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Inventory Sharing and Distribution Path Optimization of the Omni-Channel Supply Chain in the New Retail Environment

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Abstract: Under the background of new retail, inventory sharing and distribution coordination in omni-channel supply chain have become the key to improve operational efficiency. This paper systematically analyzes the implementation mechanism, optimization strategy and value effect of inventory sharing, and points out that it faces challenges such as channel interest conflict and system integration. On this basis, the theoretical framework of co-optimization of inventory allocation and logistics distribution path is constructed, the collaborative mechanism of two-way driving of the two is explained, and the optimization strategy system covering strategy, tactics and execution is designed. The research shows that by integrating intelligent algorithms such as demand forecasting, inventory optimization and path planning, the closed-loop decision of supply chain can be realized. Finally, this paper puts forward implementation countermeasures from five dimensions of data center construction, mechanism innovation, algorithm optimization, organizational collaboration and technology empowerment, providing theoretical reference and practical guidance for retail enterprises to realize the digital transformation of supply chain.

Keywords: SMES; New Retail; Omni-Channel Supply Chain; Inventory Sharing; Logistics and Distribution; Optimization of Path

1. Introduction

The rise of the new retail model is profoundly reshaping the supply chain structure of the retail industry. Under the trend of online and offline integration, cross-channel supply chain management has become a key support for the core competitiveness of enterprises [1]. In traditional inventory management, channel data is fragmented and inventory visualization is insufficient, and the low efficiency of manual collaboration leads to delayed replenishment decisions, resulting in the coexistence of out-of-stock and slow-moving products, which has long constrained the improvement of industry operational efficiency [2]. In this context, optimizing the allocation of cross-channel inventory through inventory sharing mechanisms and implementing scientific planning of logistics distribution routes by combining intelligent algorithms have become important topics of common concern in both academia and industry.

Inventory sharing is the core strategy of the omni-channel supply chain. Its essence is to integrate the inventory resources scattered across different channels and regions into a unified dynamic allocation pool, replacing the fragmented model of independently setting warehouses in multiple channels. Based on the "one inventory" system constructed by the real-time data platform, inventory information can be updated in minutes and intelligently allocated. In practice, it has been verified that it can significantly reduce the proportion of channel inventory and improve the efficiency of cross-channel stock transfer. It represents a dual upgrade of supply chain management concepts and technologies [3]. At the same time, the optimization of logistics delivery routes serves as a key support for the execution of the supply chain, directly affecting customer experience and enterprise costs. In the new retail environment, consumers' requirements for delivery timeliness are becoming increasingly strict, and the demand for same-city instant delivery is growing rapidly [4]. Currently, the model and algorithm design for scenarios such as dynamic demand response and multi-objective trade-off still need to be improved. Based on this, this paper constructs a theoretical analysis framework for inventory sharing and delivery route collaborative optimization, and conducts systematic research from theoretical analysis and strategy design, with the aim of

providing theoretical references and practical guidance for new retail enterprises to optimize supply chain management.

2. Core Concepts and Theoretical Basis

2.1 Core Concepts

New retail is essentially a retail model transformation centered on consumer experience and driven by data [5]. It is not merely the simple combination of "online" and "offline", but rather utilizes advanced technologies such as big data and artificial intelligence to upgrade the entire process of product production, circulation and sales, thereby reconfiguring the relationship among the three elements of "people", "goods" and "places"[6]. "People" refers to shifting from "managing products" to "managing users". Through digital means, consumers are identified, personalized and precise services are provided to meet the demands of the new middle class for quality, experience and self-improvement. "Goods" refers to shifting from "mass production" to "production based on demand". Using data to guide production, eliminating inventory blind spots, and achieving rapid circulation and precise matching of goods. "Places" refers to breaking through time and space boundaries. Whether it is physical stores, e-commerce, social platforms or smart homes, all scenarios that can connect people and goods are considered "places". It emphasizes the deep integration of online services, offline experiences and modern logistics.

The omni-channel supply chain is a new form of supply chain evolution under the background of the digital economy. Its core lies in breaking the barriers among online e-commerce, offline stores, social media, etc., and achieving the full integration and efficient collaboration of commercial flow, logistics, capital flow, and information flow [7]. Different from the independent operation and data fragmentation state of each channel in the traditional multi-channel model, it focuses on consumer demands and relies on digital technologies such as big data and cloud computing to build an integrated fulfillment system that seamlessly connects online and offline. The omni-channel supply chain transforms offline stores, forward warehouses and other resources into distributed fulfillment terminals [8]. Combined with cross-regional inventory sharing and dynamic scheduling, it enables flexible switching between multiple fulfillment models such as "nearest delivery" and "in-store pickup", significantly enhancing response efficiency and reducing logistics costs [9].

2.2 Theoretical Basis

The inventory sharing theory stems from the concept of risk sharing. Its core logic lies in systematically integrating the geographically dispersed and channel-separated multi-node inventory resources, replacing the decentralized independent inventory units with a unified inventory pool. Without reducing the terminal service level, it reduces the redundant level of safety inventory throughout the entire chain at the overall level, achieving the intensive allocation of inventory resources. Current research mainly focuses on inventory pool theory, collaborative planning, forecasting and replenishment, and supplier managed inventory, etc [10,11]. In the omni-channel scenario, scholars have proposed the concept of "cloud warehouse inventory sharing", integrating scattered warehouses through cloud computing and big data technology, and combining intelligent allocation algorithms to achieve dynamic allocation. Research shows that the inventory sharing mechanism in the omni-channel scenario can significantly improve the overall inventory turnover efficiency of the supply chain and reduce the inventory capital occupation level throughout the entire chain [12]. Logistics distribution path optimization is a classic problem in operations research. The vehicle routing problem and its derivative models form the theoretical basis [13]. With the rapid development of new business models such as instant retail and same-city delivery, the traditional static environment-based path optimization framework has become difficult to adapt to complex real-world scenarios. In recent years, the academic community has gradually incorporated real-world elements such as dynamic demand perturbations, multi-agent goal trade-offs, and delivery personnel heterogeneity into the research framework, further expanding the research boundaries of this field [14]. Multi-objective algorithms based on dynamic weight adjustment can achieve an effective balance among order fulfillment time, rider idle time, and platform profits. The application of artificial intelligence technologies, such as neural approximate dynamic programming methods, provides new solutions for ultra-immediate

delivery problems [15].

3. Mechanism Analysis of Inventory Sharing in the Omni-Channel Supply Chain

3.1 The Implementation Mechanism of Inventory Sharing

The core of shared inventory in the omni-channel supply chain lies in breaking through traditional channel barriers and establishing a unified inventory pool management mechanism. Its realization relies on three key supports. Firstly, the data center is the technical foundation. It builds a unified inventory center, integrates data from online platforms, offline stores, and multi-level warehouses, establishes a real-time synchronization engine, ensures the consistency of the inventory ledger across all channels, and eliminates information silos [12]. Secondly, the intelligent algorithm is the operational core. It adopts a model combining shared inventory and channel quotas, and sets sharing or exclusive quotas according to sales strategies. At the execution level, the "order placement locks the inventory" strategy is implemented, combined with safety inventory alerts and dynamic replenishment algorithms, effectively preventing overstocking and stockouts [16]. Thirdly, the cross-channel organizational collaboration mechanism is the key institutional guarantee. Through reconfiguring cross-departmental collaboration processes and adjusting performance evaluation rules oriented towards the omni-channel, it eliminates conflicts of interests among different channel entities, ensuring the smooth implementation of cross-channel inventory allocation processes [17].

3.2 Optimization Strategy for Inventory Sharing

The optimization strategies for inventory sharing mainly cover three aspects [18]. Firstly, the inventory visualization strategy involves establishing a unified inventory view to achieve real-time synchronization and global accessibility of inventory quantity, storage location, and product status, completely eliminating information silos across channels and fundamentally avoiding operational risks such as "overstocking" and "wrong delivery". Secondly, the intelligent allocation strategy relies on intelligent scheduling algorithms to comprehensively consider the geographical location of orders, the real-time inventory levels at each node, cross-regional logistics costs, and delivery time requirements. It automatically matches the optimal fulfillment and delivery warehouse, replacing the traditional manual experience-based allocation mode, significantly improving the accuracy and response efficiency of inventory configuration. Finally, the batch management strategy precisely tracks the production batches throughout the product lifecycle, and sets rules for automatic identification of expired products and prioritized outbound delivery. This ensures product quality while accelerating the circulation of expired inventory and effectively reducing the risks of unsold goods and capital occupation.

3.3 The Value Effect of Stock Sharing

In the omni-channel supply chain scenario, inventory sharing can significantly bring operational gains in terms of cost, efficiency, and experience [7]. From the cost perspective, the unified virtual shared inventory pool replaces the traditional multi-channel independent stocking model, which can systematically reduce the redundant safety stock levels throughout the entire supply chain, significantly decrease the inventory capital occupation and the repeated investment in storage resources, and effectively lower the overall inventory holding cost. In terms of efficiency, the unified inventory scheduling system across the entire domain eliminates the waiting 环节 of cross-channel allocation approval under the traditional model, allowing orders to be directly matched with the nearest available inventory node for delivery, significantly improving the order response speed throughout the supply chain. From the experience perspective, inventory sharing provides the core support for omni-channel innovative services such as "same price online and offline", "local store delivery", and "on-site immediate self-pickup", effectively reducing order cancellation due to shortage, and significantly enhancing the satisfaction of end customers.

3.4 Challenges of Inventory Sharing

Although inventory sharing has significant advantages, its implementation still faces multiple challenges. The coordination of channel interests is the primary challenge. The separate assessment systems for online and offline channels, which are set up independently, can

easily lead to conflicts of interest among different channel entities, generating a natural resistance to cross-channel inventory allocation[19]. The system integration is difficult, as it requires connecting multiple heterogeneous systems. The data standards among different systems are not unified, significantly increasing the implementation cost of data integration. The inventory allocation rules are complex, requiring balancing multiple factors such as order sources, inventory distribution, and distribution costs. The expiration management risk is high, with categories such as cross-border goods facing strict quality control requirements for expiration dates.

4. Collaborative Optimization Strategy of Inventory Sharing and Distribution Path

4.1 The Collaborative Mechanism of Inventory Configuration and Distribution

Inventory sharing and logistics distribution path optimization are deeply interrelated, with a mutually reinforcing and mutually restrictive close synergy. The inventory layout, warehouse stocking, and other inventory allocation decisions made by enterprises directly determine the starting point of order delivery, influencing the distribution scope and overall path planning scheme at the root level; while the fulfillment timeliness and scheduling efficiency at the end of distribution will, in turn, affect the speed of goods outflow and return, changing the overall inventory turnover level. Scientific and balanced global inventory allocation can shorten the distance between warehouse points and consumption terminals, effectively reduce the one-way distribution mileage, and continuously cut the expenses of trunk lines and end-point transportation; the efficient distribution routes optimized by algorithms can accelerate the circulation speed of goods, compress the inventory static period, and reduce the occupation of storage funds. By synchronously and collaboratively optimizing inventory layout and distribution scheduling, the combined value-added effect can be released, achieving a synergistic gain of "1 + 1 > 2", and comprehensively improving the overall operational efficiency of the full-channel supply chain [7].

4.2 Framework of Collaborative Optimization Strategy

The framework of the inventory sharing and distribution path collaborative optimization strategy is divided into three levels: strategic, tactical, and execution. These levels progress sequentially and operate in a coordinated manner. At the strategic level, big data is relied upon to complete market demand forecasting, and in combination with the preset customer service level goals of the enterprise, the overall warehouse layout is coordinated. The overall inventory configuration plan is formulated from the source, taking into account both the holding cost of the warehouse and the quality of order fulfillment, achieving a dynamic balance between the two [20]. At the tactical level, based on the current distribution status of each warehouse and the regional distribution network, an integrated joint optimization plan for cross-warehouse inventory allocation and end-point distribution paths is designed [21]. At the execution level, intelligent optimization algorithms are employed, dynamically adjusting inventory allocation and dispatching distribution routes according to real-time order fluctuations, and quickly adapting to changes in market demand [22]. The strategic level sets the direction, the tactical level formulates the plan, and the execution level implements the plan. The three-level system supports and coordinates with each other, forming a sustainable iterative closed-loop optimization system.

4.3 Integrated Application of Intelligent Algorithms

The collaborative optimization of inventory and distribution cannot be achieved without the deep integration and coordinated operation of multiple types of intelligent algorithms. The demand forecasting algorithm relies on machine learning technology, integrates multiple external variables such as enterprise historical sales accounts, seasonal fluctuations, market activities, and regional consumption characteristics to accurately predict the market demand scale, and provides pre-data support for the overall inventory layout [23]. The inventory optimization algorithm uses operational research models to solve the global optimal inventory allocation plan under the dual constraints of inventory holding costs and customer order fulfillment service levels. The path optimization algorithm adopts intelligent optimization models, combining the inventory capacity restrictions of each warehouse to plan the distribution routes

with the lowest cost and the best timeliness. These three types of algorithms are interconnected layer by layer and data are shared, successively completing demand prediction, inventory allocation, and distribution scheduling, and building an end-to-end closed-loop intelligent decision-making chain covering the entire supply chain process.

4.4 Implementation Path and Safeguard Measures

For the inventory and distribution collaborative optimization strategy to truly take effect, it requires the coordinated support of multi-dimensional supporting measures [24]. At the technical level, enterprises should build a global integrated data platform, connect multiple data interfaces such as inventory, distribution, and market demand, and achieve real-time synchronization and intercommunication of all links of information; simultaneously, build an integrated intelligent decision-making engine, integrate multiple optimization algorithms and achieve integrated operation, providing computing power support for dynamic scheduling. At the organizational level, break down the management barriers of each channel and department that are independently segmented, and establish a regular cross-functional collaborative working mechanism; restructure performance evaluation standards, abandon the single-channel assessment orientation, and take the comprehensive benefits of the entire channel supply chain as the core evaluation basis. At the process level, simplify the order approval and circulation links of online and offline, and reduce the response time of the entire order-to-end distribution process from start to finish; build standardized emergency response processes to quickly deal with various sudden abnormal situations such as increased demand and warehouse and distribution failures.

5. Suggestions

First, establish a unified data center to enhance inventory visualization. Enterprises should focus on building a unified digital platform to integrate heterogeneous systems such as e-commerce platforms, store systems, enterprise resource planning, and warehouse management systems. This will enable real-time collection and synchronization of inventory information. By establishing a cross-channel inventory center, real-time visualization management of the quantity and status of each inventory unit can be achieved, providing a data foundation for inventory sharing and distribution optimization. At the same time, efforts should be made to promote data interconnection among the supply chain's upstream and downstream, enabling information sharing among brand owners, distributors, and end-users, and enhancing the overall visualization level of the entire chain.

Second, innovate the inventory sharing mechanism and optimize the inventory allocation strategy. Enterprises should break away from the traditional multi-item inventory thinking and establish a unified inventory management model across all channels. Through intelligent algorithms, achieve dynamic inventory allocation. Based on factors such as order sources, inventory distribution, and logistics costs, automatically match the optimal shipping warehouse. Design reasonable inventory allocation rules to balance the interests of all parties. Strengthen batch management and implement a priority outbound strategy for expired products to reduce inventory loss risks. Establish an inventory warning mechanism to trigger safety inventory alerts in advance and enhance the ability to respond to demands.

Third, optimize the delivery route algorithm to improve logistics operation efficiency. Enterprises should increase investment in the research and development of delivery route optimization algorithms, and build multi-objective optimization models that adapt to dynamic demand changes. Fully consider the heterogeneity of delivery personnel and design differentiated dispatch strategies. Apply technologies such as deep reinforcement learning to achieve batch processing of orders and intelligent assignment of riders. Establish a dynamic weight adjustment mechanism to seek a balance among order fulfillment time, rider idle time, and platform profits. Continuously optimize algorithm performance to improve solution efficiency and meet the time requirements of immediate delivery.

Fourth, enhance organizational collaboration capabilities and improve the supporting guarantee system. Enterprises should adjust their organizational structure and establish a collaborative mechanism across multiple channels and departments. Shift from single-channel performance assessment to overall performance evaluation across all channels, and motivate all parties to actively participate in

inventory sharing. Strengthen talent cultivation and enhance supply chain management and the application of intelligent algorithms. Improve the incentive and restraint mechanism to ensure the effective implementation of inventory sharing and distribution optimization strategies. Establish a fault-tolerance and error-correction mechanism to encourage innovative practices and continuously iterate and optimize.

Fifth, promote technological application innovation and build an intelligent decision-making system. Enterprises should actively embrace new technologies such as artificial intelligence and big data, and build an intelligent supply chain decision-making system. Utilize machine learning algorithms to improve the accuracy of demand forecasting and provide scientific basis for inventory allocation. Deploy intelligent scheduling systems to achieve joint optimization of inventory allocation and distribution routes. Build a real-time monitoring platform to dynamically track the operation status of the supply chain. Explore the application of digital twin technology in supply chain simulation optimization to enhance the scientificity and forward-looking nature of decision-making.

6. Conclusion

This paper is based on the transformation demands of the all-channel supply chain management in the new retail business model, and systematically explores the core mechanisms and implementation strategies of inventory sharing and collaborative optimization of distribution routes. The research first clarifies the theoretical connotations of new retail and the all-channel supply chain, and points out that inventory sharing is essentially a supply chain transformation that breaks through channel barriers and realizes "one inventory" centralized management. By building a data platform and intelligent algorithm system, enterprises can achieve the visualization of global inventory and dynamic allocation, significantly reducing redundant inventory costs while greatly improving order response speed and customer experience. However, the implementation of this model still faces multiple challenges such as channel interest conflicts, difficulties in integrating heterogeneous systems, and complex expiration management. To address these issues, this paper proposes a collaborative optimization framework for inventory allocation and distribution routes. The research shows that inventory layout directly determines the starting point of distribution, while distribution efficiency inversely affects inventory turnover, and there is a deep coupling relationship between the two. By integrating machine learning demand forecasting, operational research inventory optimization, and intelligent path planning algorithms, enterprises can build a closed-loop decision-making system from the strategic level to the execution level, achieving a synergistic gain of "1 + 1 > 2". Finally, this paper proposes specific countermeasures from five dimensions: building a unified data platform, innovating inventory sharing mechanisms, optimizing distribution algorithms, strengthening organizational collaboration, and promoting technological innovation.

References

[1] Zhang Zijian, Xue Chuanli. Research on Supply Chain Optimization of Retail Enterprises under Omni-channel Mode. Industrial Economic Forum, 2016, 3(4): 468-476.

[2] Zhan Liping. Research on the Influence of Data Element Application on the Stability of Retail Enterprises' Customer Relationship. Journal of Commercial Economics, 2026(12): 138-141.

[3] Chen Jingxian, Meng Qingfeng. Inventory Sharing Strategy for Responding to Emergencies. Chinese Journal of Management Science, 2015, 23(5): 65-72.

[4] Zhang Zhiqing, Wang Shuo, Zhu Leipeng, et al. Path Planning and Application of Logistics Terminal Distribution Based on Improved Grey Wolf Optimization Algorithm. Science Technology and Engineering, 2025, 25(34): 14890-14899.

[5] Wei Jinghong. Research on the Relationship among New Retail Channel Integration, Logistics Service Quality and Consumers' Purchase Intention. Journal of Commercial Economics, 2024(2): 95-98.

[6] Wang Fu, Liu Junhua, Chang Qing, et al. How Scenario Chain Empowers Ecological Innovation of New Retail Business Model — A Case Study of Haier Smart Home. Nankai Business Review, 2025, 28(11): 88-99.

[7] Zhang Jianjun, Zhao Qilan. Integration and Optimization of Omni-channel Supply Chain for New Retail — From the

Perspective of Service-dominant Logic. Contemporary Economic Management, 2019, 41(4): 23-29.
[8] Zhang Jiemei, Yang Liu. Research on Live-stream Marketing Optimization Strategy of Publishing Enterprises from the Perspective of Omni-channel Supply Chain. Science-Technology & Publishing, 2022(9): 114-120.
[9] Zhao Chengdi, Zhang Zhandong, Jin Meng. Welfare Effect Analysis of Physical Retailers' Supply Chain in the Era of Digital Retail. Enterprise Economy, 2021, 40(9): 76-87.
[10] Zhang Yueyue, Yang Xinyu, Xie Tingya. Supply Chain Shareholding, Structural Optimization of Slack Resources and Improvement of Corporate Innovation Resilience]. Industrial Technology & Economy, 2026, 45(6): 60-71.
[11] Liu Xu, Xu Qi. Research on Dual-channel Supply Chain Management under E-commerce Environment. Technoeconomics & Management Research, 2016(8): 56-60.
[12] Tian Hongbin, Yang Xiuyun, Tian Qitao. Empirical Study on Retail Format Evolution and Enterprise Performance in Digital Economy Era. Economic Survey, 2021, 38(2): 91-101.
[13] Wang Yong, Jin Yan, Wei Yuanfan, et al. Vehicle Routing Optimization for Express Parcel Logistics Distribution Considering Time-dependence. Packaging Engineering, 2026, 47(13): 241-255.
[14] Wang Li. Research on Distribution Path Optimization of Agricultural Product Cold-chain Logistics Based on Improved WOA Algorithm. Mathematics in Practice and Theory, 2026, 56(6): 84-94.
[15] Pi Jiancai, Yang Luxin. Artificial Intelligence, Capacity Utilization and Supply Chain Carbon Emission Reduction — From the Perspective of Resource Orchestration and Carbon Unlocking Efficiency. Economic Theory and Business Management, 2026, 46(3): 56-75.
[16] Lu Jinlin, He Wenlong. Research on the Influence of Human-AI Collaboration on Inventory Management Efficiency of Retail Enterprises. Journal of Commercial Economics, 2025(23): 177-180.
[17] Hao Lan, Demin Wan, Pengyi Shen. Research on the Influence of Omni-channel Integration of Physical Retailers on Omni-channel Usage Intention. Frontiers of Engineering Management Science and Technology: 1-13 [2026-08-17].
[18] Bai Qingguo, Ding Yingzhen, Liu Shihao, et al. Research on Low-carbon Inventory Strategy of Loss-averse Enterprises under Omni-channel Retail. Industrial Engineering and Management, 2024, 29(6): 205-216.
[19] Zhou Yongwu, Li Fei. Problems and Challenges of New Retail Operations Management. Journal of Systems & Management, 2022, 31(6): 1041-1055.
[20] Li Yang, Li Huan. How Omni-channel Integration Affects Customer Patronage — An Empirical Study from Retailer Morality Perspective. Journal of Beijing Technology and Business University (Social Sciences), 2023, 38(4): 35-46.
[21] Zeng Xing. Research on the Influence of Circulation Industry on Manufacturing Efficiency and Regional Balance from a Specialization Perspective. Journal of Commercial Economics, 2015(10): 18-20.
[22] Wang Qingfu. Analysis on Path of Rural Digital Science and Technology Innovation Empowering Agricultural Carbon Emission Reduction. Agricultural Economy, 2026(4): 30-32.
[23] Shen Mingyan, Cao Hongtao. Mechanism of Intelligent Economy Empowering the Development of New-quality Productive Forces in Commercial Circulation Industry — From the Perspective of National Unified Large Market Construction. Journal of Commercial Economics, 2026(14): 10-14.
[24] Yang Hualong, Shi Xingjiang, Xin Yuchen. Optimization of Inventory-routing and Pricing Problem for Omni-channel E-commerce. Journal of Transportation Systems Engineering and Information Technology, 2024, 24(4): 223-230.