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A Comparative Study of Pathways for Digital Transformation of Retail Enterprise Supply Chains — A Case Study of Hema Fresh and JD Convenience Stores

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Abstract. With the development of the retail industry and digital technologies, enterprise supply chains are facing demands for improved efficiency, faster response, and optimized user experience. This paper analyzes the application of digital intelligence and model innovation in retail supply chains, using JD Convenience Store and Hema Fresh as examples. The study found that big data-driven demand forecasting, intelligent warehousing, forward warehouse layout, and instant delivery are key means to improve efficiency and service. JD Convenience Store achieves integrated online and offline management through regional warehouses and high-frequency, small-batch replenishment, while Hema Fresh builds an agile supply chain based on forward warehouses and community instant delivery, demonstrating differentiated practices. Digital transformation can optimize inventory turnover, reduce out-of-stock rates, improve delivery efficiency, and enhance user satisfaction, but challenges remain, such as high costs, regional adaptability, and insufficient flexibility. Future retail supply chain development should focus on full-chain digitalization, enhanced flexibility and resilience, green sustainability, omni-channel integration, and personalized customization.

Keywords: Hema Fresh, Supply Chain, JD Convenience Stores, Digitalization

1. Introduction

In recent years, digital technology has profoundly changed the production methods, organizational models and business ecosystems of various industries. As a key link connecting production and consumption, the retail industry is undergoing profound changes. Omni-channel retailing has become increasingly popular, imposing higher demands on product quality, speed, and experience, driving the digital transformation of retail enterprises' supply chains. Under the traditional model, the retail supply chain has long faced inherent pain points, including "information silos", inaccurate forecasts, slow responses, inventory imbalances, and low collaborative efficiency. These pain points not only increase operating costs but also weaken market competitiveness. Inaccurate forecasts can cause a bullwhip effect (when customer demand changes, the seller's purchase volume exceeds the customer's purchase volume, and the manufacturer's production volume change is greater than the seller's purchase volume), resulting in upstream inventory backlogs or downstream shortages [1].

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The lack of visualization in the logistics link makes delivery efficiency low and makes it difficult to meet the demand for instant delivery.

JD Convenience Stores focus on self-operated logistics and intelligent warehousing, pursuing high-efficiency operations with nationwide coverage. Hema is characterized by forward warehouses and instant delivery, focusing on user experience and responsiveness. The practice of these two models in the context of digital transformation provides valuable cases for retail supply chain optimization. This paper will explore the impact of supply chain digital transformation on enterprises by studying and comparing the cases of Hema Fresh and JD Convenience Store.

2. Literature review

2.1. Research on supply chain management

Supply chain management (SCM) is a comprehensive management system for enterprises to coordinate internal and external resources to achieve optimal cost and to maximize service levels in the long term [2]. Traditional supply chains face limitations such as delayed information transmission, inaccurate demand forecasts, rigid inventory structure, and untimely customer response, which make it difficult to meet the requirements of modern retail for flexibility and timeliness [3].

The retail supply chain is consumer demand-oriented, with high transaction frequency, rapid iteration, and data-intensive characteristics. Its core lies in achieving accurate perception and dynamic response to consumer demand through digital means, thereby promoting efficient collaboration in procurement, warehousing, distribution and other links [4]. The retail supply chain pursues a terminal demand-driven approach and a real-time feedback mechanism, relying on big data analysis and information-sharing platforms to achieve demand forecasting, inventory optimization, and supply collaboration, forming a rapid-response operations system.

2.2. Research status of digital transformation

Retail enterprises use emerging technologies such as big data, artificial intelligence and the Internet of Things (IoT) to achieve supply chain optimization and intelligent decision-making [5].

Big data technology integrates internal sales records, market dynamics and consumer behavior information to provide data support for demand forecasting and replenishment planning [6]. By analyzing consumer purchasing preferences in real time, enterprises can accurately formulate promotional strategies and improve both inventory turnover and customer satisfaction. Artificial intelligence is widely used in warehouse automation, route optimization and customer recommendation systems to help enterprises optimize resource allocation and make intelligent decisions. In addition, IoT technology uses sensors and smart terminal devices to achieve full-process monitoring of goods, inventory and logistics status. The collaboration of the three has promoted and facilitated the strategic transformation of retail enterprises from experience-driven to data-driven, significantly improving the flexibility and responsiveness of the supply chain.

However, the application of digital technology in the retail supply chain still faces three major challenges: data silos, model dependency and cost security. Information barriers between enterprises and among internal departments hinder end-to-end supply chain collaboration. The accuracy of big data and artificial intelligence models depends on high-quality data input and industry-specific algorithm optimization. In addition, the high maintenance cost of IoT system equipment and data

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security issues have, to a certain extent, restricted its promotion and the stability of its continuous operation.

2.3. Fusion theory

Big data-driven supply chain optimization theory emphasizes that the real-time collection and analysis of multi-source heterogeneous data is the core of supply chain optimization [7]. Therefore, in order to cope with the complexity and uncertainty of the retail market, a single supply chain strategy is often insufficient. The integration of lean supply chain theory (emphasizing waste reduction and efficiency) and flexible supply chain theory (emphasizing adaptability and resilience) is a key strategy for modern retail enterprises. At the same time, it enhances the "flexibility" of the supply chain through real-time data feedback, thereby achieving a dynamic balance between efficiency and flexibility [8].

3. JD convenience store case study

3.1. Overview of JD convenience stores and supply chain characteristics

JD Convenience Stores, a key component of JD, has been gradually expanding since 2017, adopting an asset-light partnership model featuring "no franchise fees and end-to-end empowerment". Leveraging JD's retail platform, JD's logistics system, and JD Digital Technology, these convenience stores have developed unique supply chain characteristics:

First, they feature high integration. Convenience stores share supply chain resources with JD's online retail platform, including product procurement, warehousing and distribution systems, and data platforms. Second, JD Convenience Stores utilize a multi-tiered warehousing and distribution network, encompassing regional warehouses, forward warehouses, and terminal delivery stations, enabling high-frequency, small-batch replenishment. Third, they are driven by digital intelligence. Product selection, replenishment, and promotions at JD Convenience Stores are all based on big data and intelligent algorithms, enabling real-time interaction between stores and users. Finally, JD Convenience Stores adheres to a user-centric philosophy, positioning itself as "online and offline integrated", emphasizing immediacy and convenience, and reflecting high-frequency, low-price, and tiered demand.

These characteristics offer favorable application scenarios for digital intelligence applications and also highlight the exploration value of JD Convenience Stores in the innovation of retail supply chain models.

3.2. Digital intelligence applications of JD supply chain

3.2.1. Demand forecasting and decision support

JD widely uses big data and artificial intelligence technologies in supply chain management. Through real-time collection and analysis of user browsing, search, purchase, and evaluation data, JD can build accurate user portraits and combine machine learning algorithms to predict demand, so that the forecast deviation is controlled within 5%. This data-driven forecasting model effectively reduces demand uncertainty and reduces the occurrence of the bullwhip effect.

In addition, JD has developed an intelligent decision-support system that provides optimization recommendations for promotion, replenishment, and inventory allocation. For example, JD Logistics "Logistics Brain" system realizes real-time simulation of billions of orders by integrating

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large language models (LLM) and digital twin technology, and the fulfillment efficiency increased by about 12% during the "Double 11" period in 2024 [9].

3.2.2. Intelligent warehousing and inventory management

JD convenience store inventory management relies on its intelligent warehousing system, the core of which comprises JD's self-developed warehouse management system (WMS) and warehouse control system (WCS), which achieve precise inventory management and operational automation. By connecting with regional warehouses, stores can achieve "multiple replenishments per day", significantly reducing the need for safety inventory. Using radio frequency identification (RFID) and barcode technology, store inventory is synchronized with the backend in real time, enabling inventory visualization and preventing information delays. For fresh produce, the system automatically calculates the shelf life and turnover rate, and refines first-in-first-out (FIFO) management processes. JD's digital supply chain has significantly improved inventory turnover and order fulfillment efficiency. According to JD's financial report, its inventory turnover days remain at around 30 days, far below the industry average [10].

3.2.3. Innovation in logistics and distribution models

JD's self-built logistics is its core competitive advantage. Relying on the seven major logistics networks across the country and the "last mile" distribution system, JD has proposed a "time-limited delivery" service, that is, orders placed before 11 a.m. on the same day will be delivered on the same day; orders placed after 11 a.m. will be delivered the next day [11]. In the terminal delivery link, unmanned vehicles and drone delivery technologies are introduced to improve delivery efficiency and strengthen brand image. In addition, convenience stores have further assumed the role of community logistics service nodes. For example, stores can serve as express pick-up points and delivery transit stations for instant retail, realizing the deep integration of retail and logistics. Through this innovative model, JD Convenience Stores have the dual functions of express pick-up points and instant retail forward warehouses, realizing the closed-loop combination of retail and logistics networks. While improving customer convenience and satisfaction, this model also optimizes logistics costs through order aggregation and intelligent route planning, thereby improving the overall gross profit margin.

3.3. JD supply chain model innovation practice

JD Convenience Stores have explored and formed various supply chain model innovations in the process of digital transformation. As shown in Figure 1, JD Convenience Stores' digital supply chain integrates demand forecasting, intelligent warehousing, and innovative delivery models.

The first is full-link digital integration. Convenience store product selection, ordering, warehousing and distribution, and after-sales service are all integrated with JD's big data platform, forming a closed-loop supply chain encompassing "front-end demand perception - mid-end operational optimization - back-end delivery and fulfillment", significantly improving overall efficiency. Secondly, there is the integration of B2B and B2C. Convenience stores not only serve end consumers but also provide goods and logistics support to small community businesses, driving the development of a networked supply chain. JD Convenience Stores thus serve as both retail terminals and wholesale nodes, embodying the innovative "retail as a channel" philosophy. Furthermore, technology empowers franchisees. Through a unified system platform and operational

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tools, franchisees gain real-time visibility into sales and inventory dynamics, leveraging big data to guide product selection and promotional activities, thereby reducing operational complexity. While traditional convenience stores rely on individual experience, JD Convenience Stores leverage "small store big data", significantly improving operational efficiency. Finally, there's the synergy of the new retail ecosystem. Convenience stores collaborate with businesses like JD "deliver-to-home" service and JD Health to promote cross-industry supply chain collaboration and innovation. For example, stores can not only sell daily necessities, but also undertake fresh produce delivery and healthcare services, further expanding their role in community life services.

Figure 1. JD convenience store digitalization process

4. Hema fresh case study

4.1. Company overview and supply chain characteristics

Hema Fresh is positioned as a "new retail fresh food supermarket", advocating online and offline integration and instant community retail. Hema Fresh's core philosophy is "consumption scenarios drive the supply chain ." By integrating forward warehouses, stores, distribution centers, and mobile orders, it achieves "30-minute delivery" instant delivery.

Hema stores are not only retail locations but also distribution centers and forward warehouses, meeting the immediate consumption needs of community residents. Hema has established an end-to-end data chain, integrating user-side order data, consumer preferences, social media feedback, and inventory and logistics data to support product selection, pricing, inventory management, and delivery scheduling. The forward warehouse's low-volume, high-frequency replenishment model enables rapid supply chain response, particularly suited to the time-sensitive, low-tolerance requirements of fresh food. Consumers can shop in-store or order through the app, creating a seamless shopping experience and enabling multi-channel order processing in the supply chain.

4.2. Digital application of Hema supply chain

4.2.1. Big data product selection and demand forecasting

Hema Fresh uses big data technology to select products and forecast demand, covering the entire product life cycle. Combining historical sales data, user preferences, holiday characteristics, weather factors, and public social opinion, machine learning models are used to analyze the potential of different products across stores in different regions. This enables accurate product selection and personalized promotions, effectively increasing user stickiness and repurchase rates. More importantly, through intelligent data analysis, Hema can mitigate inventory overstock, stockouts, and waste, while enhancing store service capabilities. Intelligent replenishment and inventory allocation reduce inventory backlogs and fresh product losses, and improve turnover efficiency. Data-driven supply chain management reduces the uncertainty of store operations and provides a quantitative basis for decision-making [12].

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4.2.2. Forward warehouse and inventory management model

One of the core innovations of Hema Fresh's supply chain is the forward warehouse model. The forward warehouse model supports a small-batch, high-frequency, rapid replenishment model. The forward warehouse and store inventory are synchronized in real time, using RFID, barcodes and intelligent picking systems to achieve dynamic inventory adjustments. Based on forecasted demand and historical data, the system automatically adjusts the inventory allocation of each forward warehouse and store to ensure the timeliness and freshness of fresh products. Through first-in-first-out (FIFO) management and shelf life monitoring, the waste of fresh products is minimized. According to the lean supply chain theory, Hema reduces waste by reducing intermediate links; at the same time, combined with the flexible supply chain theory, it uses the forward warehouse model to quickly respond to local needs.

4.2.3. Instant delivery and user experience improvement

"30-minute instant delivery" is a significant feature of Hema's supply chain and its differentiated competitive advantage. Instant delivery and personalized recommendations have improved user satisfaction and repurchase rate, and the average customer unit price is higher than that of traditional supermarkets. Its delivery radius is usually controlled within 3 kilometers. Based on big data and intelligent scheduling algorithms, the backend system can intelligently distribute orders and dynamically optimize rider routes, combining diverse delivery methods, such as unmanned vehicles and drones, to handle different scenarios and order densities. Consumers can place orders through the App and view the delivery progress in real time, experiencing a transparent and controllable service process [13]. Instant delivery not only improves consumer convenience but also enhances the resilience and agility of Hema's supply chain in high-frequency fresh-food scenarios.

4.3. Hema's supply chain model innovation practices

In summary, through its small-batch, high-frequency forward warehouse model, Hema has achieved instant delivery of fresh food and the ability to quickly respond to demand. From product selection and inventory management to delivery scheduling, every link in the supply chain is dynamically adjusted with the support of a data platform, forming a closed-loop management system. Stores serve as both retail locations, distribution centers, and forward warehouses, seamlessly integrating with the app's order system to form a closed-loop new retail ecosystem. Data analysis supports personalized marketing, inventory optimization, and logistics scheduling, improving operational efficiency and store management efficiency.

Through these innovative practices, Hema has established a highly agile new retail supply chain model tailored to the immediate needs of the communities, setting a benchmark for the industry.

Figure 2. Hema store digitalization process

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5. Comparison of two paradigms of digital transformation

5.1. Comparison of core dimensions of transformation paths

As shown in Table 1, compared to traditional convenience store supply chains characterized by multi-tiered distribution, manual labor, a single POS system, and traditional operating models, JD Convenience Store and Hema Fresh have different innovations in their digital transformation paths and strategic emphases. JD Convenience Store focuses on "supply chain integration" and "digital empowerment". Leveraging JD Convenience Store logistics system, it leverages big data product selection, intelligent warehousing, and efficient distribution to establish a high-frequency, small-batch, rapid replenishment mechanism, enhancing both inventory turnover efficiency and customer convenience. Its transformation path focuses on optimizing supply chain operations through technology and promoting standardization and data-driven retail outlets.

In contrast, Hema Fresh's core approach lies in integrating scenarios and innovating user experience. Through its "forward warehouse + online ordering + instant delivery" model, it deeply integrates the supply chain with consumer scenarios, strengthens cold-chain logistics for fresh produce, and enables intelligent inventory management and real-time online-offline collaboration. Hema emphasizes differentiated competition based on high-quality products and user experience. This fundamental difference in path leads to systematic differences between the two in supply chain models, technology application focus and user experience.

Table 1. Core feature comparison of JD convenience stores, Hema fresh, and traditional convenience stores

Dimension	JD Convenience Store	Hema Fresh
Supply chain model	Digital supply chain, relying on JD Logistics system, adopts an integrated warehouse and distribution model, with fast inventory turnover.	Mainly fresh food, forward warehouse + online order delivery, some self-operated warehouses directly supply stores
Application	RFID, Internet of Things (IoT), inventory management systems, mobile payments, smart shelves	Highly dependent on APP and QR code shopping, smart inventory management, and cold chain monitoring
Product structure	Comprehensive merchandise, including fresh food, snacks, beverages, and daily necessities, with a medium to large inventory	Focusing on fresh and ready-to-eat foods, with abundant inventory, emphasizing high quality and freshness
Operating Model	Smart shopping experience, combining fast online shopping with convenient offline pickup, fast delivery service and some in-store pickup.	Strong online traffic and personalized recommendations, offline experience stores + takeaway delivery, focusing on user experience

5.2. Analysis of challenges and limitations

While both companies have achieved significant results in their digital transformation, their innovative models also come with challenges and limitations, primarily in the areas of cost, technology, and operations. JD Convenience Store need for logistics and technology investment has long-term pressure on the profitability of some franchisees. Hema's forward warehouse model also faces challenges, such as high investment in warehouse construction and distribution systems, and high per-store operating costs.

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Both companies' supply chain operations rely on data platforms and algorithmic models. Disruption to data sources or errors in algorithm parameters can impair supply chain functionality, and even cause operational disruptions. When confronted with sudden demand surges or special events, some of JD Convenience Store forward warehouses still struggle to quickly adjust inventory or allocate resources. Convenience stores lack the flexibility to replenish inventory during sudden demand fluctuations, and supply lags persist. Furthermore, both enterprises face barriers to expanding their reach in third- and fourth-tier cities, where demand for instant retail remains low.

Thus, future trends in the retail supply chain should focus on deepening front-end and back-end integration, promoting continuous technological upgrades, and leveraging big data. A flexible and sustainable supply chain will become core, and the ability to cope with demand fluctuations and emergencies is crucial.

6. Conclusion

This paper takes JD Convenience Stores and Hema Fresh as case studies to explore the digital transformation and application practices of retail supply chains. The study found that the application of digital technologies in supply chains can significantly improve efficiency and user experience. Through big data forecasting, intelligent warehousing, and logistics optimization, companies can achieve precise replenishment, accelerate inventory turnover, and improve delivery efficiency, while also reducing out-of-stock and inventory costs.

In terms of supply chain models, JD Convenience Store relies on regional warehouses, forward warehouses, and intelligent delivery to build a high-frequency, small-batch replenishment system that emphasizes integrated online and offline management. Hema Fresh, through forward warehouse deployment, instant community delivery, and personalized services, has established an agile, scenario-oriented supply chain. Both demonstrate the impact of digital transformation on operational efficiency and user experience, but the choice of model must be weighed against the company's business positioning and market environment. This paper primarily relies on the case studies of JD Convenience Store and Hema Fresh. Furthermore, the analysis of supply chain adaptability in third- and fourth-tier cities and during emergencies has limitations. Future research could expand the sample to include more retail companies across different regions and product categories, and further explore the flexibility, cost control, and sustainable development strategies of digital supply chains in multiple scenarios.

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