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# Research on Innovative Management of Smart Cold Chain Logistics: Taking Cobia Shanwei of Guangdong as an Example

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**Abstract:** Intelligent cold chain logistics is the product of the wide application of modern information technology in the logistics industry, and is the inevitable result of the logistics industry's development to an advanced stage. Shanwei, as the "seafood gourmet capital" of China, has rich marine resources, which provide good conditions for the growth of cobia. However, with the development of the Internet, big data, blockchain, artificial intelligence, and other technologies, cold chain logistics has entered the era of intelligence. Shanwei cold chain logistics is facing a series of challenges, such as a low intelligence level, and a more traditional mode, affecting the quality of frozen products and timeliness of transportation, restricting the development of the frozen products industry. Intelligent cold chain logistics is of great significance in improving the supply level of cobia and ensuring food safety.

**Keywords:** Intelligent cold chain logistics; Fresh products; Cobia Shanwei; RFID technology

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## 1. Introduction

### 1.1. Research background

With the transformation and upgrading of the logistics industry and the comprehensive development of territorial spatial planning, Shanwei's transportation conditions are gradually optimized, and it is planned to integrate into the Guangdong-Hong Kong-Macao Greater Bay Area. In this context, Shanwei City has formulated the "Shanwei Logistics Special Plan (2021–2035)." The proposal of this policy and goal points out the development strategy and goal of the smart cold chain in Shanwei City, which marks that the fresh supply chain model of Shanwei City will get a series of innovative optimizations. With the continuous development of technologies such as the Internet of Things, big data, artificial intelligence, and blockchain, it is gradually applied to the cold chain logistics industry, which promotes the development of cold chain logistics in the direction of wisdom, digitalization and number intelligence, such as the emergence of new forms such as cloud

warehouse, contactless distribution and cold chain cloud platform [1]. Shanwei's traditional aquatic product supply chain makes it difficult to fully meet the current market demand of the fresh industry, in the context of digital transformation, digital smart cold chain logistics will become an important tool for the transformation and upgrading of the fresh industry, and promote the innovation of cobia smart cold chain logistics.

Cobia belongs to the genus Cobia family of Percostomiformes. It is a kind of high-quality and precious aquatic product with tender meat and delicious taste, rich in amino acids and polyunsaturated fatty acids in muscle, comprehensive composition of trace elements, and high nutritional and medicinal value. It is loved by consumers and has become a part of Shanwei seafood culture. It is also an important breeding object of Shanwei modern marine ranch project. But at present, the cold chain transport mode in Shanwei area is more traditional, for the transportation of fresh cobia in large goods, the level of intelligence is low, the transportation efficiency is not high, and the transportation cost cannot be further reduced. Fresh cobia in the transport process of small goods cannot maintain a constant low temperature for a long time, affecting the quality and safety of the transport process of cobia.

## 1.2. Research significance

In the current era of the digital economy, digital transformation is of great significance to the development of smart supply chain models in the fresh industry [2]. Smart cold chain logistics uses the Internet, big data, the Internet of Things, and other technical means to achieve logistics information, intelligent and efficient management methods, improve the cold chain logistics transportation efficiency, and achieve technology-driven efficiency improvement [3]. The application of intelligent cold chain logistics in cobia logistics ensures that cobia is always in a suitable temperature and humidity environment in the process of transportation, storage, and sales, reducing the risk of deterioration, corruption, and bacterial reproduction of cobia, thus maintaining the freshness and quality of cobia. At the same time, it can also optimize the transportation path, reduce the loss of goods in the transportation process, effectively meet the practical needs of consumers for high-quality cobia, and realize the high-quality and efficient transformation of products from the site to the table [4].

## 1.3. Literature review

Ma (2023) links the development of the industry with professional talent resources and believes that the talent support system of cold chain logistics enterprises is not perfect, and cannot effectively stimulate the initiative of employees, resulting in most employees not learning independently, and cannot promote the development of fresh cold chain logistics industry [5]. Li *et al.* (2024) believe that future development of cold chain logistics should actively grasp the development opportunities of digitalization and industrialization integration, enhance the level of information technology, strengthen resource integration, strengthen the formulation and improvement of relevant standards, train professional talents, and promote the standardization and process of the development and implementation of cold chain logistics [6]. Wu *et al.* (2024) calculated the value based on the life cycle method by using the entropy weight method to calculate the index weight, and then carried out the greenness evaluation with the grey relational degree method, and concluded that the energy utilization rate of vehicles is a factor that has a greater impact on the greenness, and improving the cargo load rate can improve the greenness of fresh agricultural products cold chain logistics [7]. Guo (2019) believes that in reality, compared with the conventional logistics system, the cold chain warehousing logistics mode in the new era needs more advanced means to support its operation and management. The use of mature information technology can reasonably monitor the links in the supply chain, to avoid supply chain breaks, reduce the

risk of logistics work, strengthen the effect of logistics work, and ensure the safety of cold chain logistics transportation [8]. Based on the research of radio frequency identification technology, Hu (2023) concluded that the use of the Internet of Things application system and the application of RFID technology in the construction of the temperature control management system of agricultural cold chain logistics can make the cold chain logistics management more efficient, accurate and transparent, and reduce the loss rate of agricultural products in circulation. This can reduce the loss and circulation of waste of agricultural products, and promote the circulation of agricultural products to achieve intelligent and automated conclusions [9]. Shu *et al.* (2023) based on radio frequency identification technology to design a centralized supervision system of imported cold chain food, the system uses RFID identification reader, can realize the whole process of unified information entry of the owners, imported cold chain food enterprises, carriers, storage enterprises, customs and other main bodies, the owners can download, scan and upload imported cold chain food label information. Through the system's remote view of the cold storage operation site of the goods, the regulatory authorities through the system can be the site of the collection of goods and dynamic supervision, to achieve from "information entry, on-site inspection, real-time query" to "online complaints" and other functions of one-stop processing [10].

## 2. Analysis of the current situation

### 2.1. Market demand and supply

In recent years, China's national economy has continued to develop, per capita disposable income has increased, the consumption capacity of aquatic products is also improving, and with the change of consumption concepts, people are more in pursuit of high-quality seafood. The market demand for fresh products is also increasing, as one of the precious sea fish, cobia, its high meat rate, nutritional value is extremely rich, and diverse practices, cobia is deeply loved by consumers.

Shanwei is the strategic fulcrum of Guangdong's coastal economic zone, with an important outlet to the sea and rich Marine resources. Its sea area reaches 23,900 square kilometers and its coastline is 455 kilometers, ranking second in Guangdong Province and first in East Guangdong Province. Among them, Shanwei has Jieshi Bay, Red Bay, and three sea lakes among the three major bays in East Guangdong. There are 12 ports along the coast, and it is one of the four major fishing grounds in China. The market supply of fresh products in Shanwei area is very large, and it has great potential and space for the market demand at home and abroad. At the same time, it also faces fierce competition in the domestic and foreign markets and the quality requirements of consumers. The fresh products in Shanwei area mainly include seafood products represented by fresh fish, fish balls and dried fish, which are sold to domestic and foreign markets. Among them, the seafood products represented by cobia are "cobia XO sauce." After a special processing method, the fish is mixed with other seasonings to improve the preservability, increase the taste and facilitate transportation. The transportation of fresh cobia is affected by the size of the fish itself, the maintenance of freshness and timeliness in the transportation process. The traditional cold chain transportation and backward management equipment not only affect the quality and timeliness of cobia in the transportation process but also restrict the development of the fresh products industry, which makes it difficult to meet the requirements of consumers.

### 2.2. Cold chain logistics status analysis

#### 2.2.1. Insufficient infrastructure construction

According to the National Development and Reform Commission, China's per capita storage area will only

be 0.13 cubic meters per person by 2022, far lower than that of developed countries. Cold storage capacity is unevenly distributed geographically, mainly in coastal zones and first-tier developed cities while central and western regions and major agricultural producing areas are short of cold storage resources [11]. The number of supporting facilities such as refrigerated trucks is small, the technical level is low, and the transportation efficiency is low.

### 2.2.2. The cost of cold chain logistics is relatively expensive

It is mainly composed of transportation costs, storage costs, inventory costs, and management costs, of which transportation and storage costs account for a large proportion. The low degree of informatization of cold chain logistics, from the origin to the consumer cannot get the matching chain information in time, resulting in unequal production and demand.

### 2.2.3. The application of emerging technologies is insufficient

The automation level of cold chain logistics is not high, the mode is more traditional, and the automated operation of warehouses and distribution centers can be realized by using technologies such as smart devices, apis and cloud databases. The application rate of robot technology is not high, and it cannot be used to help manage inventory from warehouse to delivery area to achieve the effect of reducing manual intervention, reducing labor costs and improving production efficiency. Taking Shanwei as an example, the fresh products company in Shanwei still adopts the traditional experience classification in the selection of logistics companies, compares the quotation information of third-party cold chain logistics companies with the traditional telephone contact, and selects the best partner based on their reputation. The cost loss is high, and the data management and business operations have been in a backward state for a long time. The refrigerated transportation of small goods is the traditional combination of foam box and ice pack, and through the third-party logistics company for distribution, this packaging combination cannot provide enough cold chain protection, especially in long-term transportation or extreme temperature conditions, the cooling effect of ice pack is limited, cannot maintain a constant low temperature, affecting the quality and safety of goods. This kind of refrigeration will produce a large amount of waste, which will have an impact on the environment.

### 2.2.4. The regulatory system is not sound

Food safety risks are high. At present, China has not yet formed a completely independent cold chain logistics system, the development of cold chain logistics still only stays in the transport and refrigeration links, and the use of advanced information technology in cold chain logistics management system is still obviously insufficient, the standard of cold chain logistics is not unified, the lack of top-level design between various departments, failed to form a “whole chain” regulatory system. The “broken chain” of cold chain logistics occurs from time to time, resulting in the supply chain of agricultural products and fresh food being broken, and there are also problems of low storage quality and high decay rate of products, which affect the purchasing experience of consumers [12].

## 3. Target improvement

### 3.1. Improve the efficiency and intelligence of cold chain logistics

Improvement can be done through strengthening infrastructure construction and improving the coverage and

efficiency of cold chain logistics. Besides, increasing investment in cold storage, refrigerated trucks and other facilities, optimizing the layout and structure of cold chain logistics, improving the transportation capacity and speed of cold chain logistics, and reducing the cost and loss of cold chain logistics can be good ways to improve on the target. At the same time, new technologies such as the Internet of Things, big data and cloud computing are used to improve the intelligence level of cold chain logistics and realize the visualization, traceability and control of cold chain logistics. The transportation and packaging of small goods are innovated to ensure that the goods are always in the appropriate ambient temperature during transportation and to ensure product quality and safety.

### 3.2. Establish unified standards and green supervision

Improve the supervision system and establish unified standards and norms for cold chain logistics. At the same time, the establishment of a standard green cold chain supervision mechanism improves energy efficiency, reduces energy consumption, reduces operating costs, reduces environmental pressure, effectively promotes the healthy development of China's cold chain logistics distribution system, meets market demand, and improve consumer satisfaction [13].

### 3.3. Upgrading the cold chain logistics industry in Shanwei area

Use smart logistics to empower existing cold chain logistics enterprises in Shanwei, promote cold chain logistics enterprises to reduce costs, and then improve the comprehensive ability of cold chain logistics to serve the food manufacturing industry to achieve the deep integration of cold chain logistics and food manufacturing industry.

## 4. Improve the method

To solve these problems and enhance the competitiveness of cobia, intelligent cold chain logistics is an effective solution. Smart cold chain logistics is a new model that uses emerging technologies such as the Internet of Things, big data and artificial intelligence to realize real-time monitoring, comprehensive control, intelligent optimization and automation of the whole process of cold chain logistics to integrate and extend the cold chain logistics value chain. Smart cold chain logistics can improve logistics efficiency, reduce logistics costs, improve logistics services, ensure logistics security, and realize many benefits of logistics greening. The use of smart cold chain logistics can improve quality and efficiency, ensure the quality and safety of goods, and reduce logistics costs.

### 4.1. Implement digital management

Through the Internet of Things technology, all kinds of data and information are collected in real-time to provide users with high-quality information and consulting services, and enterprises with the best decision support. At the same time, blockchain technology is used to ensure the security and reliability of data, achieve full traceability, and prevent information tampering. Through the Internet of Things technology, intelligent optimization of demand forecasting, inventory management, transportation route planning, distribution scheduling and other links of fresh products can also be realized, improving the utilization rate of logistics resources and operational efficiency. For example, according to the weather, seasons, market demand and other factors, forecast the demand for products, optimize inventory management and transportation plans.

## 4.2. Implement full link real-time tracking and temperature control management

Based on wireless RFID technology, a real-time tracking system of cold chain logistics information can be built. This system includes a label data sensing terminal, card reader data transmission terminal, and background server data management terminal. Through the wireless RFID card reader, you can obtain the real-time temperature of food, vehicle operating position information, agricultural product information, and other data, from the cold chain logistics starting point to the endpoint, to achieve real-time tracking and monitoring of cold chain logistics information, ensuring the quality of goods in the entire transportation process, once abnormal, the system will issue an alarm to help logistics personnel take measures in time.

## 4.3. Construction of the automated warehouse

Through automation technology, optimize the storage link, realize the intelligent storage of fresh products automatic identification, classification, picking, loading and unloading, distribution and other operations, reduce manual intervention and errors, and improve the speed and accuracy of logistics operations. Through RFID tags, it can realize the rapid reading and writing of data and processing, track the location and status of the goods in real-time, reduce the loss of inventory, and show high efficiency in the identification and tracking of large-scale items [14].

## 4.4. Use innovative technologies and materials

For the food deterioration of small goods in refrigerated transportation, its microbial corruption and its metabolism and oxidation amount are affected by packaging, the natural environment and other factors, the use of intelligent sensors and labels in the field of food detection has the advantages of higher sensitivity, faster detection speed, real-time monitoring and on-site detection can be realized to ensure the quality and safety of goods, with strong practicability [15]. At the same time, the application of phase change materials to improve the packaging box, phase change materials can form a stable temperature barrier around the goods, to prevent temperature fluctuations on the goods. The use of nanotechnology to improve the performance of packaging materials enhances their thermal insulation performance, and antibacterial performance, and improves the insurance effect and safety of small goods.

## 4.5. Establish a sound supervision system

Formulate standards and operating norms covering all links of cold chain logistics, strengthen coordination and communication between departments, establish a whole-process traceability system, form a “whole chain” regulatory system, ensure that every link can be monitored and recorded, improve the green standardization, safety and transparency of cold chain logistics, and achieve standardization and standardization of cold chain logistics. Strengthen the quality testing and risk assessment of cold chain logistics, discover and deal with the “broken chain” problem of cold chain logistics promptly, and ensure the safety and quality of cold chain items.

## 4.6. To build a smart logistics platform for aquatic products in Shanwei area

Improvements such as continuously enriching the service scenes, promoting the cost reduction and efficiency of cold chain logistics and realizing data precipitation in the local area can be done. The platform is interconnected with provincial and national platforms and social third-party platforms, and constantly enhances the capacity of the digital empowerment industry.

## 5. Summary

To sum up, the smart cold chain logistics management system based on the construction of digital technology enables Shanwei fresh industry. The case of Shanwei cobia, it shows how to effectively improve logistics efficiency, how to ensure product quality and safety in transportation, and how to reduce costs in management mode. With the continuous upgrading of information technology, cold chain logistics is also developing in the direction of more intelligent and automated, which continues to bring more efficient, safer and more convenient logistics services to the fresh industry.

## Disclosure statment

The authors declare no conflict of interest.

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