

Research on the Whole Process Control of Cold Chain Transportation under the Background of Resource Saving

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Abstract: With the continuous improvement of people's requirements for food safety and quality, cold chain logistics has become the focus of much attention in the logistics industry. my country's Cold chain logistics is developing rapidly in China, but the overall level is low, and the cold chain loss rate of fresh agricultural products is high, causing huge waste. Road transportation is an important part of cold chain logistics. 90% of the freight volume in the cold chain logistics is completed by road transportation, but the proportion of broken links in the transportation process reaches 60%, which seriously affects service quality of cold chain logistics. Cold chain logistics is directly related to people's life safety and physical health, and it is also an important way for my country to build a resource-saving society. However, one of the problems with the inadequacy of the cold chain is the incomplete management system, extensive management methods, and imperfect management systems and standards of the cold chain transportation enterprises, refrigerated and heat-preserving vehicles and other basic elements by the industry management department. Therefore, it is necessary to establish a closed-loop management and control system for the entire process of "market access-process monitoring-service evaluation-joint rewards and punishments" centering on road cold chain transportation. The high-quality development of logistics creates a good market environment, improves the service quality and management level of cold chain transportation, and reduces the loss of agricultural products in the cold chain logistics process.

1. Introduction

Cold chain logistics is a logistics activity, and it uses refrigeration technology as the basis and refrigeration technology as a means to keep cold chain items in a specified temperature environment from production, circulation, sales to consumers, ensuring the quality of cold chain items, reducing the loss of cold chain items. With the improvement of the consumption level of Chinese residents and the enhancement of food quality and safety awareness, the demand for cold chain logistics is growing rapidly, and the market scale is expanding. Transportation is the basic link and important carrier of cold chain logistics, and it plays a major role in supporting the development of cold chain logistics. The new pattern of "dual cycle" economic development and the construction of a strong transportation country have put forward new requirements for the development of cold chain logistics. Full-process temperature control traceability, standardization of facilities and equipment, and standardization of operating standards will become inevitable requirements for transformation and high-quality development. Establishing the whole process managing and controlling system of cold chain transportation by road is of great significance for innovating management mechanisms, strengthening cold chain transportation supervision, improving cold chain logistics service quality, and promoting the



healthy and sustainable development of the cold chain logistics industry.

2. The overall situation of China's cold chain logistics development

China is a big country in global agricultural production and fresh food consumption. The output of fruits, vegetables, meat, and aquatic products has ranked first in the world for many years, forming a strong cold chain logistics market demand. In recent years, with Chinese economic and social development and the continuous improvement of the people's living standards, the whole society has put forward higher requirements for the diversification, freshness and nutrition of fresh foods, and the rapid development of fresh food e-commerce has stimulated The demand for cold chain logistics continues to grow, and the scale of the cold chain logistics market continues to expand. From 2015 to 2019, Chinese total cold chain logistics demand increased from 153 million tons to 233 million tons, an annual growth rate of more than 10%; The cold chain logistics market has increased from 180 billion yuan to 339.1 billion yuan, with an average annual compound growth rate of 17.04%; The total amount of cold chain logistics increased from 350 million yuan to 6 trillion yuan, with an average annual growth rate of about 20%. With the rapid expansion of the market, the development of cold chain logistics facilities and equipment has also been accelerated, and technical conditions have improved. In 2019, the total amount of cold storage in the country reached 60.525 million tons, an increase of 15.56% year-on-year, ranking third in the world; The number of refrigerated vehicles nationwide has reached 214,700 units, and the proportion of the number of vehicles in operation has increased from 0.7% in 2015 to 1.8%. With the rapid development of information technology and automation equipment, the "broken chain" problem of cold chain transportation has been further solved. The refrigerated transportation rate of fruits, vegetables, meat and aquatic products has increased from 20%, 30% and 36% in 2015 to 35%, 57%, 69%, an increase of more than 50%.

Although the cold chain logistics industry has achieved rapid development, in general, the overall foundation of China's cold chain logistics is relatively weak and is in the initial stage of development. There are still unbalanced infrastructure supply, low level of specialization of transportation equipment, and cold chain logistics services. Poor quality, imperfect standard and normative system, information technology application needs to be strengthened, and the entire chain supervision system has not been established. This leads to a low proportion of cold chain circulation, large losses, and high costs, which are in line with the needs of economic and social development and people's desire for a better life. There is a certain gap. Since 2017, the State Council, the Ministry of Transport, the Ministry of Commerce and other industry authorities have intensively introduced a number of policies to support the healthy development of cold chain logistics, requiring strengthened supervision, innovative methods, sound systems, and improved standards to create a fair and orderly Standardize a healthy market environment, improve the phenomenon of "bad money driving out good money" in the cold chain logistics industry, and promote the high-quality development of cold chain logistics.

3. Current situation and problems of cold chain transportation supervision by road

3.1. Regulatory status

The transportation administration department is the unit in charge of road cold chain transportation, mainly in accordance with the "Food Safety Law", "Food Safety Law Implementation Regulations", and "Road Freight Transport and Station Management Regulations" for road cold chain transportation enterprises and refrigerated and insulated vehicles (including temperature control Equipment) for supervision. The supervision method is mainly based on prior administrative licensing.

—The relevant provisions of the Food Safety Law: The containers, tools and equipment used to store, transport and load and unload food should be safe, harmless, kept clean, prevent food contamination, and meet special requirements such as temperature and humidity required to ensure food safety. Store and transport food together with toxic and hazardous materials.

—The relevant provisions of the Regulations on the Implementation of the Food Safety Law: The storage and transportation of food with special requirements on temperature, humidity, etc. shall have

equipment and facilities such as cold preservation, refrigeration or freezing, and maintain effective operation; the trustee shall ensure the conditions for food storage and transportation Meet food safety requirements and strengthen food storage and transportation process management.

—The relevant provisions of the "Road Freight Transport and Station Management Regulations": those engaged in special transportation such as refrigerated preservation, tank containers, etc., shall have special containers, equipment and facilities suitable for the transport of goods, and be fixed on special vehicles.

For road cold chain transportation enterprises, the county-level road transportation management agency shall implement the administrative license for road cargo transportation operation in accordance with the "Road Goods Transportation and Station Management Regulations", and issue the "Road Transportation Operation License" to the licensee; and require cold Chain transport companies have transport vehicles that are suitable for their business and have passed inspections. For refrigerated transport vehicles, the road transport management agency shall issue a "Road Transport Permit" to refrigerated and heat-preserving vehicles put into transport.

3.2. The problem

At present, Chinese road cold-chain transportation market is disordered, with uneven service quality. The cold chain "not cold" and "broken chain" problems are prominent, and many market risks, quality problems and safety hazards have been exposed. According to statistics, the current cold chain circulation rates of fruits, vegetables, meat, and aquatic products in Chinese are 22%, 34%, and 41% respectively, and the refrigerated transportation rates are 35%, 57%, and 69%, respectively. Most fresh products are still at room temperature. In developed countries such as Europe, America and Japan, the average refrigerated transportation rate of perishable food has exceeded 90%, and the cold chain circulation rate is as high as 95-98%. One of the important reasons why Chinese cold chain logistics service level is generally lower than that of developed countries is the lack of industry supervision.

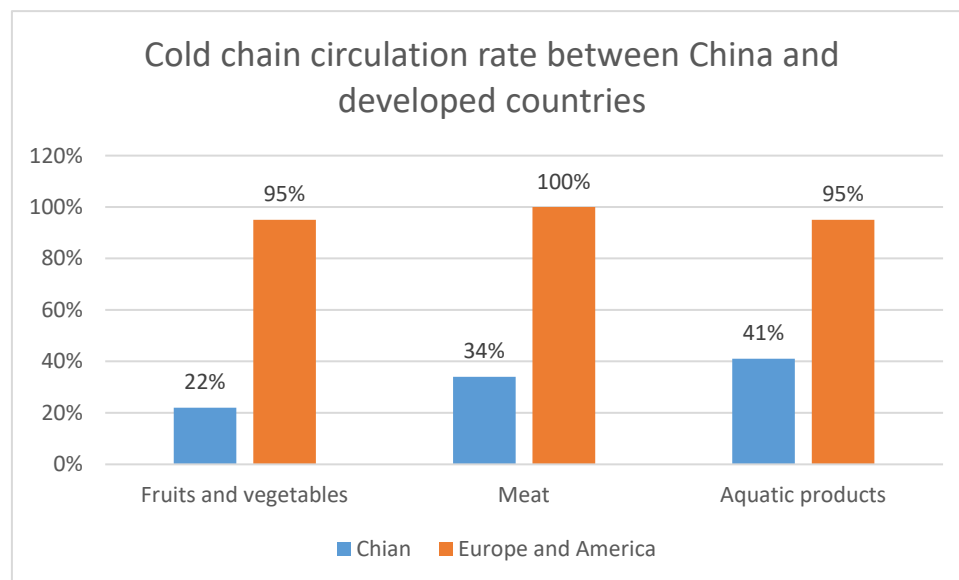


Figure 1 Comparison of cold chain circulation rates between China and developed countries in Europe and America

(1) Extensive management methods, market access and exit mechanisms need to be improved

As an important link to ensure the quality and safety of food and drug circulation, cold chain transportation is a relatively weak link in the cold chain logistics supervision system. At present, the transportation department has extensive management methods for basic elements such as cold chain logistics enterprises, refrigerated and insulated vehicles, and temperature control equipment, and lacks

special management systems and measures. The cold chain transportation market entry and exit mechanism is not sound. Although road cold chain transportation belongs to the category of special transportation, the current industry does not combine the characteristics of cold chain transportation to specifically formulate systems and standards for the permission of refrigerated and insulated vehicles, and the inspection of vehicles and temperature control equipment. The annual inspection of freight vehicles lacks specialized technical performance testing such as vehicle refrigeration function and temperature perception function. The relevant technical requirements for refrigerated and heat-preserving vehicles and temperature control equipment are not regarded as the basic conditions for vehicle operation. Vehicles that meet the relevant standards also do not have a sound exit system, resulting in irregular operation of refrigerated and insulated vehicles. There are cases where shipping containers are converted to refrigerated and heat-preserving vehicles for transportation, and there are also ordinary vehicles using "ice + quilts" for transportation. As a result, the corrosion rate of cold chain logistics is high, and it is difficult to ensure the safety of food circulation.

(2) Management is not unified, and the implementation of regulations and standards is not in place

Chinese cold chain transportation is dominated by roads, and refrigerated vehicles are the core transportation equipment of cold chain logistics. At present, various localities have inconsistent understanding of the relevant provisions of the "Road Freight Transport and Station Management Regulations", resulting in inconsistent management of refrigerated vehicles and inadequate policy implementation. The main dispute lies in the management of refrigerated vehicles under 4.5 tons. Most provinces (municipalities, autonomous regions) transport management departments manage refrigerated vehicles under 4.5 tons as ordinary freight vehicles, and cancel the "dual certificates" for road cold chain transportation under 4.5 tons. Neither permits nor filings are required, leading to road transportation. The management agency basically does not have the data and related information of cold chain transport enterprises and refrigerated vehicles under 4.5 tons. In 2020, the Ministry of Transport issued the 'Notice on Further Doing a Good Job in the Reform of "Decentralization and Management" of General Freight Vehicles with a Total Mass of 4500kg and Below', requiring that the access management of light vehicles engaged in refrigerated and fresh-keeping transportation enterprises be further regulated according to law. Strengthen the interim and ex-post supervision of the operations of transportation companies. The notice clarified that cold chain transportation, as a dedicated transportation rather than an ordinary truck, is a key area of transportation supervision. It also emphasizes the requirements for the access management of refrigerated and insulated vehicles under 4.5 tons.

Chinese national standards and industry standards have already made relevant requirements for refrigerated vehicles and temperature control equipment. For example, refrigerated vehicles should be equipped with temperature recorders, which should be fixed and firm, and should be able to truly reflect the temperature of goods during transportation; Refrigerated vehicles should be sprayed or pasted on the visible parts of the exterior of the car body with the obvious words "refrigerated truck" and the English letters of the refrigerator truck category. Although there are standards to follow, there is a lack of supporting systems and measures, the standards have not been effectively implemented, and the use of refrigerated and insulated vehicles is still chaotic.

(3) Supervision methods are weak, and supervision during and after the event needs to be improved urgently

At present, Chinese transportation management departments mainly rely on administrative licensing for road cold chain transportation, and lack of ability to supervise during and after the event, lack of effective supervision of cold chain transportation temperature and compliance inspection of transportation vehicles, lack of industry service evaluation and effective credit management Means, it is difficult to restrain corporate behavior, and the phenomenon of "bad money expelling good money" has not been eliminated. There is an urgent need to innovate management ideas, give full play to technological advantages, use electronic and information methods to improve existing supervision methods, improve credit supervision efficiency, and explore effective means suitable for the supervision of the entire process of cold chain transportation.

(4) Insufficient external communication and coordination, joint supervision capabilities need to be

improved

Cold chain logistics administration departments mainly include market supervision, development and reform, commerce, transportation, agriculture and rural areas, public security, housing and urban and rural construction, natural resources and ecological environment, etc. There are overlapping functions among different departments in the whole process of cold chain logistics from origin to consumers. At present, the transportation department and other departments such as market supervision, commerce, public security and other departments have not established a coordinated and coordinated supervision mechanism. Each department manages based on its own functions and operates independently. There is insufficient coordination and policy connection between each other. The cold chain logistics supervision of the whole chain has not yet been established.

4. Design of the whole process managing and controlling system

4.1. Control system framework

The whole process of cold chain transportation involves loading, transportation, distribution, and receiving from the operation link. From the industry control level, it includes before, during, and after transportation. Before transportation, it mainly involves licensing and temperature monitoring. After supervision and transportation, it includes cold chain logistics enterprise services and credit evaluation. The control system for the whole process of cold chain transportation aims to cover before, during and after transportation, with the basic principles of combining online monitoring and offline management, combining administrative and technical means, and combining daily monitoring and special inspections. With the improvement of government governance, market governance and social governance as the core, the formation of a coordinated and co-governance pattern of the "trinity" of government, market and society. Aiming at different management objects such as refrigerated and heat-preserving vehicles, temperature control equipment, and cold chain transportation companies, a closed-loop management and control system of "market access-process monitoring-service evaluation-joint rewards and punishments" is formed, and management is improved through innovative regulatory mechanisms. We will guide cold chain transportation enterprises to gradually realize standardized operations, and comprehensively improve the service quality and management level of road cold chain transportation.

4.2. Content of administration

The content of **administration** includes three links before transportation, during transportation and after transportation. Before transportation, it mainly involves market access; During transportation, it is mainly temperature monitoring and supervision; And after transportation, it includes cold chain transportation enterprise services and credit evaluation.

(1) Admission to market

First of all, cold chain transportation is a dedicated transportation category, and cold chain transportation companies are the main operators of road cold chain transportation and should have the operating qualifications for cold chain transportation. This is the first hurdle for market access.

Secondly, refrigerated vehicles are the core equipment of cold chain transportation. As special freight vehicles, management should be strengthened. This is the key to market access. Due to the special requirements of temperature, temperature monitoring equipment is the core equipment of refrigerated vehicles. Therefore, the technical performance requirements of temperature monitoring equipment should be the basic conditions for the operation of refrigerated vehicles. On the one hand, the technical performance requirements of refrigerated trucks and their temperature control equipment should be put forward; on the other hand, the performance inspection of temperature control equipment should be included in the annual comprehensive performance testing of operating vehicles. The refrigerated trucks and temperature control equipment shall be tested in accordance with the requirements of the standards. Vehicles that meet the requirements of relevant standards will continue to be put into use, and those that do not meet the requirements of relevant standards are not allowed to be put into the cold chain transportation market. Through comprehensive performance testing, we will strictly control the market

entry of refrigerated vehicles, guide high-energy, low-efficiency, and non-compliant refrigerated vehicles to withdraw from the market quickly, and continuously improve the technical level of cold chain transportation equipment.

(2) Process monitoring

In the cold chain transportation of food, temperature is the most important factor affecting its quality and safety. Most of the problems of cold chain not cold and broken chain occur in the transportation process, and the refrigeration equipment is shut down artificially in order to save fuel based on profit-driven and cost considerations. According to statistics, the proportion of chain disconnection in the cold chain transportation process is as high as 60%. Therefore, it is obviously not enough to rely solely on the self-discipline and self-regulation of cold chain transportation enterprises. It requires regulatory pressure and constraints from industry management departments. Temperature is the key control point of the cold chain transportation process monitoring. The industry management department must adopt intelligent methods to change the traditional supervision mode. The cold chain transportation vehicle monitoring and electronic waybill management are the core, and the vehicle in transit, the temperature control situation and the cargo situation Carry out dynamic monitoring, timely grasp the temperature control situation of the cold chain transportation process, support supervision and inspection, accident traceability, operation analysis, service evaluation, etc., connect pre-access and post-evaluation, and open up the "two points and one line" of the cold chain transportation chain ", to support the establishment of a closed-loop control system.

(3) Service evaluation

The evaluation of the service quality of cold chain transportation is an important starting point for industry management departments to strengthen the post-supervision of cold chain transportation, and it is also the basis for the construction of a social credit system. Judging from the current regulatory practices in many developed countries, it is an obvious trend to shift from the singleness of the regulatory body to the pluralism. Among diversified supervision, supervision by industry associations and other social intermediary organizations and self-supervision by enterprises are the most important forms. Therefore, service evaluation mainly relies on third-party institutions such as industry associations and scientific research units to carry out service evaluations in the context of the development of big data, and publish evaluation results, incorporate them into the integrity system, and promote information exchange and sharing with market supervision, commerce, public security and other departments to improve The cost of violations has the effect and effect of regulating the market. At the same time, it will strengthen industry operation analysis to provide a basis for government decision-making and macro-control.

(4) Joint rewards and punishments

Joint rewards and punishments are the comprehensive application of service evaluation results, including vertical and industry hierarchical and classified management, as well as horizontal information sharing and management linkage with other government departments. The industry must promote the classified and hierarchical management of cold chain transportation companies, implement differentiated management of cold chain transportation companies based on the evaluation results of service quality, and link with measures such as enterprise evaluation, preferential policies, and transportation capacity to standardize the market, The role of supporting the good and eliminating the bad. Outside the industry, it is necessary to strengthen communication, coordination and cooperation with relevant departments such as market supervision, commerce, and public security, to establish an effective linkage mechanism for industry supervision, promote information sharing and joint pilot projects with relevant departments, and form a full-chain cold chain logistics supervision system.

4.3. Control measures

The management and control of cold chain transportation must continuously adapt to the new situation and changes, improve the management and control methods, and enhance the efficiency of management and control. In terms of management and control methods, from tradition to wisdom, from single to multiple. That is to say, the transition from the past mainly administrative means to the coordination and

cooperation between administrative means, legal and standard means, and economic means, complements each other, and continuously enriches and innovates control means. At the same time, it is necessary to take the road of scientific and technological supervision, strengthen the in-depth integration of technology and supervision, improve the level of informatization of supervision, realize information sharing among regulatory agencies, between regulatory agencies and regulatory objects, and avoid regulatory delays and high costs, ensure the quality and efficiency of supervision.

(1) Regulations and standards

Regulations and standards are the basis for the implementation of management and control. The means of supervising market economic activities through the formulation and application of regulations and standards play an important role in the management and control of cold chain transportation. Therefore, the improvement of cold chain transportation control should be based on the characteristics of cold chain transportation. In view of the current problems and emergencies in cold chain transportation, we have to propose the formulation of corresponding special management measures or the revision of existing regulations. At the same time, we will study and formulate basic and critical standards and regulations to improve the effectiveness and operability of regulations and standards, so as to build a sound system of regulations and standards for cold chain transportation.

(2) Administrative measures

Administrative means are the means by which the state adopts administrative orders, instructions, indicators, regulations and other administrative measures to regulate and manage the economy through administrative agencies. Specifically for cold chain transportation, administrative entities can supervise the cold chain transportation market by setting up cold chain transportation enterprises and administrative licensing methods for market access for refrigerated and insulated vehicles.

(3) Technical means

Adopt advanced technologies such as the Internet, the Internet of Things, and big data to achieve smart management and control. The characteristics of smart management and control include: First, the application of big data, that is, through the full collection of massive data, multiple overlays, mutual stimulation, mining and release of more information, so that the industry situation can be accurately recognized, the control measures are implemented, and the implementation effect valuable; Second, refined management and control, that is using problem-oriented and service-oriented thinking, relying on information technology to restructure business, and solve the problems and weak links in traditional supervision. For example, through technical means to collect the source of cold chain transportation information, temperature control during transportation and monitoring of in-transit conditions, accident investigation and traceability, etc.; Third, dynamic and real-time supervision, that is the rapid transmission of information. It will change the level of work mode. The management department discovers the problem at the first time, initiates a response, and handles it properly. Such as temperature control early warning and emergency response, the regulation of cold chain logistics capacity in the event of public safety emergencies, etc.

(4) Economic means

Economic means are measures that use economic policies and plans to influence and regulate social and economic activities through the adjustment of economic benefits. Specifically in cold chain transportation, the development of cold chain logistics requires not only government supervision, but also economic means and financial intervention, such as the regulation of capacity allocation, the issuance of passes, the inclination of first evaluation and the combination with loan insurance, etc. The industry's guidance and encouragement of intensive, large-scale, specialized, and standardized cold chain transportation will improve the service quality of cold chain logistics and promote the high-quality development of the industry.

5. Related suggestions

(1) Strengthen the top-level design and establish the whole process managing and controlling mechanism of cold chain transportation by road

Strengthen the top-level design of road cold chain transportation management at the national level.

Study and formulate the "Road Cold Chain Transportation Management Measures" to clarify relevant regulations and requirements for market access, vehicle and equipment management, transportation operation and supervision and inspection, and classification and classification management. Provide system guarantee for the establishment of the whole process management mechanism of "market access-process monitoring-service evaluation-joint punishment" for road cold chain transportation, so that industry management can be based on. At the same time, through the "Road Cold Chain Transportation Management Measures" and other normative documents to quote the existing recommended standards for cold chain transportation to improve the implementation of standards. By innovating regulatory mechanisms and improving management methods, we will enhance the modernization of industry governance capabilities and create a good policy and institutional environment for the high-quality development of cold chain logistics.

(2) Speed up the development of standards and strengthen the access management of refrigerated transport vehicles

According to national and industry-level regulatory requirements, refrigerated vehicles must be strengthened as special freight vehicles, and temperature monitoring equipment performance requirements must be taken as the basic conditions for the operation of refrigerated vehicles. One is to accelerate the research and formulation of relevant technical performance standards for refrigerated vehicles. The technical performance requirements, inspection items and methods for refrigerated trucks have been added to the relevant standards for the technical performance of road transport vehicles. It can be used as an evaluation of the effectiveness and usability of refrigerated vehicles entering and exiting the road transportation market for production and operation activities. It can provide the basis and basis for the subsequent comprehensive performance testing of refrigerated trucks, and then provide support for strengthening the market access management of refrigerated trucks. The second is to strengthen the application of "informatization + intelligence" detection methods. The road cold chain transportation monitoring platform can provide refrigerated transport vehicles with "informatization + intelligence" detection methods through daily monitoring data, which can facilitate, quickly and accurately determine the effectiveness of key equipment such as refrigerated vehicles' driving temperature recorders and refrigeration units. As one of the basis for comprehensive performance testing of refrigerated vehicles, the operation monitoring report of Refrigerator will improve work efficiency and management level, and will also help guide cold chain transportation companies to improve the level of technical equipment of vehicles.

(3) Accelerate the cultivation of high-quality enterprises and play a leading role in demonstration

One is to establish the goal of "supporting the good and driving the bad, standardizing the market, and improving quality". Carrying out cold chain logistics pilot demonstrations and brand creation should focus on vehicle access management, transportation organization model innovation, transportation temperature control management, upstream and downstream information sharing, standard formulation and application. Advocate the concept of full temperature control and continuous cold chain chain, and further play the positive guiding role of the industry. Creating a development environment that continuously improves the quality and efficiency of cold chain transportation services can meet the requirements of food circulation safety. The second is to encourage high-quality cold chain logistics companies to integrate urban and rural cold chain logistics resources through equity holdings, mergers and reorganizations, collaborative alliances, etc., and use advanced transportation organization methods such as multimodal transportation, drop-and-hook transportation, and joint distribution to promote the intensification of cold chain logistics , Large-scale development, leading the industry to transform and upgrade high-quality development.

(4) Strengthen multi-departmental linkage and coordination to form a supervisory force

Cold chain logistics is a long-chain combination mode from front-end production area, mid-end circulation production, warehousing, sorting, packaging, transportation to terminal distribution and delivery. It involves market supervision, development and reform, industry and information, transportation, commerce, agriculture and rural areas, public security and other industry management departments. It is difficult for a single department to form a full chain of supervision. It requires

coordination and convergence of various relevant management departments. In the next step, the transportation department should strengthen coordination and cooperation with relevant departments such as market supervision, commerce, public security, etc., establish an effective linkage mechanism for industry supervision, promote information sharing and joint pilot projects with relevant departments, and form a whole chain of cold chain logistics supervision system.

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