# Research on Cost Optimization of Supply Chain Network in Dairy Industry

Fuya Gu *

Department of Accounting, Nanjing University of Science and Technology, Nanjing, China

*Corresponding author: 18251853332@163.com

**Abstract.** The domestic dairy consumption market is constantly expanding, but most dairy products are perishable and difficult to preserve. Therefore, the supply chain network of the dairy industry is special and its cost is relatively high. Based on Marshall L. Fisher's supply chain matching model, this paper constructs an agile supply chain network for the dairy industry, which is cost-optimized for each node and the whole.

**Keywords:** Dairy products, Supply chain network, Cost optimization.

## 1. Introduction

With the improvement of people's living standards and the improvement of dietary structure, the domestic dairy consumption market is constantly expanding, which not only brings opportunities to logistics companies, but also brings challenges. Because most dairy products have the characteristics of perishability and are not easy to preserve, and dairy products need to be processed, transported and distributed in a relatively strict temperature environment in the entire supply chain, and high-tech is also required to provide real-time temperature control information, so the supply chain network cost of dairy products is much higher than that of ordinary products. In the era when society has entered the era of great cooperation and alliance, the competition between enterprises has also changed into competition between supply chains. As the British scholar Christopher said: "There is only a supply chain in the market and no enterprises, and the competition in the 21st century is not the competition between enterprises and enterprises, but the competition between supply chains and supply chains." Therefore, if companies want to enhance their competitiveness and gain a foothold in the product market, they must implement supply chain management. Especially in the dairy industry, where the supply chain network is special and the cost is high, supply chain management is particularly important. The mutual coordination and close cooperation between various enterprises in the supply chain include not only vertical coordination between upstream and downstream enterprises, but also horizontal collaboration between similar enterprises. Under the premise of ensuring the quality of dairy products, cost optimization of supply chain networks is an efficient way to reduce product costs. Therefore, the design of a reasonable dairy supply chain network, reduce the cost of the supply chain network, and improve the operational efficiency and customer satisfaction of the entire supply chain network have become the current research hotspots.

## 2. Literature review

### 2.1 The structure of BP neural network

At present, many scholars at home and abroad have studied the dairy product supply chain from different perspectives. Li Qianxi (2020) found that the market demand-oriented adjustment of production and supply, the maintenance of a good production order and competition order, to ensure the market regulation balance, so that all parties in the supply chain benefit. Jie Maohua et al. (2019) took Yili Group as the research object, discussed the two issues of "why should we carry out the informatization of green supply chain cost management" and "what is the path for the implementation of green supply chain cost management informatization", discussed the important role of green supply chain cost management informatization in the stage of enterprise development, and built an integrated

path of enterprise cost management informatization based on green supply chain management. Qin Ye and Kang Yaowu (2014) elaborated on the development of the logistics chain of China's dairy industry and the impact of urban-rural integration on the supply chain of the dairy industry, and put forward the ideas and related measures for the integration of logistics supply chain in China's dairy industry based on the background of urban-rural integration. Yan Yan et al. studied the optimization of the total operating cost of the supply chain under the constraint of limited resources and the failure of normal network and single node failure for perishable products. Based on food safety, Li Susu and Xie Ruhe (2012) studied the safety and reliability of food cold chain logistics using quantitative analysis methods, and established an optimization model of cold chain logistics costs, which realized the balance and cost optimization between energy consumption costs and cargo loss costs.Qian Guixia (2014) et al. took Hohhot as a case study to study the problem of revenue distribution in the dairy supply chain, and proposed a revenue distribution model that satisfied all node members of the dairy supply chain and had a win-win situation. Chen Xin (2013) et al., with the goal of maximizing total desired returns, studied the joint pricing and inventory control problems of fixed-life-cycle perishables based on consideration of order costs, inventory holding costs, backorders, and penalty costs for lost orders. Bilgen and Celebi (2014) studied the scheduling and distribution planning problems of multiple yogurt production lines on dairy product lines, and established a linear mixed integer programming model to give the best production plan and distribution plan for each production line Nicholson et al. (2013) took the US dairy products as an example, studied the impact of multi-product food supply chain facility location on the cost of each part of the supply chain, and proposed a transshipment model to minimize the total cost of the supply chain.

In summary, the current research results on the optimization of the dairy supply chain are still relatively small, most of which are studied for some problems in the food cold chain logistics, and the special requirements of the dairy products themselves for the supply chain network are not fully considered, and the design of the distribution network is not combined with the related costs, benefits and other issues. In addition, after more than a decade of research and investigation, Professor Marshall L. Fisher of the Wharton School of the University of Pennsylvania believes that the reason for poor supply chain performance is that the product type does not match the supply chain type, and proposes a supply chain matching model.

Based on the supply chain matching theory, this paper will study the supply chain network design of dairy products and the cost optimization of the entire supply chain network according to the production characteristics of dairy products and their special requirements for distribution networks. The specific content is as follows: Based on the supply chain matching theory, the particularity of the production and transportation of dairy products and some specific requirements for the distribution network are specifically analyzed, and then the agile supply chain network matched with it is designed.

## 3. Construction of dairy supply chain network under supply chain matching theory

### 3.1 Supply chain matching theory

The supply chain matching theory was first proposed by Marshall L. Fisher in 1997, who pointed out that whether a product type matches its supply chain type is related to supply chain performance. To design an effective supply chain strategy, you must first consider the demand characteristics of the product, then determine the product type, and finally determine the supply chain type that matches its product type. According to the demand characteristics of the product, the product is divided into functional and innovative products. Among them, functional products have the characteristics of stable demand, long life cycle, less diversity, and fierce market competition, while innovative products have the characteristics of unstable demand, short life cycle, more diversity, high average stock-out rate, and short lead time for production by order. Supply chain types are divided into efficient and agile supply chains. Efficient supply chains target minimum cost for supply demand, maximum production performance, and inventory minimization. Agile supply chains aim to respond

quickly to demand, using a modular approach to delay product differentiation and maintain buffer inventories to cope with demand and supply uncertainties. On this basis, Fisher proposed a supply chain matching model as shown in Figure 1.

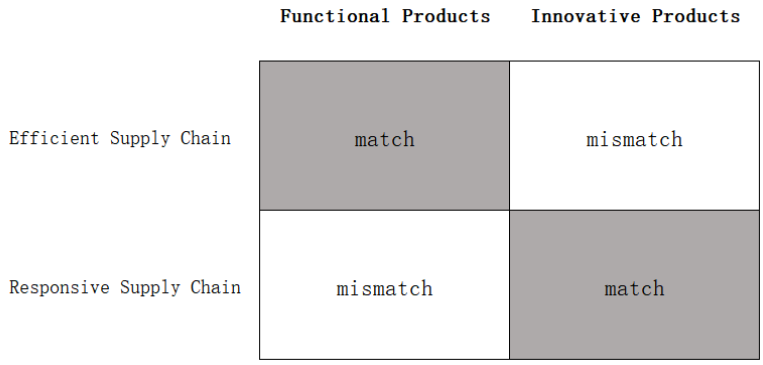


Figure 1. Supply chain matching model

### 3.2 Construction of dairy supply chain network

The demand for dairy products is expanding year by year, especially the consumption of liquid milk is much higher than the growth of milk powder, of which the demand for diversified liquid milk varieties is also showing a rapid growth trend. At the same time, the demand for dairy products is related to factors such as the taste of the product, seasonal changes, and the age structure of the consumer group. Secondly, dairy products have the characteristics of small batches, multiple varieties, perishable, short life cycle and so on. For the production of dairy products, the raw material is usually animal fresh milk, and its storage conditions and temperature requirements are strict, so it is generally required that its processing plant be close to the milk source. In the modern society with a clear division of labor in urban suburbs, taking into account factors such as cost, quality, and environment, China's milk sources are generally distributed in the suburbs. However, with the advancement of urbanization in China, the population is concentrated in cities and towns, and most of the consumer market for dairy products is concentrated in cities and towns. As a result, dairy processing plants are generally farther away from the consumer market. Although dairy products have a certain shelf life, they have higher requirements for transportation conditions and their equipment, such as ice cream must be in an environment below -18°C, cold storage, refrigerated trucks, satellite positioning systems, etc. Coupled with the fact that the product processing plant is far from the consumer market, the retailer is relatively scattered, etc., it is necessary to establish or lease an appropriate distribution center in the process of transporting the product from the manufacturer to the retailer, otherwise it will lead to the deterioration of the product during transportation and the loss of the product cannot be delivered to the retailer in time.

Combined with the four main strategic goals of dairy supply chain network design: time, cost, quality and service, that is, the shortest time, the lowest cost, the highest quality and quality service, it can be judged that dairy products are a class of innovative products. According to Fisher's supply chain matching theory, it should match an agile supply chain. In view of the main characteristics of dairy products that are not easy to preserve, product diversification, and manufacturers are far away from retailers, the supply chain structure diagram is designed as shown in Figure 2.

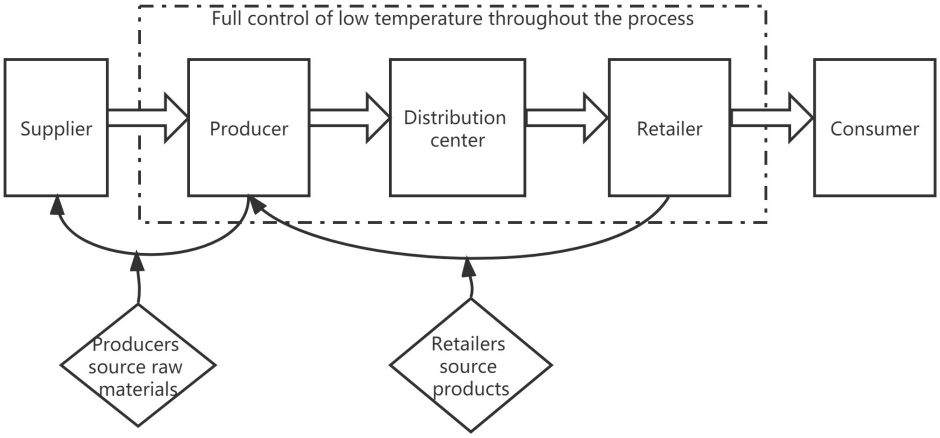


Figure 2 Supply chain structure diagram

## 4. Cost optimization of supply chain network

### 4.1 The composition of cost

Analyzing the supply chain network model shown in Figure 3.2, it is easy to see that its costs are composed of the following aspects: supplier costs, producer costs, distribution center operating costs, and retailer costs. Use SC for supplier costs, MC for producer costs, OC for distribution center operating costs, and RC for retailer costs.

Total cost SUM_C = SC+MC+OC+RC

### 4.2 Node cost optimization

#### 4.2.1 Supplier cost optimization

From the perspective of supplier costs, it can be divided into three parts. The first part is the total cost of the supplier handling the raw materials that are not sold; the second part is the total cost of the raw materials produced by the supplier; and the third part is the transportation cost of the supplier's transportation of raw materials to the producer.

The main raw material of dairy products is fresh milk, that is, the supplier's main product is fresh milk. Fresh milk has a short shelf life and high storage conditions, so the product needs to be sold immediately and processed. For producers, in addition to the way of purchasing from dairy farmers, several major domestic dairy enterprises have built their own pasture milk, which is more conducive to controlling the quality and output of raw materials fresh milk, reducing the total cost of raw materials that have not been sold; at the same time shortening the distance and cycle of raw material transportation, reducing the transportation cost of raw materials from suppliers to manufacturers.

#### 4.2.2 Producer cost optimization

The manufacturer's cost is mainly composed of its raw material procurement cost, product production cost and transportation cost. The improvement of the product production process is an important means to optimize the production cost of the product. Secondly, as far as transportation costs are concerned, first optimize the location of the production plant as much as possible, shorten the transportation distance and select a convenient site. For dairy companies whose output is not particularly large, outsourcing transportation to professional cold chain transportation companies can reduce this input, reduce transportation costs, and accelerate cost recovery.

#### 4.2.3 Distribution center operating cost optimization

The cost of operation of the distribution center is mainly the cost of being leased or constructed by the manufacturer. For dairy enterprises whose output is not particularly large, they can choose leasing

to reduce the investment in the construction of fixed assets in this regard, thereby reducing the cost of distribution links and accelerating the recovery of costs.

#### 4.2.4 Retailer cost optimization

Through the analysis, it can be seen that it consists of product procurement costs, inventory costs and out-of-stock costs or disposal costs of remaining products. Among them, under normal circumstances, the relevant inventory of the product during its shelf life has the following characteristics: (1) When the product arrives at the retailer and starts selling, the inventory of the product at this stage will decline rapidly because it is relatively fresh. (2) In the middle of product sales, as customer demand is gradually satisfied, the sales speed of the product will gradually become slower and smoother, and the inventory reduction will be more uniform at this time. (3) When the product reaches its corresponding sales time limit, it must appear one of the following three results: I. product surplus, II. product sales, III. product out-of-stock. Different results correspond to different inventory costs and out-of-stock costs.

Therefore, in the case of the same product procurement cost, reasonably and accurately assess the customer's product demand, and adjust its error with the actual order volume of the retailer. Forecasting the demand for products and making the purchase volume as consistent as possible with the actual market demand will greatly reduce the inventory cost and out-of-stock cost of retailers.

### 4.3 Overall cost optimization of the supply chain

The starting point for a comprehensive budget is the sales budget. Modern companies often use the method of sales to determine production when budgeting, so accurate forecasting of sales volume makes sense for cost optimization of the entire supply chain. From the cost analysis of the above nodes, it can be seen that in the dairy industry, which has a short consumption cycle, strong diversity, and high storage and transportation costs, serious deviations from the actual sales forecast may produce excessive inventory, resulting in a large amount of storage costs occupied by products, and even direct losses caused by product expiration. The backlog pressure on the final product is also passed up from the retailer to the producer and then to the raw material supplier. However, too little forecasting will also lead to the waste of the company's public fixed assets, that is, the increase in manufacturing costs allocated to each product, and the inability to make full use of the scale effect to reduce product costs, thereby forming a cost advantage. At the same time, the unmet demand for customer products will also cause the lack of market share of the company's products, which is not conducive to the expansion of the company's product market.

In summary, a reasonable and accurate assessment of the customer's product demand and the adjustment of the error between the actual order volume of the retailer can effectively reduce the cost of each node member of the supply chain and the supply chain as a whole.

## 5. Conclusions

The domestic dairy consumption market is constantly expanding, most dairy products have the characteristics of perishability and are not easy to preserve, and dairy products in the entire supply chain need to be processed, transported and distributed in a relatively strict temperature environment, and at the same time, high-tech is needed to provide real-time temperature control information, so the supply chain network cost of dairy products is much higher than that of ordinary products. Therefore, cost optimization of supply chain networks can be an important component of cost management in the dairy industry.

This paper begins with an agile supply chain network for the dairy industry through Marshall L. Fisher's supply chain matching model. Next, the supply chain network is cost-optimized: First, the supply chain cost components are analyzed, which are mainly divided into four parts: supplier costs, producer costs, distribution center operating costs, and retailer costs. Secondly, the cost of each node is optimized and analyzed. The result is an optimization of the overall cost of the supply chain.

Because in today's market, the competitive advantage of the supply chain as a whole is the real competitive advantage of the enterprise.

## References

[1] Li Qianxi. Development of supply chain system in Japan's milk industry[J].China Dairy Industry,2020,48(05):42-47+58.

[2] Jie Maohua, Wang Jiao, Liu Yuanyang, Yin Zhixuan. The Implementation Path of Green Supply Chain Cost Management Informatization: Based on the Longitudinal Case Study of Yili Group[J].Management Case Study and Review,2019,12(04):431-448.

[3] QIN Ye, KANG Yao-wu. Logistics supply chain integration in dairy industry based on the background of urban-rural integration[J].Logistics Technology,2014,33(7):355-357.

[4] Yan Yan, Liu Xiao, Zhuang Xintian, et al. Perishable logistics distribution plan based on flexible supply chain[J].Journal of Systems Management,2012,21(2):258-263.

[5] Li Susu,Xie Ruhe. Cost Optimization Analysis of Cold Chain Logistics Based on Food Safety[J].Systems Engineering,2014,32(12):29-34.

[6] Qian Guixia, Zhang Yipin, Wu et al.Revenue sharing in dairy I ndustry supply chain-A case study of Hohhot, China[J].Journal of Integrative Agriculture, 2013, 12(12):2300-2309.

[7] Chen Xin, Pang Zhan, Pan Limeng.Coordinating inventory control and pricing strategies for perishable products[J].Opera- tions Research, 2014, 62(2):284-300.

[8] Bilgen B, Celebi Y.Integrated production scheduling and distri- butionplanning in dairy supply chain by hybrid modeling[J].Annals of Operations Research, 2013, 211(1):55-82.

[9] Nicholson C F, Gomez M I, Gao O H.The costs of increased localization for a multiple-product food supply chain:Dairy in the United States[J].Food Policy, 2011, 36(2):300-310.

[10] Marshall L. Fisher.What is the right supply chain for your product?[J].Harvard Business Review, 1997,75:105-116.