



RESEARCH ON FOOD COLD CHAIN LOGISTICS SYSTEM COLLABORATION

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ABSTRACT

Logistics system aims to meet customer needs in all aspects of logistics services, provides professional and efficient logistics services, to reduce the costs and improve customer satisfaction. The improvement of the overall efficiency of the logistics system cannot be achieved rely on a single enterprise, it need the collaboration between the main enterprises in logistics system, so logistics collaboration has become an important trend in the modern logistics operation. This paper focuses on the analysis of the connotation of food cold chain logistics system collaboration in order to provide the theoretical basis for the implementation of the food cold chain logistics system collaboration and specific and operational ideas for the realization of the collaborative target of food cold chain logistics system: it clear defines the goals and principles of collaboration. Finally, it analyzes the content of collaboration and collaborative process.

1. Introduction

Logistics system aims to meet customer needs in all aspects of logistics services, provides professional and efficient logistics services, to reduce the costs and improve customer satisfaction. The improvement of the overall efficiency of the logistics system cannot be achieved rely on a single enterprise, it need the collaboration between the main enterprises in logistics system, so logistics collaboration has become an important trend in the modern logistics operation (Liu et al., 2011).

Logistics collaboration has crucial strategic significance for the operation of logistics system. To see it simply, the collaboration of logistics system refers to the formulation of corresponding logistics plan and implementation strategy by each main enterprise in logistics system based on the overall objectives of the system (Zhang and Chen,2014). They jointly set up the logistics system through mutual cooperation in the actual operation of the process, and aim to improve the level of logistics service, reduce

logistics costs, enhance logistics efficiency (Qi and Tian,2011).

After the clear definitions of food cold chain logistics and logistics collaboration, this paper puts forward the meaning of food cold chain logistics collaboration (Zheng et al.,2013). Food cold chain logistics system collaboration means that in the flow process of the entity from supplying place to receiving place, the main enterprises in food cold chain logistics system through mutual cooperation, information and resource sharing to achieve the seamless joint in all aspects of food cold chain logistics in order to maintain food in required temperature environment which is necessary to maintain its quality (Qiu and Zhang,2009), to realize the goals of food security, the improvement of the efficiency of food logistics and reduction of logistics cost.

This paper focuses on the analysis of the connotation of food cold chain logistics system collaboration in order to provide the theoretical basis for the implementation of the food cold

chain logistics system collaboration and specific and operational ideas for the realization of the collaborative target of food cold chain logistics system: it clear defines the goals and principles of collaboration. Finally, it analyzes the content of collaboration and collaborative process. As shown in figure 1.

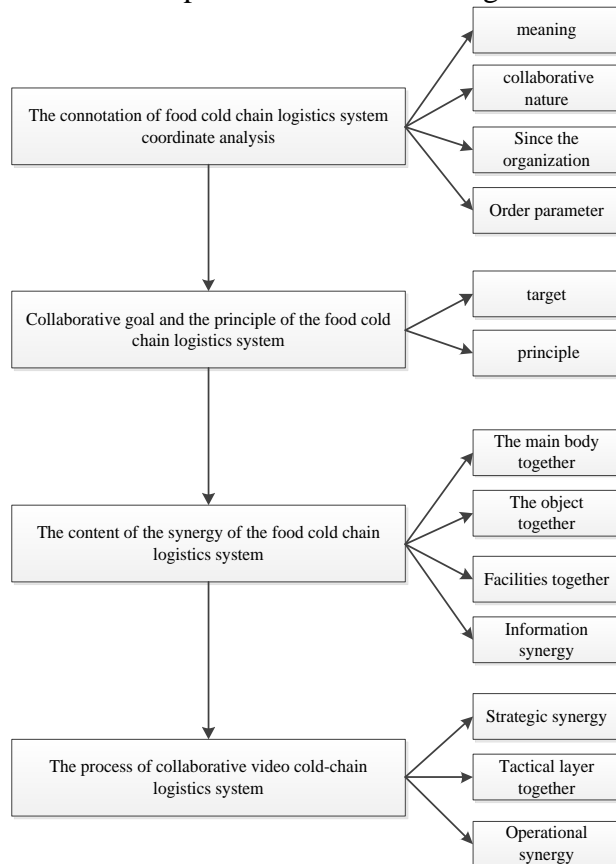


Figure 1. The Content of collaborative video cold-chain logistics system

2. Materials and methods

2.1. The goal of Food cold chain logistics system collaborative

Food cold chain logistics system collaboration achieves the seamless connection of food cold chain logistics in the actual operation process by mutual cooperation and information and resource sharing. In view of this, it can be concluded that the food cold chain logistics collaboration has three objectives, namely, safety, efficiency and cost. See Figure 2.

(1) The safety objective of the food cold chain logistics collaboration

On the one hand, the food cold chain logistics reaches a higher standard of food logistics safety by the standardization of food logistics operation, so as to guarantee the safety in the process of logistics. On the other hand, the food cold chain logistics must conducted effective supervision to ensure the timely detection of problems and reduce the hazards to a minimum. This can be realized from two aspects. One side is to establish strict inspection to conduct effective inspection of food; another side is to implement temperature monitoring in the process of logistics to prevent harmful effects due to temperature change (Li et al.,2015).

(2) The efficiency objective of the food cold chain logistics collaboration

For various kinds of fresh and perishable food, the less time from production place to consumption place, the more able to ensure the freshness and quality, which requires the food cold chain logistics system with high efficiency. There are two factors to determine the efficiency of food cold chain logistics: one is the efficiency of the logistics between subjects in different system, another is the efficiency of the transfer between subjects in the logistics system(Hu et al.,2015). The main factor that determines the efficiency of the logistics between subjects in different system is the efficiency of the transport system, and the main factor that determines the efficiency of the transfer between subjects in the logistics system is the collaborative degree of each subjects. The objectives of food cold chain logistics collaboration are to improve the collaborative degree of each subject (Wang et al.,2009), reduce the waste of time in handover process at different nodes, and enhance the logistics efficiency between different subjects through mutual cooperation and information and resource sharing to ultimately increase the efficiency of the whole food cold chain logistics system (Hang and Wang,2014).

(3) The cost objective of the food cold chain logistics collaboration

As a subsystem of social economic system, food cold chain logistics system regards the economic efficiency as an important goal. The above has been stated that the operating costs of food cold chain logistics system are higher than that of the general logistics system. This is because the operation of food cold chain logistics needs to be equipped with a dedicated refrigeration facilities supported by logistics networks. In terms of facilities, the biggest difference between the cold chain logistics and the normal temperature logistics is that the cold chain logistics need refrigerated trucks, insulation vehicles and cold storage. These facilities not only cost a lot, but also consume high energy in the operation process, which resulting in high investment and operating costs. To a certain extent, resource sharing can reduce the investment of enterprise's resources and the operation cost of cold chain logistics(Li,2010). Secondly, the food cold chain logistics collaboration can shorten or eliminate the invalid link in the logistics process and reduce the logistics time. And the food in the process of logistics needs refrigerated transport vehicles, which have higher refrigeration costs in transit, so we can shorten the logistics time to reduce the logistics cost.

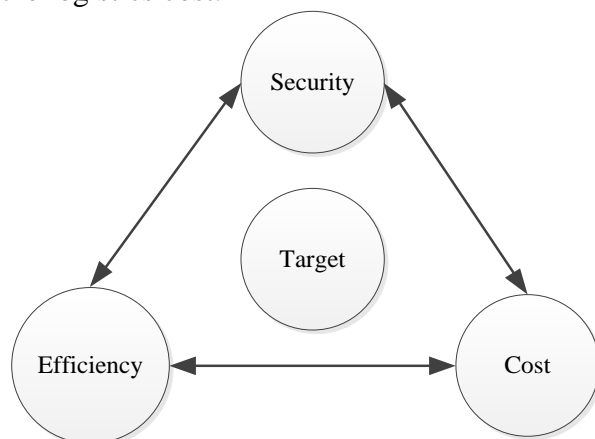


Figure 2. The food cold chain logistics system goal together

2.2. Content analysis of the food cold chain logistics collaboratio

Food cold chain logistics system can be divided into three types of elements: subject, object, facilities. Correspondingly, collaborative object can be classified as subject collaboration, object collaboration and facilities collaboration; in the collaborative process of various elements, information collaboration plays an important role, so the food cold chain logistics collaboration can fall into the subject collaboration, object collaboration, facilities collaboration and information collaboration from the aspect of content. The following are the details of the food cold chain logistics system collaboration, see Figure 3.

2.3. The subject collaboration in food cold chain logistics system

The subjects of food cold chain logistics system refer to the members in food cold chain logistics including the suppliers of food raw materials, the manufacturers of food processing, the retailers of food wholesale, the providers of food logistics. This paper expounds the collaboration between the subjects in food cold chain logistics from two aspects: the nature and the number of the collaborative subject.

(1) Classify according to the nature of collaborative subject in food cold chain logistics system

From the point of the nature of collaborative subject in food cold chain logistics system, the collaboration in food cold chain logistics includes horizontal collaboration and vertical collaboration.

① The subject horizontal collaboration in food cold chain logistics

In general, the food cold chain includes the suppliers of food raw materials, the manufacturers of food processing, the retailers of food wholesale, the providers of food logistics and other members; these members are also the main enterprises of food cold chain logistics. The vertical collaboration between subjects in food cold chain logistics means the collaboration between the same type enterprises

in different food cold chain logistics systems, such as the suppliers' collaboration between different food raw materials, manufacturers' collaboration between various food processing and the providers' collaboration between different food cold chain logistics, as shown in Figure 4.

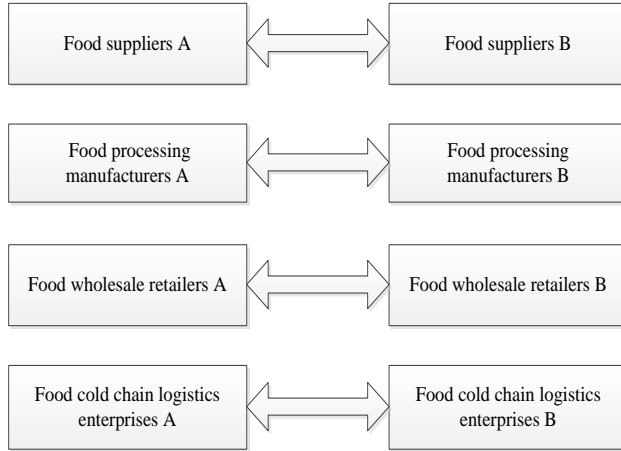


Figure 3. Food cold chain logistics main body horizontal coordination

The suppliers' collaboration between different food raw materials refers to the cooperation between the suppliers of food raw material in order to obtain the collaborative effect.

Such as the cooperation between the suppliers who belong to same type of food enterprises in order to solve the problem of insufficient resource of refrigeration storage and reduce the costs and risks of investment.

The suppliers of food raw material in different food cold chain can achieve the goal of enhancing their competitive power through the horizontal collaboration to improve both competitiveness of the food cold chain.

②The subject vertical collaboration in food cold chain logistics

For the food cold chain logistics system, the collaboration forms between the subjects are as follows: the collaboration between food suppliers and food processing manufacturers, the collaboration between food manufacturers and retailers, etc., as shown in Figure 5

There are two forms in the collaboration between food suppliers and food processing manufacturers: one is under the powerful food suppliers, in order to strengthen the function of sales or achieve the efficiency of logistics business, food suppliers play the main role in the logistics, or they carry out the distribution with high frequency and small volume for food processing manufacturers by the use of their information network. Another is that the food suppliers' power are relatively weak, but the food processing manufacturers' strength are strong, the logistics activities processed intensively by food processing manufacturers.

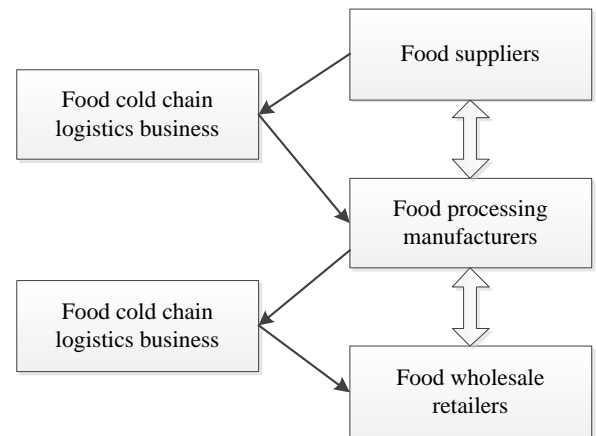


Figure 4. Food cold-chain logistics vertical coordination

(2) Classify according to the range of collaborative subject in food cold chain logistics system

The collaboration between subjects in the food cold chain logistics refers to the collaboration between the various sectors in the same enterprise to achieve their own collaborative effect. That is, after the implementation of the overall collaboration between the various departments within the enterprise, the overall efficiency of the enterprise is beyond the sum efficiency of the various departments of the enterprise.

Take the food cold chain logistics enterprise as an example, the internal collaboration means that the departments within the enterprise like business department,

warehousing department, transportation department and customer service department realize collaboration of every department in terms of personnel, equipment, institutions and organizations to achieve the common goal of improving the business efficiency and benefit.

The collaboration between these departments not only helps to achieve the seamless convergence of enterprise internal business process, but also improves the efficiency of enterprise operation.

The implementation of subject internal collaboration is the basis for food cold chain to achieve collaboration; only each subject straightens out their business process, realizes the efficient and smooth operation in all business processes and related organizations and personnel.

2.4. Object collaboration in food cold chain logistics system

The object of food cold chain logistics system is food. Compared with the objects of the general logistics, the food’s characteristics and its requirements for food cold chain logistics can be explained from two aspects: the temperature and the time, the following will discuss object collaboration in food cold chain logistics system from these two aspects.

(1) Temperature collaboration in food cold chain logistics system

Temperature is the most typical factor that reflects the difference between food and other logistics objects.

Food, especially the food that needs to be frozen and refrigerated, should be ensured its safety and quality, reduce the loss, and the logistics process of these foods must be in a specific temperature range.

Different types of food have different requirements on the temperature, which can be divided into four categories: cooled food, frozen food, iced fresh food and ultralow temperature food. Different kinds of food must be stored in a special low temperature environment to ensure its quality, prevent food safety problems caused by its deterioration, and reduce losses. The characteristics of the food are exactly why the operation of food cold chain logistics system is more difficult than the general logistics system. But there is a broken link in the operation process of food cold chain logistics. Seamless connection between the subjects in the food cold chain is not realized which often leads to temperature fluctuations of food in the process of transport or storage, and brings about higher loss rates and food safety issues.

Table 1 The coordinated development of food cold chain logistics system process

	Organization	Resources	Information
Strategic synergy	Construction of cooperative organization Collaborative maintenance and continuous improvement of the organization	Software resource synergy Hardware resource synergy	Determine the information system strategy Determine the information sharing mechanism
Tactical layer together	Subjects to the enterprises determine the content The main body enterprise internal organization adjustment	Software resources tactical coordination layer Hardware resources tactical coordination layer	Share the order information Information sharing distribution plan Shared inventory information
Operational synergy	The application of information technology Operation standardization and normalization		

(2) Time collaboration in food cold chain logistics system

In addition to the temperature, another characteristic of the food is reflected in its special requirement of time. The general goods outside the food also have higher demands for the time in the process of logistics, which mainly to improve the efficiency of logistics

and reduce the cost of logistics. The shorter the time used in the logistics process, the higher the logistics efficiency, the lower the corresponding logistics costs. For food, its requirements for reducing the logistics time are not only reflected in the reduction of logistics costs, but also in the special requirements of the time, such as the restriction of shelf life.

Beyond the restriction of time, we cannot guarantee the food's quality, taste, character, which may resulting in food safety issues. Therefore, in order to shorten the time of food

logistics and improve the efficiency of food logistics, the time collaboration in food cold chain logistics system needs to be realized.

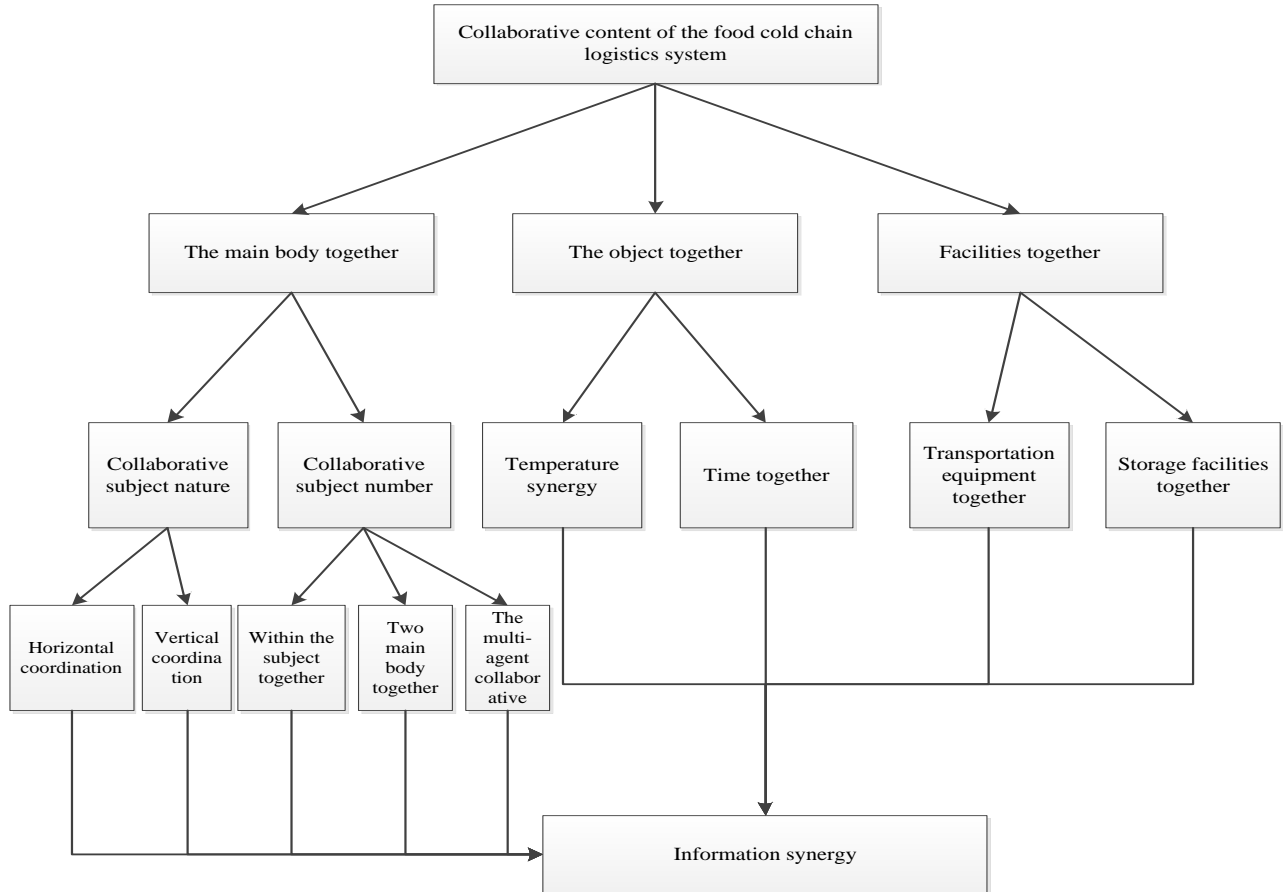


Figure 5. The classification of food cold chain logistics system coordination

2.5. Facilities collaboration in food cold chain logistics system

Facilities collaboration in food cold chain logistics system refers to a consensus reached between subjects on transport equipment purchase, maintenance, use and other aspects so as to improve equipment utilization rate. The main transport equipment used in cold chain logistics activities are: refrigerated vehicles, railway refrigerated vehicles, refrigerated ships, refrigerated containers, refrigerated aircraft, etc. In order to meet the requirements of food safety, transport equipment should satisfy the relevant demands. For example, non-toxic, harmless, no extraneous odor, no pollution, and meets the

relevant requirements of food hygiene. The carriage body should be equipped with automatic temperature recording device to record the temperature inside the carriage body. The equipment also should be regularly inspected and maintenance, and immediately stop using if find any abnormalities of equipment, and timely maintain the equipment.

3. Results and discussions

The strategic collaboration of food cold chain logistics system carry out qualitative and quantitative analysis of the whole food cold chain based on conceptual model and collaborative management theory; the research

content includes the management factors and mechanism of logistics system collaboration. The performance of the strategic collaboration is beyond the limit of tolerance for each other in the past, but to bear responsibility for each other, to pay and to harvest. The tactical collaboration mainly includes the logistics collaborative strategy between upstream and downstream enterprise in food cold chain with a direct relationship between supply and demand; tactical collaboration integrate business processes between enterprises, which tightens business joint of each link and smooth the flow. Operational collaboration is the key and foundation for supply chain to realize collaboration, which mainly study on how to realize synchronization operation and information collaboration in supply chain; it integrates the information between partners or members tightly, realizes the real-time flow and sharing of information, which makes the partners have a better collaboration, and quickly response to changes and needs of customers and partners.

The collaboration process of food cold chain logistics system starts from the strategic collaboration to carry on the tactical collaboration based on the operation collaboration; the results of operation collaboration will affect the tactical collaboration. In the same way, the tactical collaboration will also impact the strategic collaboration. As shown in figure 7.

This paper analyzes the collaboration process of food cold chain logistics from three aspects: the organization (subject), resources and information according to the characteristics and elements of food cold chain logistics system, as well as the above content of the food cold chain logistics system collaboration, as shown in Table 1.

3.1. Strategic collaboration in food cold chain logistics

As mentioned before, the information is an important method and means to ensure the realization of cooperation; the collaboration can be guaranteed only when the matched information strategy is established after

analyzing the collaborative strategy on the organization and resource in food cold chain logistics system. Therefore, the first step in information strategy is to plan the goals of system's information construction and construct the framework under this goal based on the strategic targets of food cold chain logistics system. We should note that in determining the goals of information construction of the food cold chain logistics information system, the situation of members' information construction in the organization also need to be taken into account, such as the adopted information system, the modules included in the information system. Combining the actual situation with the goals of system information construction to make the information construction goals in line with the actual situation of the system, and also make the construction of the information system easy to be promoted among the members. Besides, the contents of the information system construction which depend on practical situations of the organization members and the resources collaboration will determine which modules,

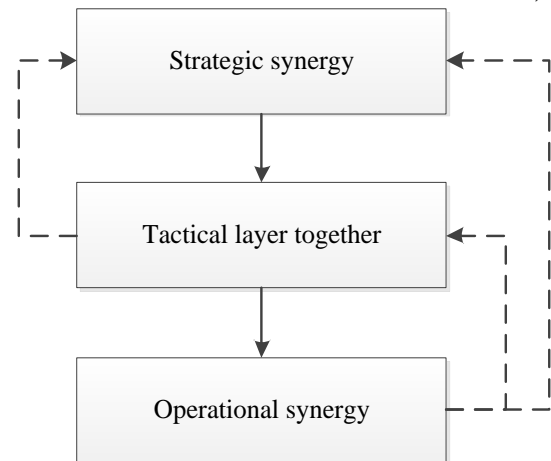


Figure 6. The collaborative process food cold-chain logistics system

what function should be included in the information system or what type of information sharing need subjects to realize for satisfying the organization and resource needs.

3.2. Tactical collaboration in food cold chain logistics

The production of enterprises will affect the supply of downstream enterprises.

In food cold chain logistics system, the downstream enterprises determine their inventory and production according to the production of upstream suppliers. Similarly, production of downstream enterprises also decided his demand to the supplier, thus they will affect the supplier's inventory and production plan. Hence, manufacturers can use the supplier's production and distribution plan to improve their planning standard, suppliers can also provide reliable supplies for the manufacturer based on the manufacturer's production plan. Moreover, exorbitant inventory is considered to be an important factor which influences the performance of food cold chain logistics system. Through the sharing of each subject's inventory information in food cold chain logistics system can greatly reduce the safety stock level of the whole logistics system and increase the competitiveness of the logistics system. For example, manufacturers timely adjust production through the understanding of the distributor's inventory information, etc.

3.3. Operational collaboration in food cold chain logistics

In order to guarantee no error happened in the various processes of the food cold chain logistics operation, we need to formulate appropriate operating standards in the actual operation process. In order to cover the various processes of the logistics operation, the formulated standards of food cold chain logistics operation need to include temperature records, tracking and monitoring, cargo inspection, cargo transportation and cargo warehousing and other fields.

At the operational level, the use of information technology makes all kinds of information can flow smoothly between each main enterprise; furthermore, the use of these techniques also can improve logistics efficiency; operating standards and norms formulation make

the strategic and tactical measures implemented in accordance with the norms of operation. The combination of these two aspects makes the strategic collaboration and tactical collaboration of food cold chain logistics achieved at the operational level.⁵

In addition to the temperature, another characteristic of the food is reflected in its special requirement of time. The general goods outside the food also have higher demands for the time in the process of logistics, which mainly to improve the efficiency of logistics and reduce the cost of logistics. The shorter the time used in the logistics process, the higher the logistics efficiency, the lower the corresponding logistics costs. For food, its requirements for reducing the logistics time are not only reflected in the reduction of logistics costs, but also in the special requirements of the time, such as the restriction of shelf life. Beyond the restriction of time, we cannot guarantee the food's quality, taste, character, which may resulting in food safety issues. Therefore, in order to shorten the time of food logistics and improve the efficiency of food logistics, the time collaboration in food cold chain logistics system needs to be realized.

4. Conclusions

The content of food cold chain logistics system is divided into subject collaboration, object collaboration, facilities collaboration and information collaboration. This paper expounds the subject collaboration in food cold chain logistics from two aspects: the nature and the number of the collaborative subject. The natures of the collaborative subjects in food cold chain logistics system include horizontal collaboration and vertical collaboration. The numbers of the collaborative subjects in food cold chain logistics system include internal collaboration of a single subject, collaboration between the two subjects and the collaboration among multiple subjects. The object collaboration in food cold chain logistics system includes temperature collaboration and time collaboration. Facilities collaboration in food cold chain logistics system includes transport equipment collaboration and

warehousing facilities collaboration. In addition, it divides the collaborative process into strategic collaboration, tactical collaboration and operational collaboration. It also analyzes the collaboration process of food cold chain logistics from three aspects: the organization, resources and information according to the characteristics and collaboration content.

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