as well as business requirements, most of the employees in the cold transport department are transferred from the former express delivery department, and quite a few of the recruited employees have insufficient understanding of cold chain logistics professional knowledge and technology, resulting in fewer talents in cold chain logistics management and operation. Therefore, there is a certain phenomenon of irregular operation, which has greatly affected the overall level of cold transport services.

## **3. Analysis of risk factors of food cold chain logistics**

### **3.1 Warehousing risk factors**

(1) New employees are not familiar with the operating environment of the warehouse and are not skilled in technology. Once a dangerous situation occurs, they are often panicked, leading to improper operation.

(2) Aging of electrical appliances, short circuit of electric wires, electric vehicle battery charging time is too long, etc., may cause fire accidents, because the logistics storage place has a large building area, storage of more goods, and most of the warehouse building structure for the color steel structure, this steel structure building span is large, the warehouse space is large, once the fire will spread rapidly, forming three-dimensional burning, Steel structure buildings soften and collapse under high temperature baking, the risk is high, and the rescue is difficult, so fire prevention measures must be taken.

(3) If the warehouse goods are improperly stored, it is prone to the risk of flooding when extreme weather such as rainstorm and typhoon occurs.

(4) There are risks in preservation technology. Fresh agricultural products have specific storage conditions for temperature and humidity. Due to imperfect hardware facilities such as storage equipment, advanced cold chain technology, inappropriate management, and limited coverage of cold chain, the risks of fresh agricultural products in the storage process will increase.

### **3.2 Technical risk factors**

(1) The cold chain facilities are not perfect. At present, the construction degree of China's cold chain transport facilities is low, it is difficult to achieve seamless connection between road, railway and water transport, and the problem of "broken chain" is serious and difficult to avoid in the cold chain process, mainly manifested in information technology and storage and transportation equipment mechanization and packaging automation.

(2) Cold chain technology is backward. Due to the poor technical level of many cold chain logistics enterprises, the automation ability of cold chain preservation is limited, the lack of professional operation technicians and management personnel of cold chain logistics, the cold storage management system is not perfect, the tracking ability of RFID, GPS and other positioning systems is limited, and the sealing environment of domestic production of cold chain transport vehicles is not strict. Therefore, in the process of transportation, it is difficult to ensure the freshness and safety of fresh food in the circulation process, which will directly cause information congestion and poor in all aspects of cold chain logistics, so that there are problems in the quality and safety of refrigerated and frozen products and other products in transit, unconsciously increasing the risk of food.

### **3.3 Distribution risk factors**

The risks of distribution mainly include the risk of distribution timeliness, the risk of distribution damage, the risk of uncertain distribution route and the risk of misdelivery of goods.

There are many intermediate links in the distribution process, which will inevitably encounter natural environmental risks. Natural environmental risks are not controlled by human factors, with strong unpredictability, and cold chain raw eggs and milk and other products have regional characteristics, cross-regional transport routes are long, need to maintain a low temperature environment in each link, resulting in low circulation efficiency, prolong the time required for products to customers, all of these have brought risks and uncertainties to the cold chain transport and distribution process.

### **3.4 Information risk factors**

Fresh food is prone to security risks of information system when it is transported in cold chain logistics. Cold chain logistics of fresh food is closely related to network environment. In the era of big data, cybersecurity incidents occur frequently, not only to ensure system security, but also to examine the entire supply chain and extract, analyze and understand the various operations of supply chain infrastructure services. If the supply chain system is vulnerable, there is a risk of cyber attack. Small operators are often less secure and vulnerable to attacks. At the same time, enterprises also face the risk of information sharing, because of asymmetric information, incomplete information, inappropriate selection of business partners and other reasons, will not only reduce corporate profits, will let enterprises lose other opportunities, and then unconsciously curb the improvement of enterprise competitiveness, increase the supply chain operating costs.

## **4. Risk assessment of SF Food cold chain logistics based on analytic hierarchy process**

**4.1 Overview of Analytic Hierarchy Process**

The analytic hierarchy process(AHP) is a systematic method that takes a complex multi-objective decision problem as a system, decomposes the objective into multiple objectives or criteria, and then decomposes several levels of multi-indicators, and calculates the hierarchical single ranking and total ranking through the qualitative index fuzzy quantization method, so as to optimize the decision of objectives and multi-schemes.

**4.2 Risk assessment of SF Food cold chain logistics based on analytic hierarchy process**

**4.3 Building the ladder hierarchical model**

Based on the understanding of the concept of analytic hierarchy process (AHP), the paper first investigates the actual situation of SF Express, and establishes a hierarchical structure model according to the risk factors in the cold chain food supply process of SF Express by combining the actual development situation of SF Express cold chain logistics with the theoretical research on risk management of cold chain logistics. As shown in Figure 1.

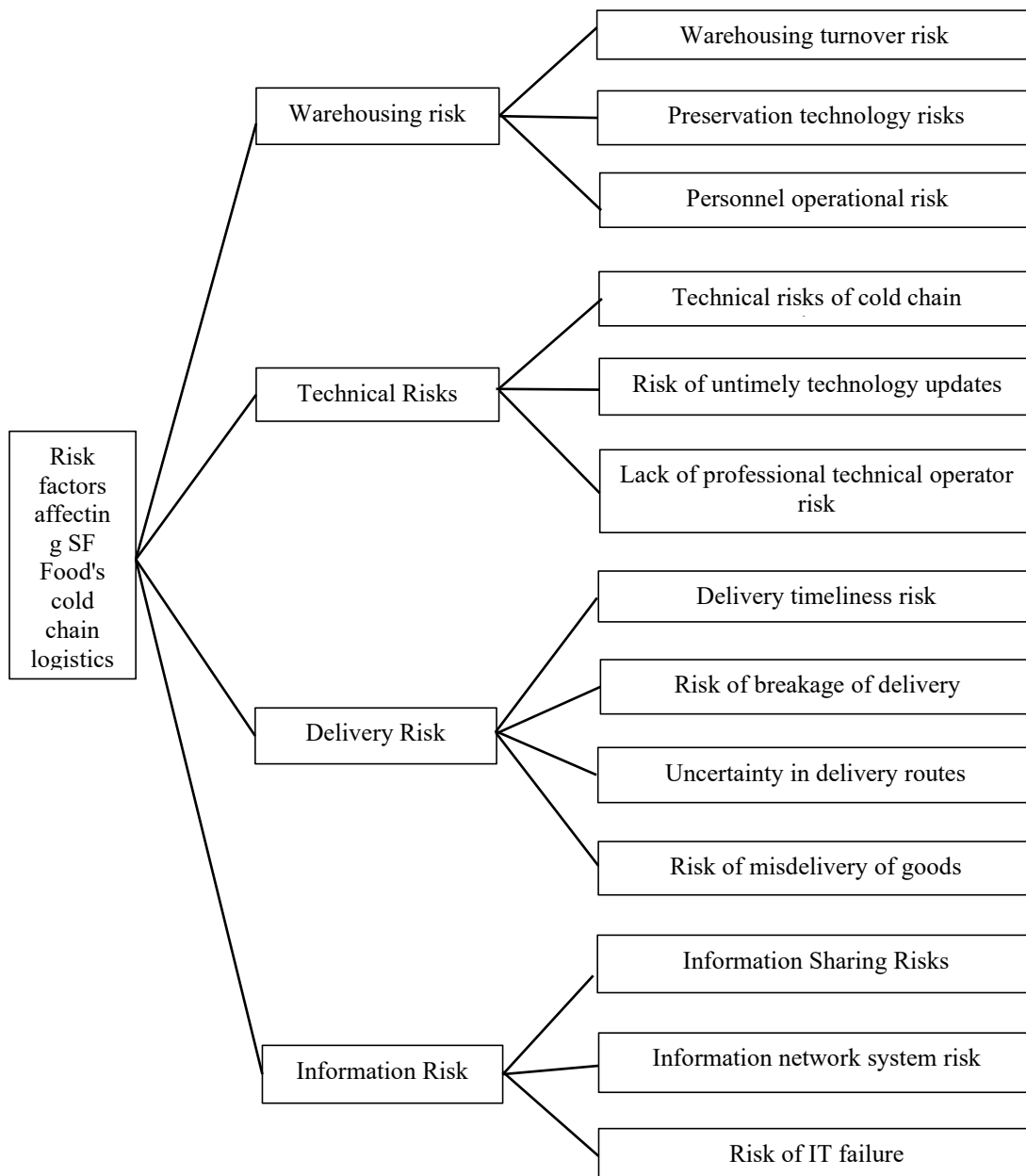


Fig. 1 Risk factors affecting SF food cold chain logistics

4.3.1 Construct judgment matrix

After constructing the hierarchical organizational structure model, it is still necessary to analyze the relative weights of each factor and complete the model-based overall analysis, so that the relative weights of all C-level factors and A-level risk objectives can be easily obtained. Finally, a relatively complete risk assessment system has been established by using the AHP evaluation method, and an objective and comprehensive assessment and diagnosis has been made on the current situation of SF's cold chain logistics risk management. According to the above research results, the corresponding suggestions are put forward. Because of the complexity of SF's cold chain logistics risk to a certain extent, its indicators are not simply calculated according to a fixed formula, but there are different weights. The advantage of this method is that it can use some identification and evaluation indicators to make pairwise comparison of the influencing factors and judge which factor has a greater impact, so as to quickly discover more key factors affecting the risk of SF Express's cold chain logistics.

This paper invites the operation and management personnel of relevant departments of SF cold chain logistics enterprises to score the importance of each factor on SF cold chain with a comparative scale of 1-9. The scale of the judgment matrix elements is shown in Table 4.1. According to the scoring results, the judgment matrix is constructed, and the calculation results are shown in Table 2, Table 4, Table 5, Table 6 and Table 7.

Table 1. Scale method for judging matrix elements

Scale	Implication
1	Elements i and j are equally important
3	i element is slightly more important than j element
5	The i element is significantly more important than the j element
7	Element i is more important than element j
9	i element is more important than j element
2、4、6、8	The median of the two adjacent judgments above
Count backwards	The judgment of comparing factor i with j, then the judgment of comparing factor j with i

Table 2. Risk factors affecting SF food cold chain logistics A

A	B1	B2	B3	B4	weight	$\lambda_{max} = 4.1751$ C.I. = 0.0584 C.R. = 0.0649
B1	1	2	1	3	0.3597	
B2	1/2	1	1/3	1	0.1465	
B3	1	3	1	1	0.3120	
B4	1/3	1	1	1	0.1818	
B1 warehousing risk, B2 technical risk, B3 distribution risk, B4 information risk						

For the normalization of each column vector of matrix A, the first column calculation process is as follows:

$$W_{11} = \frac{1}{1 + \frac{1}{2} + 1 + \frac{1}{3}} = 0.3529 \tag{Formula 1}$$

$$W_{12} = \frac{\frac{1}{2}}{1 + \frac{1}{2} + 1 + \frac{1}{3}} = 0.1765 \tag{Formula 2}$$

$$W_{13} = \frac{1}{1 + \frac{1}{2} + 1 + \frac{1}{3}} = 0.3529$$

Formula 3

$$W_{14} = \frac{\frac{1}{3}}{1 + \frac{1}{2} + 1 + \frac{1}{3}} = 0.1176$$

Formula 4

The remaining columns can be normalized in the same way.

$$\begin{bmatrix} 1 & 2 & 1 & 3 \\ \frac{1}{2} & 1 & \frac{1}{3} & 1 \\ 1 & 3 & 1 & 1 \\ \frac{1}{3} & 1 & 1 & 1 \end{bmatrix} \rightarrow \begin{bmatrix} 0.3529 & 0.2857 & 0.3 & 0.5 \\ 0.1765 & 0.1429 & 0.1 & 0.1667 \\ 0.3529 & 0.4286 & 0.1 & 0.1667 \\ 0.1776 & 0.1429 & 0.3 & 0.1667 \end{bmatrix}$$

Formula 5

$$W_1 = \frac{0.3529 + 0.2857 + 0.3 + 0.5}{4} = 0.3597$$

Formula 6

The same can be obtained  $W_2 = 0.1465$ 、 $W_3 = 0.3120$ 、 $W_4 = 0.1818$

$$AW_1 = 1 \times 0.3597 + 2 \times 0.1465 + 1 \times 0.3120 + 3 \times 0.1818 = 1.5101$$

Formula 7

The same can be obtained  $AW_2 = 0.6122$ 、 $AW_3 = 1.2931$ 、 $AW_4 = 0.7599$

$$\lambda_{\max} = \frac{1.5101}{4 \times 0.360} + \frac{0.6122}{4 \times 0.146} + \frac{1.2931}{4 \times 0.312} + \frac{0.7599}{4 \times 0.182} = 4.1751$$

Formula 8

Computation consistency index C.I.,  $C.I. = \frac{\lambda_{\max} - n}{n - 1} = \frac{4.1751 - 4}{4 - 1} = 0.0584$

Formula 9

Table 3. R.I. correspondence table

n	1	2	3	4	5	6	7	8	9	10	11	12
R.I.	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.53

The consistency ratio C.R. is calculated. When C.R.<0.1, the judgment matrix has passed the consistency test. When C.R. is  $\geq 0.1$ , it means that the judgment matrix should be modified until the test condition is reached before the next step.

$$C.R. = \frac{C.I.}{R.I.} = \frac{0.0584}{0.9} = 0.0649$$

Formula 10

According to the results, C.R.=0.0649<0.1, indicating that the consistency test of the judgment matrix is qualified.

Table 4. Warehousing risk judgment matrix B1

B1	C1	C2	C3	weight	$\lambda_{max} = 3.0536$ <i>C.I.</i> = 0.0268 <i>C.R.</i> = 0.0462
C1	1	1/3	4	0.2706	
C2	3	1	6	0.6442	
C3	1/4	1/6	1	0.0852	
C1 storage turnover risk, C2 preservation technology risk, C3 personnel operation risk					

Table 5. Technical risk judgment matrix B2

B2	C4	C5	C6	weight	$\lambda_{max} = 3.0037$ <i>C.I.</i> = 0.0019 <i>C.R.</i> = 0.0032
C4	1	1/2	3	0.3090	
C5	2	1	5	0.5815	
C6	1/3	1/5	1	0.1095	
C4 cold chain equipment technical risk, C5 technology update is not timely risk, C6 lack of professional technical operator risk					

Table 6. Distribution risk judgment matrix B3

B3	C7	C8	C9	C10	weight	$\lambda_{max} = 4.1171$ <i>C.I.</i> = 0.0390 <i>C.R.</i> = 0.043
C7	1	4	2	1	0.3755	
C8	1/4	1	1/3	1/2	0.1009	
C9	1/2	3	1	1/2	0.2078	
C10	1	2	2	1	0.3158	
C7 delivery time risk, C8 delivery damage risk, C9 delivery route uncertainty, C10 cargo misdelivery risk						

Table 7. Information risk judgment matrix B4

B4	C11	C12	C13	weight	$\lambda_{max} = 3.0183$ <i>C.I.</i> = 0.0092 <i>C.R.</i> = 0.0158
C11	1	3	1	0.4434	
C12	1/3	1	1/2	0.1692	
C13	1	2	1	0.3874	
C11 information sharing risk, C12 information network system risk, C13 information technology failure risk					

Table 8. SF Food cold chain logistics risk factor index weight summary

goal	Primary index	weight	Secondary index	weight
SF Food cold chain logistics risk assessment	B1	0.3597	C1	0.2706
			C2	0.6442
			C3	0.0852
	B2	0.1465	C4	0.3090
			C5	0.5815
			C6	0.1095
	B3	0.3120	C7	0.3755
			C8	0.1009
			C9	0.2078
			C10	0.3158
	B4	0.1818	C11	0.4434
			C12	0.1692
			C13	0.3874
B1 storage risk, B2 technical risk, B3 distribution risk, B4 information risk, C1 storage turnover risk, C2 preservation technology risk, C3 personnel operation risk, C4 cold chain equipment technical risk, C5 technology update risk, C6 lack of professional technical operator risk, C7 distribution aging risk, C8 distribution damage risk, C5 technology update risk, C7 technical risk, C8 distribution damage risk. C9 distribution route uncertainty, C10 cargo misdelivery risk, C11 information sharing risk, C12 information network system risk, C13 information technology failure risk				

The analytic Hierarchy process (AHP) was used to summarize the development results of SF Food cold chain logistics, and the weight results were summarized and analyzed, as shown in Table 8: the weight of risk in each level index of cold chain logistics from large to small is sorted as follows: warehousing risk, distribution risk, information risk and technical risk. Corresponding prevention suggestions are given for cold chain warehousing risks with relatively large risk coefficients, and any risk on the secondary index will cause serious irreversible losses to the total benefit of SF Logistics. Therefore, risk control measures are taken for related risk factors. This has important guiding significance for the upgrading and development of the food cold chain logistics industry.

## **5. SF food cold chain logistics related risk control measures**

### **5.1 SF Food cold chain logistics warehousing risk control measures**

Since the warehousing process accounts for the largest proportion of risks, the future operation of SF cold chain logistics should focus on and prevent such risks. The first is to enhance the standardization of operations. Through a series of measures to ensure that every link in the enterprise logistics system can be standardized operation. It mainly includes the following aspects: establish a scientific and perfect management system, strengthen personnel training, increase rewards and punishments, and conduct systematic training for warehouse personnel. Warehouse employees should be familiar with and master the basic requirements and relevant knowledge of warehouse operations, clear their responsibilities and tasks, determine the work content, methods and precautions, so that they can complete the work in accordance with the prescribed operating standards; At the same time, the staff training can be randomly assessed, and the staff with good evaluation results will be awarded bonus points and included in the performance, so as to improve the enthusiasm of the staff to participate in the training. Employees who operate according to operating standards are rewarded, otherwise the performance of relevant employees is deducted, and warnings are given to enhance the standardization of employee operations.

Secondly, we should do a good job in the management of warehouse goods and make reasonable arrangements for inventory. Different types of agricultural products should be selected according to their own characteristics and storage conditions suitable storage areas to ensure that all kinds of agricultural products can be safely and stably stored in a suitable environment to avoid pollution caused by external factors on agricultural products. Based on the inventory management system, the information such as shelf life, storage time and storage situation of agricultural products can be mastered, and timely disposal of timely or expired agricultural products.

Finally, in daily work, according to the requirements of use, all kinds of machinery and equipment and parts are reasonably configured to ensure that they are in good condition, do a good job in safety management, and strengthen personnel training. The staff shall check the condition of the warehouse equipment on a regular basis and inform the maintenance personnel of the failure or abnormal situation in a timely manner.

### **5.2 SF Food cold chain logistics distribution risk control measures**

Through the calculation of weight, it can be seen that the proportion of distribution risk is second only to warehousing risk, so the avoidance of distribution risk is also crucial in cold chain logistics. At present, many enterprises in China have adopted refrigerated trucks with a relatively low degree of automation to freeze or refrigerate food. This method is not only costly, but also has certain security risks, which requires us to regularly update and manage the cold chain equipment.

Through the establishment of pre-warehouse to carry out reasonable logistics distribution network layout. Many enterprises have been stimulated by the market to develop rapidly, and this transfer has a direct guiding effect on the cold chain logistics industry mode of delivery, so that the previous logistics distribution mode has begun to change to the pre-warehouse, which can greatly accelerate the distribution of goods.



Pay attention to changes in the transportation environment. Transportation environmental risk is unavoidable in the process of food cold chain logistics transportation, but corresponding measures can be taken to reduce the degree of harm. For example, managers need to regularly pay attention to official weather forecasts, timely adjust or develop risk control plans according to meteorological changes, or regularly hold various natural disaster disposal exercises, etc., to ensure the safety and timely arrival of cold chain food transportation.

Do a good job of transport vehicle management. The cold chain department should choose the appropriate loading method and means of transportation according to customer needs, and scientifically plan the distribution route; Before planning the distribution route, it is necessary to clarify the distribution purpose and cold chain distribution capacity, and work out a reasonable distribution route based on the actual traffic conditions to improve product distribution efficiency and ensure the timeliness of transportation.

### **5.3 SF Food cold chain logistics technical risk control measures**

Compared with other risks, technical risks are not so important, but with the progress of science and technology, the cold chain should improve the corresponding technical resource allocation. Combined with the development of SF's food cold chain logistics system at this stage, we should continue to improve the allocation of technical resources, mainly the following points should be done: First, enterprises should pay close attention to the training and introduction of technical personnel, strengthen the selection of technical personnel, the definition of authority, and the formulation and evaluation of new remuneration. Supervise and exit all aspects of management, give play to the technology-driven effect, and let enterprises enter the orderly virtuous cycle of innovation-driven growth. At the same time, it is necessary to establish a perfect incentive and constraint mechanism to promote enterprises to continuously improve the level of technological innovation in order to enhance their core competitiveness. Second, it is necessary to increase investment in the research and development of cold chain core technology, and independently innovate on the basis of absorbing the low-temperature packaging preservation technology of foreign advanced cold chain enterprises to develop new low-temperature packaging preservation technology and equipment with intellectual property rights, so as to further improve the distribution efficiency of China's cold chain logistics enterprises. Make full use of internal and external technical resources to serve the enterprise's own development. The third is to form the driving effect of technological resources. Enterprise executives should deeply understand the relationship between the allocation of technological resources and the optimization activities of SF's food cold chain logistics service products, make full use of the intermediary role of technological resources allocation, and maximize the driving effect of technological resources. Its various refrigeration equipment can achieve real-time tracking, real-time positioning, timely supervision of changes in the internal temperature of the refrigerator, and strict quality and safety of the product transformation from suppliers to demand suppliers.

### **5.4 SF Food cold chain logistics information risk control measures**

Although the proportion of information risk is the least, in the whole process of cold chain logistics, any link will cause logistics transportation can not be completed, so we should strengthen the management of information resources, so as to reduce information risks. Enterprise information resources involve all aspects of the enterprise and run through all aspects of the development of SF Express food cold chain logistics system. Attention should be paid to the management of enterprise information resources. Do a good job in information resource planning, conduct in-depth planning and management of information resources from the macro and micro levels, and play a guiding role in the implementation of subsequent service product optimization paths. The establishment and improvement of an enterprise information resource management organization requires the integration and management of internal and external information in each service product optimization path of SF Express's food cold chain logistics system. Establish a sound cold chain

logistics system and safety traceability mechanism, improve the overall operation efficiency of the supply chain, and achieve seamless connection between all links of the entire supply chain from raw material procurement to finished product distribution.

We will improve the cold-chain information network. Cargo monitoring technology can use network data to build a cold chain logistics system, fully integrate the existing e-commerce service platform and shared information system, further improve the cold chain logistics information network and establish a cold chain distribution information service alliance [. Cargo monitoring equipment can not only realize the real-time positioning of logistics vehicles, but also monitor the location and movement trajectory of cold chain transport vehicles in real time, so as to plan the best transportation route and reduce transportation costs. Finally, through the grasp of important circulation links and strengthening the dynamic supervision of the cold chain process, the specialization and modernization of cold chain logistics facilities and equipment are promoted to ensure the quality and freshness of each circulation link of refrigerated products.

## 6. Conclusion

By combing and integrating relevant literature, it can be found that scholars have analyzed and identified the risk of cold chain logistics from different perspectives, which has played a positive role in promoting my research on controlling and reducing the risk of cold chain logistics. In order to have a clearer understanding of the risks of cold chain logistics and avoid risk factors, this paper takes the cold chain logistics of SF Food as an example on the basis of previous studies, and takes the cold chain logistics of SF Food as the research focus. Through the field investigation of SF Food, the existing problems of SF Food are found. In the field of fresh food supply chain, based on a large number of market researches, the analytic hierarchy process is adopted. Aiming at the risk evaluation of SF food cold chain logistics, a comprehensive evaluation system model of SF Express is constructed. By calculating the weight assignment of each risk factor, it is found that warehousing risk is the most important risk factor affecting the development of SF cold chain logistics. Based on the calculated weight, research conclusions are drawn and corresponding preventive measures are proposed for these factors. In order to make our country cold chain logistics can better avoid the existing risk. This system has considerable theoretical and guiding significance in other similar fields of safety risk assessment and management of fresh cold chain food supply chain.

## Acknowledgements

Setting: School of Management Engineering, Liaoning Institute of Science and Engineering  
Project: 2024 Basic Scientific Research Project of Liaoning Institute of Science and Technology  
Project name: Research on optimization model of engineering project supply chain

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