The Ways of Logistics Cost Control in Food Industry Supply Chain

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Abstract. This article starts from the food industry supply chain system and supply chain management’s present situation, based on the analysis of existing research results on supply chain cost control at home and abroad, combined with domestic and international logistics cost composition analysis, and then from the perspective of China's food industry’s points, investigates supply chain optimization strategy for supply and sales integrated food enterprise, which including the standardization of product design, facility location, inventory management, and the proposal of using information technology to realize information sharing and to support ultimate implementations of the scientific management decisions.

Introduction

The gradual weakening of the demographic dividend advantage, the intensified competition in the existing market, the impact of e-commerce, and the change of customers' consumption concept brought by the economic and technological development, all make the food industry tend to white-hot competition. Customer demand tends to be personalized, the speed of market change is accelerated, and the life cycle of products is shorter, all these also drive enterprises to gradually transform from terminal competition to competition among supply chains. The supply chain system of the traditional food industry is long and complex, which is inconsistent with the personalized, diversified and economically rational development direction of customer needs. Higher customer satisfaction under the same management level means higher costs. Food industry supply chain cost optimization has become an urgent issue.

With the development of market economy in the past 30 years, the management degree and maturity level of a single node in the supply chain system could only have limited improvements when targeting a single link. The improvement of the competitiveness of terminal products depends more and more on the optimization of the whole supply chain system.

Status and Research Status of Supply Chain System and Logistics Cost Management

Current Situations of Supply Chain Costs in the Food Industry

The supply chain system of food industry is a closed loop system from demand to order fulfillment. A typical logistics model of the food industry, which is customer-oriented and traces back to the supply and production process, is shown in Fig. 1.

There are a series of problems in the supply system of the food industry. First, under the pull supply chain model of demand forecasting, inaccurate market demand planning will lead to the corresponding out-of-stock cost and inventory holding cost. Second, the transportation cost caused by non-value-added distribution and long-distance distribution as a result of unreasonable distribution of the supply chain; Third, inventory holding cost brought by unreasonable inventory management; Fourth, the multiple sub-packaging and handling costs caused by the lack of standardization of products, as well as the extra distribution costs caused by non-full-load; Fifth, the recall cost caused by quality problems; Other corresponding costs caused by information asymmetry and food safety etc.
To sum up, the current situation of food industry supply cost and related management is as follows:

1) Unreasonable distribution of logistics network, frequent change of suppliers by manufacturers through procurement bidding, and dispersion of industrial customers are not conducive to the establishment of reasonable distribution for food production enterprises. Long-distance distribution and non-value-added distribution will lead to high distribution costs.

2) The high uncertainty of market demand and inaccurate sales plan lead to the overstocking of product A and the shortage of product B. And high market demand uncertainty in turn leads to longer ordering period, increased unreasonable transportation and inventory.

3) The high level of inventory holding has become a serious management problem in the food industry. The unreasonable network layout and uncertainty of market demand will lead to high inventory holding.

4) Insufficient product standardization and inconsistent logistics operation standards result in a large number of unnecessary work such as depackaging, repackaging and multiple handling. The influence of product design on supply chain operation is crucial. Food products are consumer products with large sales volume, high turnover, fixed validity and low gross profit. According to the survey data of China federation of logistics and purchasing, in the circulation of goods in China, the circulation cost caused by unnecessary moving accounts for about 25% of the total circulation cost.Under the requirements of food safety, the production standards will be higher and higher, so the competitiveness of products largely depends on the control of supply chain costs.

**Bottleneck of Logistics Cost Control**

He Dengcai, vice President of China federation of logistics and purchasing, points out that the main operations of logistics include transportation, storage and management, in the circulation cost of our country, the cost of storage and management is high. In 2017, the total cost of logistics nationwide was 11.1 trillion yuan, accounting for about 15% of GDP, significantly higher than the average level of 8%-9% in developed countries. Among them, China's logistics storage costs accounted for 33.1%, management costs accounted for 13%. Compared with developed countries, the storage cost of logistics in China is twice that of them, and the management cost is three to four times that of them. The proportion of logistics cost in product cost is about 30%-40% in China, 15%-25% in other developing countries, and 10%-15% in developed countries [1].

The ratio of logistics cost of GDP in China is obviously higher than that in developed countries, to which the economic structure of different countries has a great influence. According to the above research data, the single ton kilometer cost in circulation cost is selected as a primary index to
objectively measure the logistics cost. According to financial media data, in 2017, the total logistics cost of a ton per kilometers in China was 0.09 us dollars, while that of the US was 0.21 us dollars, about twice that of China.

From the perspective of logistics cost structure, according to the 2016 research report on China's logistics industry, the total cost composition of social logistics in China in 2015 is shown in table 1. Among them, management expenses increased by 5.2%, being the fastest growth number.

<table>
<thead>
<tr>
<th>Expenses types</th>
<th>Transportation expense (trunk line + warehouse distribution)</th>
<th>Storage expense</th>
<th>Management expense</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage</td>
<td>50.9%</td>
<td>35.5%</td>
<td>13.6%</td>
</tr>
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</table>

It can be seen from the above data that, first, although the storage and management costs of social logistics in China show a downward trend, they are still higher than those in developed countries. Second, although our country transportation costs accounted for the highest, but its single ton per kilometer cost is less than 1/2 that of the US. On September 21, 2016, Provisions on the administration of highway management for over limit transport vehicle (transportation ministry decree no. 62, 2016) comes into force and emphasizes on cracking down the problem of vehicles having the total weight over the prescribed limit, single ton per kilometer fright costs will increase and tend to reasonable. Third, although China has the highest proportion of transportation costs, when compared with the developed countries it is not absolute weakness. Under the current industry status, the cost control should focus on the problems mentioned in above chapters of this paper.

Research Status of Supply Chain Cost at Home and Abroad

Many scholars at home and abroad have done a lot of research on supply chain optimization and cost control methods. Donald F. Wood pointed out that logistics in the United States develops from different stages of product distribution, material management, enterprise logistics and supply chain logistics, and continuously improves the level of logistics integration from the perspective of supply chain management. Whinton et al. proposed the relationship between two supply chain operation modes of "push" and "pull" and their relationship to supply chain integration. These two operating modes not only improve the efficiency and flexibility of the supply chain, but also promote the cooperation among enterprises in the supply chain network [2,3]. Wu Zhihua, Hu Feifan (2011), particularly using the modern grain logistics center of Jiangsu province as an example, analyzes the weakness of current food supply and the direction of supply chain integration. Their article discusses about value-added supply chain integration and using logistics outsourcing as an approach to promote enterprise core competitiveness, to promote the company to realize scale, intensive development and integrated development of supply chain. Marc et al. constructed the corresponding strategic model and algorithm based on the current situation of international logistics network [4] to control costs and improve efficiency by optimizing the supply chain network and reducing non-value-added logistics. Erhan et al. established an optimization system model of logistics distribution from the perspective of transportation and warehousing by selecting the most suitable order quantity, optimizing the total cost of transportation and warehousing, where two major logistics costs are incurred [5].

The supply chain system mainly includes suppliers, manufacturers and customers. Suppliers can be regarded as a cluster of suppliers, and customers also include wholesalers, distributors, retailers and end customers. Based on this model, four sub-types of system cost are considered: production cost, logistics cost, inventory cost and management cost. This paper, through the analysis of the current situation of supply chain cost management in the food industry, combined with the current situation of management and the author's work practice, puts forward a logistics cost control method in the food industry supply chain system.
Main Contents of Cost Control of Food Industry Supply Chain System

Supply chain system optimization management emphasizes the cooperation and coordination of each node in the supply chain, and carries out organic integrated control management inside and outside the enterprise to achieve the overall optimal goal.

According to the characteristics of the food industry and supply chain cost analysis and its present situation, according to the problems listed in of above chapters for food industry supply chain cost, this paper mainly analyzes the following contents for the food industry supply chain system cost optimization: First, start from product and process design, set up product design and standard operation flow, reduce invalid operations to increase efficiency; Second, targeting the optimization design of supply chain network, think about layout optimization under stable production-supply and sale mode, by taking into account the supply chain downstream production demand and the final demand, establish proper central warehouse, warehouse and transfer point, through scientific and accurate supply chain network layout, reduce the long distance distribution and non value-added transfer; Third, push the invisible inventory management in the logistics cost of the supply chain of the traditional food industry to a more important position, comprehensively assess the demand of the downstream customers of the supply chain and the production situation of the upstream, and reduce the inventory holding level as much as possible in the case of reasonable shortage and delivery delay (excluding the items that are not allowed to be out of stock). Fourth, on the basis of the establishment of supplier managed inventory, cross-industry alliance and information sharing, improve the forecast level of production enterprises under the demand forecasting mode, so as to reduce the inventory level at all parties in the supply chain to the greatest extent [6], and minimize the cost of out of stock, back to storage costs and high inventory costs.

Establish Standardization of Product Design and Logistics Operation

The complexity of the product is supported by cost. The complexity of marketing and product design can be reduced by adopting standard components as much as possible, and the process and structure can be simplified, so that supply chain cost control is not at the expense of service. The higher the complexity of the product, the higher the complexity of customer demand must be, and without affecting the efficiency it will need more complex supply mode to deal with. Then the economies of scale of the supply chain are bound to be unable to be guaranteed, cost control is out of control.

If the economies of scale cannot be achieved in production, the unit production cost will be on the high side. Unit operating costs for distribution and warehousing operations will also be high. In addition, in the actual circulation process of non-standard parts, a large number of packaging operations will be involved in order to match customer requirements of different transportation modes, stowage batches and different product states, which will also increase the cost.

So in the initial stages of product design, all three departments, production, marketing and design, should work together. In stages of raw material procurement, production, logistics and marketing circulation, three departments should consider how the components involved are circulated to establish proper product design standard, select standard parts and pay attention to quality control from the very beginning, determine the optimal product packing standard and the most appropriate operation standard in different stages, effectively reduce the cost control complexity of other stages by this overall control approach.

Optimization of Logistics Network Structure

Logistics network refers to a distribution network composed of supply points, logistics centers, demand points and transportation routes. For large-scale food supply chain systems, multi-logistics centers are common.

The network structure model of the supply chain in food industry is generally composed of five levels: suppliers, manufacturers, warehouses, distribution centers and customers, which are connected to form an organic and integrated functional network chain structure organization, as shown in Fig. 2.
Food supply chain network structure is complex; in actual locations of logistics facilities, it is necessary to consider the hierarchical supply and demand situation, service level, local economic level and natural policy environment, and for logistics centers, it is also necessary to consider the number of facilities, location, scale, service scope, resource matching and other conditions.

For the large multipoints-to-multipoints complex supply network chain in actual business, there are three main analysis methods. The first is to analyze key supply points and sales points; the second is to draw a circle encompassing adjacent supply points and sales points as a cluster for analysis; and the third is to use mathematical modeling tools to do precise optimization and matching, which requires the highest data accuracy.

The optimization of logistics network needs to establish the site selection structure model of multiple logistics centers. Fig. 3 is the general model of multiple logistics centers network of food industry supply chain. Suppose there are m supply points and n demand points in the network, the quantity of goods in supply and demand is known. In order to better meet the demand in this model, supply points could deliver to multiple logistics center and demand points, each logistics center could deliver to multiple supply points and each customer could require/accept materials from multiple supply centers (supplier/logistics center). A constraint condition is that different supply points provide different products, when supply is abundant or not considering any special cases, the customer can only be supplied by the optimal price supplier.
After the establishment of the model, the mixed integer programming method is used to locate multiple logistics centers. The modeling target of this method is to establish optimize mode in term of the least cost and transform to integral linear programming on single aim. According to the time requirements of different customer groups in the food industry, combined with the specific operational characteristics of the company, the actual distribution volume, demand, line rate and other basic information, with the lowest total cost of logistics center layout scheme being the function target, to solve the optimal distribution point coordinates and the optimal business volume distribution in each supply and demand chain [7]. The specific method will not be further developed here in this paper.

Use lowest cost as objective function, do not presumably use sales area as the key elements to determine logistics distribution center, give more considerations to objective data, and include a number of alternatives in overall consideration, comprehensively take into account economic level, fixed investment, resource conditions, transport rate (different from single perspective of transportation distance) etc in this model, distribution center address solved by this method has a relatively smaller deviation between budget cost and actual cost.

**Food Industry Inventory Management Optimization Plan**

As analyzed above, inventory management costs mainly come from out-of-control planning and forecasting mechanism, and worsen in the low inventory management level and opaque information flow. Inventory management ostensibly solves the problem of quantity of goods, but because it involves cross-departmental cooperation, the focus on inventory management is to change the organizational structure first, and discuss the improvement of inventory management technology level under the effective organizational management mechanism.

Food industry inventory optimization management plan could be described from following aspects.

**Support Total Inventory Management through Business Process Reengineering.** In the original inventory management, the demand information acquired by the upstream supply chain entity is obtained from its direct downstream entity rather than the actual demand information from customers. Consumers' demand for commodities is uncertain, but it basically follows a certain market rule. The change of consumers' demand will be within a certain range when excluding major policy influences and price decisions of sales companies. However, in the forecast supply mode, each level will hold certain inventory and "overreact" to its direct downstream demand, resulting in the bullwhip effect as we know, as shown in Fig. 4 below.

![Figure 4. Bullwhip Effect in Supply Chain.](image)

By centralizing inventory management to a unified professional department through business process reengineering, all parties of the supply chain can get information at the same time and support business parallelism [8]. Then, through reasonable supply batch coordination, the order demand can be satisfied with the lowest possible inventory. Business process reengineering after enterprise dynamic alliance can improve the response speed on the basis of reducing the overall inventory level of the supply chain, and also make the supply chain system obtain stronger competitive advantage [9].
The business process reengineering of enterprises supports total inventory management and helps enterprises to unify inventory management standards.

**Make Scientific and Comprehensive Inventory Holding Management Decisions.** This paper will only discuss the scientific use of ABC classification for scientific inventory holding management decision making. Among the many methods of inventory management, ABC classification (Activity Based Classification) is the most commonly used means of management. There are many kinds of materials in stock, and the efficiency of managing all these materials at the same time is usually not high. So it’s needed to clarify their relative positions and priorities. ABC classification is generally divided according to the proportion of material funds. Class A materials are considered to be the most important objects to be managed, accounting for about 10% of all materials, 20% of class B materials, and 70% of class C materials. The demand ratio of the three types of materials A, B and C is about 7:2:1, and the management importance of the three types of materials decreases successively [10]. ABC decomposition curve is shown in Fig. 5.

![ABC Grading Curve](image)

According to the results of ABC classification, the balance between management power and economic effect is conducive to enterprises’ actual improvement on the rate of return of resource investment.

**Comprehensively Consideration of Inventory Cost Management.** The Objective Function Of System Optimization Is Generally Cost. In The Inventory Management cost accounting of food industry, the focus is to comprehensively analyze the inventory cost of different industries and enterprises according to their characteristics.

Firstly, in the comprehensive inventory cost management of supply chain system, explicit ordering cost, warehousing cost and hidden inventory holding cost should be included [11].

Secondly, the food industry inventory has a certain shelf life, the food enterprise inventory cost also includes the inventory of deterioration cost and out of stock cost [12], not just the day-to-day running costs of the warehouse. The business process reengineering mentioned above provides strong organizational support for this inventory cost accounting approach.

Thirdly, after establishing the parameters of inventory cost, the cost shall be sunk into categories or even varieties through activity-based costing. The improvement of inventory management analysis accuracy will directly provide a reliable resource for the company's strategic guidance.

Fourthly, inventory management cost optimization should be actively benchmarked. Multi-dimensional benchmarking should be carried out from the aspects of management standards, expense indicators, assessment methods and performance evaluation results, rather than merely from the cost results of benchmarking.

**Use Information to Realize Information Sharing and Support the Implementation of Scientific Management Decisions**

Informatization is an essential basis for enterprises to realize scientific management and improve cost accounting, and also an important support for business process reengineering, product standardized management and effective customer inventory control.
The food industry should make use of the information integration mode of INTERNET to establish an efficient Intranet within the enterprise, so as to ensure the smooth flow of information within the enterprise; then, establish an external network across organizations with suppliers, dealers and final customers, so as to achieve the purpose of e-commerce, synchronous operation and resource sharing. At the same time, with the gradual refinement of food safety requirements and the improvement of management, a higher level of informatization and higher degree of information sharing can also enable enterprises to respond more effectively to the national management requirements of food safety traceability from the field to the food table.

Conclusion

Food industry competition and cost benchmarking at every stage of the supply chain at home and abroad, both call for enterprises to take actions to transform from pure product supply to providing more valuable products by employing optimized internal supply solutions, and at the same time require that enterprises must continuously use advanced technology solutions and process optimization to improve supply chain agility and speed of response.

This paper takes the food industry supply chain system as the object, and proposes to optimize and improve the supply chain system from four aspects including establishment of standardization, logistics site selection optimization, inventory management optimization and information upgrading. From the analysis of the present situation to the proposals of optimization for the present situation, the paper makes a preliminary analysis of the optimization decision of the supply chain system from multi-dimensions.

References


