Hindawi
Journal of Mathematics
Volume 2021, Article ID 4827903, 9 pages
https://doi.org/10.1155/2021/4827903

*Research Article*

# Research on Enterprise Supply Chain Optimization Model and Algorithm Based on Fuzzy Clustering

**Shizhen Bai and Hongbin Sun**

*School of Management, Harbin University of Commerce, Harbin 150028, China*

Correspondence should be addressed to Hongbin Sun; sunhongbin@jmsu.edu.cn

Received 28 October 2021; Revised 6 December 2021; Accepted 8 December 2021; Published 28 December 2021

Academic Editor: Miaochao Chen



Reasonable logistics distribution network structure can not only effectively reduce the cost of logistics enterprises themselves but also reduce the social cost. Through effective supply chain management, enterprises can significantly reduce costs, improve competitiveness, and enhance their ability to resist risks. Because the single-level distribution network structure of production enterprises is not suitable for large-scale logistics distribution, this paper proposes a distribution network structure design that accords with economies of scale and establishes an enterprise supply chain optimization model based on the fuzzy clustering algorithm. Using this optimization method to optimize the inventory of enterprise logistics supply chain, the operation is fast, the result is correct and reasonable, and it can provide good decision support for the distribution network of logistics enterprises. Through information technology and modern management technology, we should effectively control and coordinate the logistics, information flow, and capital flow in the production and operation process and organically integrate the internal supply chain with the external supply chain for management, so as to achieve the goal of global optimization.

## 1. Introduction

In the traditional distribution system, due to the small demand and types of goods, retailers can reduce the distribution frequency of suppliers by relying on more inventory and longer order cycle so as to reduce the distribution and transportation cost [1]. However, in order to reduce capital overhang and provide diversified goods, retailers must reduce the inventory of various goods, and at the same time, providing the best service quality in the modern distribution system must be considered. In order to reduce the backlog of funds and provide diversified commodities, retailers are bound to reduce the inventory of various commodities, and at the same time, they must consider providing the best service quality [2]. With the intensification of market competition, customers have higher and higher requirements for the quality of electronic goods, and the demand for return has gradually increased. Manufacturers have gradually relaxed the conditions for return, resulting in an increasing number of returned products. Many companies feel that they are unable to handle the returned products completely [3]. In order to develop in competition, logistics enterprises must form their own scale benefits and competitive advantages, which must take logistics scale and reducing the cost of distribution goods as the main means [4]. Therefore, it is necessary to study the problems of network layout, delivery mode, and transportation route, so as to optimize its distribution network structure [5]. With the continuous change of trade environment, the competitive situation faced by enterprises is becoming more and more complex. The higher and higher requirements for product production quality and the shorter requirements for product production cycle have changed the competition among enterprises. They no longer pursue the competitiveness of products alone but also pay more attention to the operation efficiency of supply chain [6].

Due to the increasing competitive pressure and the globalization of economic activities, enterprises have to concentrate limited resources on their core business, focus on cost reduction and improvement of operation efficiency, and focus on cultivating their core competitiveness and outsource noncore parts [7]. Therefore, all logistics activities in the value chain may be outsourced to third parties, thus

forming a rapidly growing logistics service market and a huge growth space for third-party logistics suppliers [8]. The response time of products to end users is the cumulative effect of the whole process of the supply chain. It is of no practical significance to simply emphasize the rapid response of a certain link. The problem of response time must be studied from the whole production and logistics process. Inventory control has always been an indispensable part of modern enterprise production management and operation management, and it is also one of the main activities of supply chain management [9]. The quality of inventory control directly affects the realization of value-added of supply chain and plays a vital role in the coordinated development of supply chain. At present, most enterprises have a distribution network with less hierarchical structure. Products produced from factories are directly sent to their end users after one or two deployment at the middle node of the network [10]. Clustering is one of the important branches of data mining. Fuzzy clustering analysis provides fuzzy processing ability for real data based on fuzzy theory. And it is based on the characteristics of objective things, closeness, and similarity through the establishment of fuzzy similarity relationship of the objective things clustering analysis method. It has been widely used in many fields. Therefore, according to the role and positioning of logistics center and distribution center in the enterprise supply chain, this paper proposes a distribution network structure design in line with economies of scale and establishes an enterprise supply chain optimization model based on the fuzzy clustering algorithm, which is beneficial to strengthen the information exchange between node enterprises and shorten the logistics time.

In the logistics system, inventory routing problem is a supply chain management problem integrating two core elements in the logistics process, namely, inventory control and transportation routing problem [11]. In the previous research of the logistics system, these two are often used as separate submodules for independent decision-making. However, from the current situation, some enterprises are affected by the concept, system, and other factors in inventory management, resulting in frequent inventory management problems. Specifically, the supply chain inventory management problems mainly include the following aspects. First, nodal enterprises lack supply chain ideology. The nodal enterprises only consider the effectiveness of their own inventory management, resulting in poor information exchange and low information transmission efficiency of the whole supply chain system. Second, the enterprises focus on short-term benefits. In inventory management, the enterprises only consider short-term benefits and ignore the impact of the upstream and downstream links of the supply chain operation on enterprise development. Third, the inventory procurement system is not perfect. Because the budget system is not standardized and the market survey is not comprehensive, the enterprises lack perfect management process in the procurement work, resulting in various departments pay more attention to their own tasks, thus increasing more than the actual demand of the budget and affecting the effect of budget management. Finally, inventory management is not scientific. With the increase in business demand, manual inventory management is no longer suitable. However, the enterprises do not innovate inventory management methods in time, which affects the accuracy of inventory management data and is not conducive to enterprise management decisions.

Therefore, in order to solve the inventory management problem in supply chain mode, the whole process response time of supply chain is proposed. It involves many new management problems, especially how to coordinate the management of production, logistics, and information among cooperative enterprises in the whole supply chain [12]. The reason why enterprises want to maintain an appropriate amount of inventory is that inventory has four functions: regional specialization, obtaining economies of scale, balancing demand, and reducing uncertainty [13]. For the supply chain, inventory decision-making not only has great risk but also has a considerable influence on the profits of enterprises. Only pursuing the logistics management strategy with the lowest inventory cost or the lowest transportation cost in the enterprise makes, it easier to produce "back effect" in the process of logistics management, which seriously affects the collaborative operation of the whole logistics system [14]. A distribution center shall be established near the gathering place of sales points. The products transported by trunk lines shall be transported to the distribution center for unified management, and then appropriate vehicles shall be arranged for distribution to implement door-to-door transportation, which can greatly improve the efficiency of logistics [15]. Using this method to optimize the inventory of enterprise logistics supply chain, the operation is fast and the results are correct and reasonable and can provide good decision support for the distribution network of logistics enterprises.

The innovative contribution of this paper lies in the analysis of supply chain inventory problem under stochastic demand in view of the complexity of the multilevel inventory system in supply chain. Based on the fuzzy clustering algorithm, this paper establishes a multiobjective model of supply chain inventory optimization from the perspective of time and cost. The article is divided into five parts. The first part expounds the background and significance of studying supply chain inventory management. The second part summarizes the inventory management related literature research. The third part constructs the dynamic model of supply chain distribution strategy based on cost optimization and time optimization. The fourth part establishes a multilevel inventory optimization model based on the distribution network system. Finally, it is found that the proposed method can effectively realize the inventory minimization of the transit distribution system through the empirical test.

## 2. Related Work

Supply chain management is to effectively plan, coordinate, and control the logistics, information flow, and capital flow among enterprises in the whole supply chain and send the appropriate products to the appropriate place at the right

time in the right quantity, so as to meet the needs of customers. The first problem to be solved in the study of supply chain management is how to realize the collaborative planning among enterprises at each node of the supply chain. A collaborative supply chain multistage response time plan must be able to achieve the goal optimization of the supply chain and each node enterprise in the supply chain in the allocation of time resources.

Therefore, some scholars believe that in order to reduce the cost, it is necessary to do a good job of inventory management from the perspective of supply chain. Inventory management under the supply chain environment focuses on systematically solving inventory problems from the overall perspective of the supply chain and improving inventory management and operation to the strategic height of the enterprise. Some literatures studied the ordering strategy considering out-of-stock cost. Literature [16] established an economic batch order model for instant supply and uniform supply based on the cost of stock-outs, determined the best order cycle, stock-out time, and economic order batch, and carried out the system sensitivity of the model. Literature [17] and others analyzed the cost of out of stock. By establishing an inventory cost analysis model, the inventory cost difference before and after the implementation of the joint inventory in the supply chain was obtained, and the cost reduction was regarded as the residual income. Literature [18] discussed the theory of reuse and recycling. Literature [19] and so on established a model with random defect rate and obtained the expected profit expression by using the method of updating the compensation process and determined the optimal ordering strategy. Some literatures tried to optimize supply chain cost by applying different models to logistics location problem. Literature [11] applied the classic queuing model to the location problem and added the cost of inventory to the model. Literature [20] established a model that includes both forward logistics and reverse logistics to optimize various costs in the supply chain. Literature [21] established the optimization model of reverse logistics network, which includes the problem of site selection and capability decision. In addition, some scholars used different methods to study the problem of proposing corresponding distribution schemes according to customer needs. Literature [22] studied that the customer needs are known and adopts an uncertain heuristic algorithm to find the distribution scheme for each stage and each partition. Literature [23] established a model of economic order quantity to solve IRP problem at specific operation level. Literature [24] studied the IRP problem with changing demands and established an IRP model of mixed integer programming through real-time demands.

## 3. Dynamic Model of Supply Chain Distribution Strategy

With the development of information technology, electronic information technology has become the main way of information sharing among enterprises in logistics supply chain nodes. The range of information is very wide, including basic information such as product quality information and price, as well as production capacity of product suppliers, manufacturing capacity of processors, sales information of sellers, and forecast information of market demand. Enterprises will intentionally hide their own information such as cost, output, and purchase price in order to maintain information superiority [25]. Excessive information sharing may reveal business secrets of enterprises, which may cause huge losses to enterprises. Although information sharing can solve many problems in the operation of the supply chain, improve the overall performance of the supply chain, and achieve a win-win situation for upstream and downstream enterprises, this concept of information sharing has encountered many obstacles. It takes a certain amount of manpower, time, and money to collect, transmit, and process information, and it takes a lot of investment to build a network platform. In addition, to realize information sharing through information technology, employees need constant training, which also increases the cost of human resources. The model structure of supply chain informatization construction is shown in Figure 1.

Multilevel inventory optimization and control based on cost optimization is to reasonably coordinate and control the inventory of each node enterprise in the supply chain on the basis of minimizing the total inventory cost of the supply chain. Similar to single-level inventory optimization, the operating cost structure of a multilevel inventory system also includes holding cost $C_h$, transaction cost $C_t$, loss cost $C_s$, and transportation cost $C_{tr}$. Taking the holding cost in the inventory operating cost as an example, $h_i$ represents the inventory holding cost of the product in a unit period. If $w_i$ is used to represent the $i$-level inventory, the holding cost of the entire supply chain multilevel inventory system is as follows:

$$C_h = \sum_{i}^{n} h_i w_i. \tag{1}$$

TC represents the total cost of the multilevel inventory system operation of the whole supply chain, and the calculation formula is as follows:

$$TC = C_h + C_t + C_s + C_{tr}. \tag{2}$$

In multilevel supply chain, with the process of logistics and capital flow in the supply chain, the holding cost forms a process of cost accumulation.

Generally speaking, transaction cost $C_t$ decreases with the increase in transaction volume. For the multilevel inventory system in the supply chain, transaction cost is closely related to the cooperation relationship between supply chain enterprises. For the control of the stock-out cost $C_s$, the loss caused by the stock-out can be reduced by increasing the degree of information sharing in the multilevel supply chain and increasing the coordination and communication between the supplier and the demander.

If the increase in the overall profit can not be reasonably distributed to the member enterprises, it will inevitably cause some enterprises to resist and may even destroy the cooperative relationship of supply chain enterprises. Due to the implementation of supply chain collaborative management,

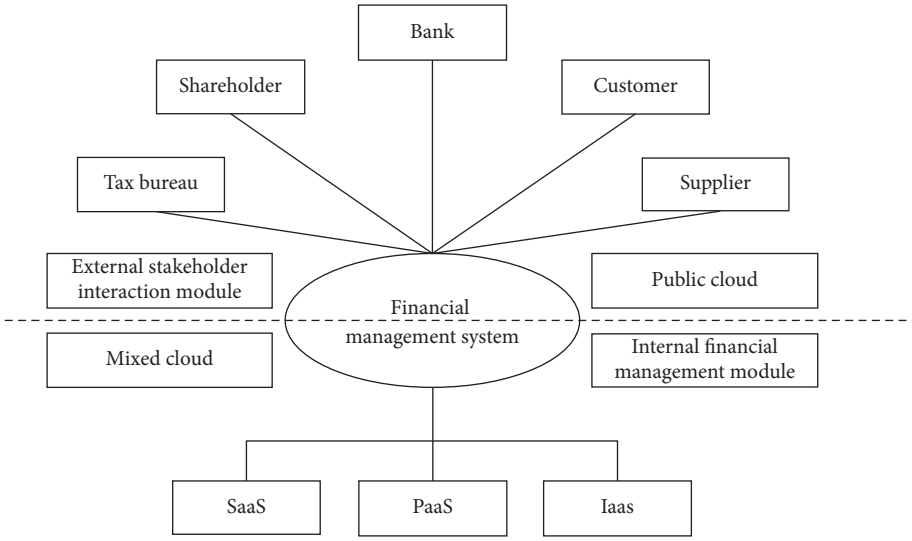


Figure 1: Supply chain informatization construction mode.

all performance indicators have been significantly improved, but there is still a certain gap with the ideal value, which is the same as the usual application process of management software. The implementation process of the whole system needs some guidance and monitoring so that the application effect gradually increases steadily. When implementing information sharing, an information management system must be established within an enterprise to collect information within the enterprise, which will inevitably lead to the adjustment of the enterprise organization. Some of the tables and calculations originally prepared by hand are replaced by computers, and the corresponding staff will be cut. The renewal of organizational structure will impact the management of enterprises and affect the stability of business operations.

*3.1. Multilevel Inventory Control Based on Time Optimization.* With the change of market environment, the competition among enterprises is no longer the traditional cost-first competition mode, especially in recent years, the competition mode based on time priority is more emphasized. Therefore, the inventory optimization of the supply chain also needs to consider the time factor, improve the response speed to users' needs, and enhance the inventory management level and product competitiveness. Most production processes can be described as a multistage system. Each production stage of the multistage system performs the processing, assembly, and other value-added processes of products, respectively, and the output of each production stage serves as the input of the late production stage [26]. In essence, supply chain is a principal-agent relationship chain based on a series of self-interested economic contracts, and there are different capacity conditions and resource constraints in each link of supply chain. Therefore, from the perspective of principal-agent theory, supply chain is not a unified economic entity that seeks to maximize benefits. In the supply chain environment of e-commerce, due to various nonquality problems of products, there are a lot of customer returns, which leads to reverse logistics in the logistics system.

Under the environment of electronic supply chain, nonquality returned goods in online sales have high integrity, so they usually do not need to be returned to the factory for repair but only need to be repackaged to re-enter the sales channels. The main body of operation is each enterprise, and the operation functions are divided according to each department within the enterprise, which makes each enterprise and even each department within the enterprise become self-interested agents. Therefore, it is impossible to avoid ignoring or even damaging the overall interests in the process of maximizing their own interests. Supply chain is the logistics, capital flow, and information flow between interrelated departments or business partners, covering the whole process from product design, raw material procurement, manufacturing, and packaging to delivery to end users. Therefore, from the whole process of product production from raw materials to final delivery to users, the supply chain is a multistage production and supply process, that is, a multistage structure of the supply chain. The simplified model is shown in Figure 2.

There are many different enterprises in different stages of a supply chain. From the point of view of meeting the needs of end users, it is necessary to go through all stages of the whole supply chain to provide the end users with the products they need. Therefore, its response cycle should be the sum of production cycle and logistics cycle in all stages of the supply chain. Multiorder response cycle is the cumulative effect of the whole process of supply chain, which is composed of enterprise response subcycles at different stages in the supply chain, and the time consumed by each node enterprise with independent functions is a subcycle. The relationship between logistics capability and supply chain performance is shown in Figure 3.

Under the mode of vendor-managed inventory, the inventory information of goods can be well known by suppliers and customers, and suppliers set up corresponding

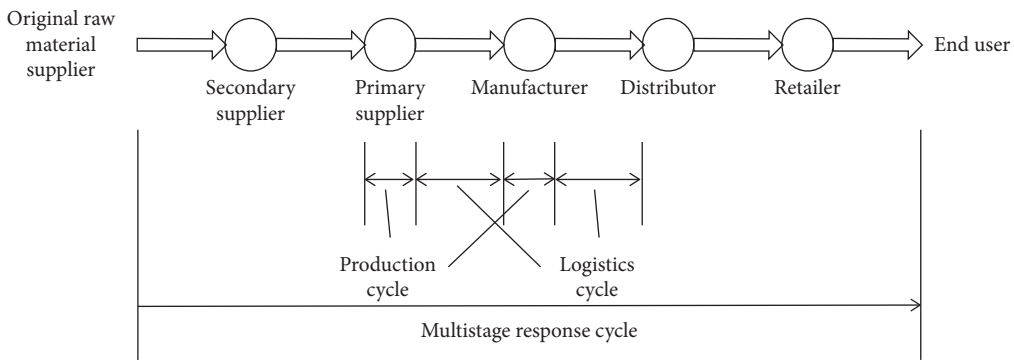


Figure 2: Multistage response cycle model of supply chain.

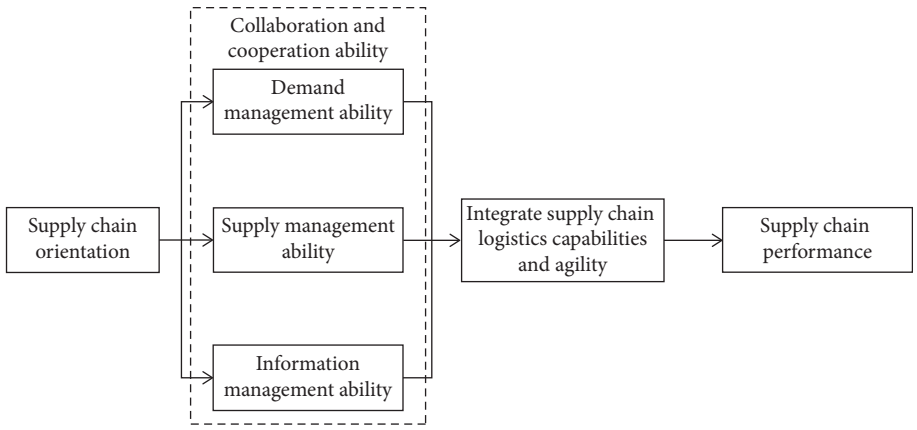


Figure 3: The relationship between logistics capabilities and supply chain performance.

distribution centers in the distribution areas, which can supply goods for demand points. The supplier will set the minimum inventory limit for the customer correspondingly and also set the maximum replenishment value. When the customer's goods are lower than the minimum limit, the supplier will replenish the customer to the maximum limit and consider the out-of-stock cost when the customer is out of stock. In the actual operation process of supply chain, the core enterprise, as the main body of supply chain design, establishment, and operation, first makes a decision on the feasible area of benefit distribution of each node enterprise from the perspective of the overall benefit optimization of supply chain, and then each node enterprise takes this decision as a parameter, makes a local optimization decision in the feasible area according to its own benefit optimization goal, and feeds back its own decision to the core enterprise. On the basis of local optimization decisions of node enterprises, core enterprises make overall optimization decisions in feasible areas. The whole decision-making process is a negotiation and decision-making process with core enterprises as the leading factor and interacting with each node enterprise. For the multilevel inventory system, the inventory time of each node is directly related to the inventory value or inventory quantity, and there is a continuous accumulation process from upstream to downstream. For a certain node enterprise, there should be corresponding time optimization measures; that is, while optimizing the inventory turnover time of the enterprise, it should also consider the coordinated operation of the whole supply chain to improve the operation level of the whole supply chain.

## 4. Multilevel Inventory Optimization Model and Algorithm

The multilevel inventory optimization model established in this paper is based on the distribution network system, which is divided into two-level inventory systems, each of which has several node enterprises, and the demand of the system is random, which belongs to a stochastic multilevel inventory system running indefinitely. In the whole process of industrial supply chain management, relevant information is involved, so enterprises and individuals at each node in the supply chain are participants in information sharing. The development of information sharing inevitably requires the participation of information sharing participants, including the publishing body and sharing body of shared information. When a system is in a stable state, affected by external factors, the whole system can still be in the original stable state through internal coordination. Participants in information sharing not only publish their own information but also share the information published by other enterprises in the supply chain, so they are both the main body of information publishing and the main body of information

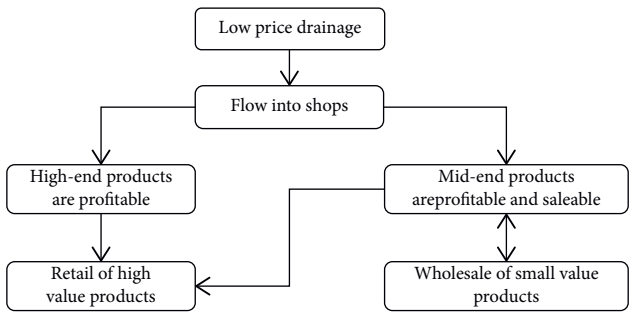


Figure 4: Product model positioning.

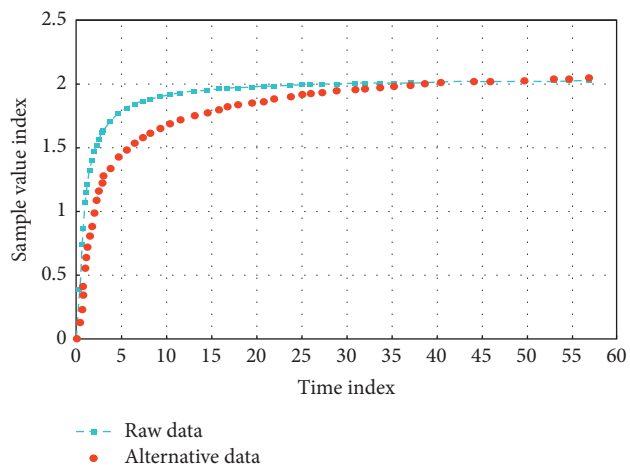


Figure 5: Statistical analysis of original data and alternative data under null hypothesis 1.

sharing. For products, it is necessary to locate the patterns of products. Product pattern positioning is shown in Figure 4.

Supply chain managers like to make the chain rigid. The quantity and quantity of supply and delivery are fixed, the frequency and time are fixed, and the delivery place and transportation mode are also fixed. However, in the event of disaster, the rigid supply chain is very fragile, and it is easy to break, resulting in production suspension and delayed delivery. Toughness is that when a disaster occurs, the batch, quantity, frequency, and time of the supply chain have changed, but it can still maintain the connection of the chain, and the channels of supply and delivery are still unobstructed, but the form has changed under the external force of the disaster. By controlling and managing the information flowing among the members in the supply chain, we can realize the effective transmission of information flow and reduce the situation of each other's own business due to lack of information communication, thus reducing the conflicts between each other and the internal friction of the system. At this time, the system is more stable and consistent because of the coordination and cooperation of all members, and the integrity of the system can be more prominent, making it easier to play the overall functionality.

Suppose $x_i \in R^n$ is the factor that affects the forecast of supply chain elasticity and $y_i$ is the forecast value of supply chain elasticity. The supply chain elasticity forecasting model based on the fuzzy clustering algorithm is to find the relationship between $x_i$ and $y_i$:

$$\begin{aligned} f&: R^n \longrightarrow R, \\ y_i &= f(x_i). \end{aligned} \tag{3}$$

In the formula, $R^n$ is a factor that affects the elastic forecast of the supply chain. According to the theory of the fuzzy clustering algorithm, the establishment of the elastic forecast model of the supply chain seeks to establish the following expression:

$$f(x) = \sum_{i=1}^{k} (a_i - a_i^*) K(x, x_i) + b. \tag{4}$$

In the formula, $x$ is the factor that affects the elasticity of the supply chain, $x_i$ is the $i$ sample among the $k$ samples, and $K(x, x_i)$ is the kernel function. The kernel function adopts the radial basis function, as shown in the following formula:

$$K(x, y) = \exp\left|-\frac{\|x - y\|^2}{2\sigma^2}\right|. \tag{5}$$

Assuming that the occurrence point is the known average structural mutation point in the sequence, the detection method is used to determine whether there is structural mutation. The statistical analysis of original data and alternative data under the original hypothesis 1 is shown in Figure 5. In the original hypothesis 2, the statistical analysis of original data and substitute data is shown in Figure 6.

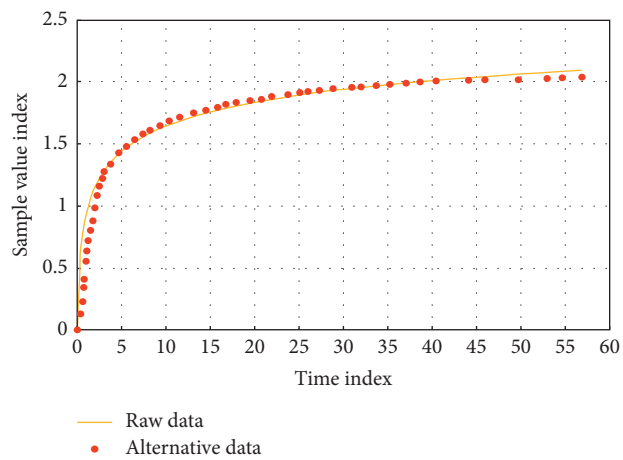


Figure 6: Statistical analysis of original data and alternative data under null hypothesis 2.

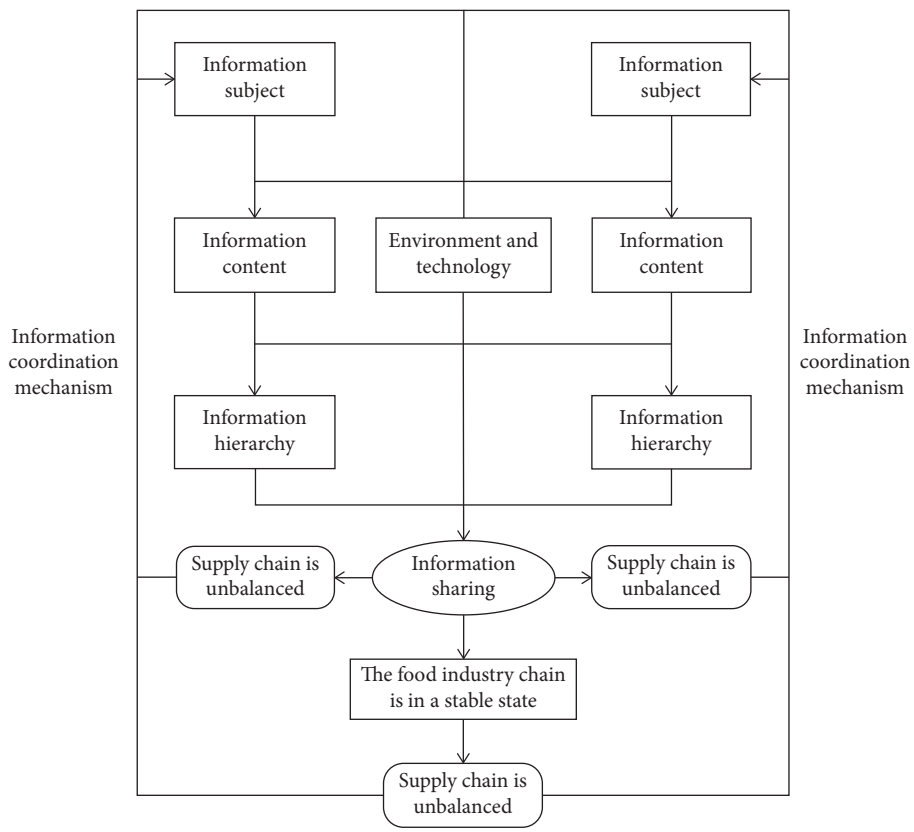


Figure 7: Logistics supply chain information coordination model.

Supply chain financial service platform is to provide customized financial services for the whole chain of supply chain, by integrating information, capital, logistics, and other resources, to improve the efficiency of capital use, create value for all parties, and reduce risks. Its main mode is to serve the upstream and downstream of core enterprises and take real transactions as the premise. All members of the supply chain, that is, the coordinating bodies, have shared information. However, due to the lack of coordination among the coordinating bodies in the system, the interests of some system members are damaged, and the logistics supply chain system is still in an unbalanced state. At this time, the main body of the supply chain is directly coordinated through the coordination mechanism to balance its overall supply chain system. The logistics supply chain information coordination model is shown in Figure 7.

To realize the resilience of supply chain, it is necessary to grasp the flexibility of supply chain operation when disaster breaks out. When the equilibrium state of any system is destroyed, the system itself will re-establish a new equilibrium state. The system is already in a balanced state through information sharing. When it is in an unstable state due to

external stimulation, it can be adjusted through coordination mechanism to make it in a balanced state again. To realize the resilience of the supply chain, we must insist on maintaining the relationship with the supply chain partners.

## 5. Conclusions

Nowadays, many enterprises are facing the complex and changeable external environment, trying to achieve the market goal of quick response through the collaborative operation of supply chains. Supply chain response time, as the whole cycle time of the production and logistics process of each enterprise in the supply chain from the customer placing the order to the final product delivery, reflects the market response capability of the supply chain. Compared with traditional inventory management problems, inventory control in supply chain has many new characteristics and requirements. Traditional inventory management focuses on optimizing the inventory cost of a single node enterprise and determines the economic order quantity and order point from the point of view of storage cost and order cost. The inventory control strategy under this decentralized decision-making mode will inevitably lead to the phenomenon of demand distortion, variation, and expansion. In this paper, the network structure of the supply chain distribution system and the choice of inventory strategy are analyzed in detail, and a multilevel inventory control method of the distribution system based on cooperative forecasting and cooperative decision-making is proposed. Based on the analysis of transshipment characteristics of the supply chain distribution system, an inventory minimization model for rational transshipment of the distribution system is established, and a hybrid algorithm combining the genetic algorithm and linear programming simplex algorithm is designed. The calculation results fully show the effectiveness of the model. The operation mode of the distribution system before and after the implementation of the model also fully demonstrates the superiority of the model.

## Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

## Conflicts of Interest

The authors declare that there are no conflicts of interest.

## Acknowledgments

This work was supported by the National Social Science Foundation Project: Research on the integrated development of ecological agriculture industrial chain between China and the Far East of Russia from the perspective of national food security strategy (19BJY152).

## References

[1] W. Zhang, X. Meng, Y. Lu, Y. Liu, and F. Han, "Research on power supply chain security risk monitoring based on fuzzy clustering," *Automation and Instrumentation*, vol. 244, no. 2, pp. 188–190, 2020.

[2] L. Chen, P. Guo, and E. Han, "Supply chain decision-making optimization model based on fuzzy theory under carbon tax," *Computer Integrated Manufacturing Systems*, vol. 23, no. 4, pp. 860–866, 2017.

[3] F. Ye and S. Kan, "Research on material supply integration algorithm for power transmission and transformation projects based on intelligent warehousing," *Electronic Design Engineering*, vol. 445, no. 23, pp. 40–43, 2020.

[4] D. Tao, R. Liu, Y. Lei, and Q. Zhang, "Cold chain logistics distribution path optimization based on green supply chain," *Journal of Industrial Engineering*, vol. 120, no. 2, pp. 93–99, 2019.

[5] Y. Guo and X. Yang, "Two-stage comprehensive optimization method for green supply chain network construction," *Computer Engineering*, vol. 42, no. 10, pp. 192–200, 2016.

[6] M. Yu, L. Hong, and J. Wang, "Supply chain structure optimization based on the cost control of core enterprises in the supply chain," *Logistics Technology*, vol. 37, no. 8, pp. 112–116, 2018.

[7] B. Ma and Z. Wu, "Solving supply chain network equilibrium problems based on improved particle swarm optimization," *Operations Research and Management*, vol. 167, no. 2, pp. 126–132, 2020.

[8] L. Xiang and Y. Qu, "Coordination countermeasures of equipment maintenance equipment supply chain under uncertain delivery," *Ordnance Industry Automation*, vol. 36, no. 8, pp. 33–36, 2017.

[9] L. Zhi, "Fuzzy multi-objective optimization model of distribution center location based on grey clustering assessment," *Industrial Engineering*, vol. 19, no. 5, pp. 24–32, 2016.

[10] M. Yu, L. Hong, and J. Wang, "Research on multi-level inventory cost optimization in supply chain," *Logistics Engineering and Management*, vol. 289, no. 7, pp. 112–114, 2018.

[11] W. Duan, X. Luo, C. Chen, and A. Luo, "Research on engineering material inventory optimization from the perspective of supply chain," *Packaging Engineering*, vol. 40, no. 5, pp. 169–173, 2019.

[12] C. Yang, "Carbon footprint optimization of product supply chain under uncertain environment," *Computer Integrated Manufacturing Systems*, vol. 248, no. 12, pp. 273–284, 2018.

[13] Y. Zhang and L. Zhang, "Two-stage supply chain sequencing problem for optimizing due window," *Journal of Operations Research*, vol. 20, no. 4, pp. 30–38, 2016.

[14] S. Chen, Y. Wang, and F. Kailun, "Research on supply chain mode and construction activity optimization of prefabricated concrete buildings based on simulation-optimization method," *Journal of Engineering Management*, vol. 170, no. 1, pp. 11–16, 2020.

[15] Y. Zhang and H. Xu, "The optimization method of supply chain inventory management," *Chinese and Foreign Entrepreneurs*, vol. 664, no. 2, pp. 86-87, 2020.

[16] X. Jia and L. Cheng, "Optimal design of green supply chain network under random and fuzzy environments," *Journal of Railway Science and Engineering*, vol. 96, no. 3, pp. 256–265, 2018.

[17] K. Kang, S. Lu, and Q. Zhang, "Research on the optimization strategy of horizontal M&A supply chain network integration under stochastic demand," *Industrial Technology Economy*, vol. 35, no. 9, pp. 43–51, 2016.

[18] X. Zhang, "Supply chain management model optimization based on blockchain," *China Circulation Economy*, vol. 32, no. 8, pp. 44–52, 2018.

[19] F. Zhang and B. Mu, "Supermarket procurement optimization under the supply chain management model," *Logistics Engineering and Management*, vol. 38, no. 4, pp. 105–107, 2016.
[20] Y. Shi, J. Yin, and B. Wang, "Research on model and algorithm of low-carbon goods collection in distributed manufacturing supply chain," *Logistics Technology*, vol. 36, no. 10, pp. 114–120, 2017.
[21] W. Zhang and M. Zhang, "Supply chain joint scheduling and algorithm for continuous production," *Computer Engineering and Applications*, vol. 55, no. 13, pp. 246–253, 2019.
[22] L. Suo, J. Yao, and J. Zhou, "Resource integration and optimization for new retail supply chain," *Business and Economic Research*, vol. 755, no. 16, pp. 7–10, 2018.
[23] M. Hu, X. Liang, Y. Yang, and M. Lin, "Supply chain performance evaluation and optimization based on LMBP algorithm in the context of big data," *Data Analysis and Knowledge Discovery*, vol. 2, no. 11, pp. 37–45, 2018.
[24] Z. Wang, Q. Shao, and X. Wang, "Logistics service supply chain optimization considering instant purchase price," *Operations Research and Management*, vol. 25, no. 2, pp. 36–39, 2016.
[25] X. Hong, T. Qu, and D. Nie, "Optimal allocation method of product family supply chain considering multi-source procurement," *Logistics Technology*, vol. 41, no. 4, pp. 90–96, 2018.
[26] B. Ma and Z. Wu, "Research on supply chain network equilibrium based on artificial bee colony algorithm," *Journal of Chengdu University of Information Technology*, vol. 3, no. 350, pp. 109–113, 2017.