

Analysis of the Supply Chain Resilience of Freshippo

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Abstract. In the context where new retail is reshaping the fresh food supply chain landscape and supply chain resilience has become the core capability for the sustainable development of enterprises in the post-pandemic era, Freshippo, as a benchmark enterprise combining fresh food and digitalization, has a leading value in its supply chain model. This paper, based on literature review and case study, aims to analyze Freshippo's supply chain resilience mechanism and propose optimization strategies, providing references for related enterprises to enhance resilience and promote the high-quality development of the industry. The research shows that Freshippo has achieved an innovative model through "30-minute same-day delivery" and "store-cum-warehouse integration" modes. It builds resilience capabilities based on distributed warehouses and multi-supplier backup, and its effectiveness has been verified during the pandemic. However, it faces challenges such as high internal store-cum-warehouse costs, insufficient quality control, external extreme climate and geopolitical risks, as well as data security vulnerabilities brought about by digitalization. In the future, fresh food enterprises can draw on the experience of Freshippo to deepen the integration of digital and intelligence, optimize costs and quality control, and at the same time strengthen risk warning and data security, to enhance the resilience of the supply chain and adapt to the long-term development of new retail.

Keywords: New retail; fresh produce supply chain; supply chain resilience; Freshippo; digital integration.

1. Introduction

With the rapid evolution of digital technologies and the upgrading of consumer demands, the new retail model has transcended the spatiotemporal constraints of traditional retail, reshaping the supply chain landscape of the fresh produce industry. Given the perishable nature and stringent timeliness requirements of fresh products, their supply chains demand exceptional responsiveness, collaborative efficiency, and risk resilience. Supply chain resilience, which is the core capability for enterprises to withstand uncertainties such as drastic market fluctuations, natural disasters like earthquakes and floods, and public health crises like Coronavirus Disease 2019 (COVID-19) while achieving sustainable development, has demonstrated increasingly strategic significance under the severe tests posed by emergencies [1]. For fresh produce enterprises, in particular, disruptions to supply chains such as delayed origin sourcing due to extreme weather, interrupted last-mile delivery during public health crises often lead to massive product spoilage, revenue loss, and damaged consumer trust. Those issues have highlighted the urgency of enhancing supply chain resilience in this sector. It has become a critical factor for enterprises to maintain stability and pursue long-term growth in a complex and volatile market environment.

This paper examines the strategic development direction of fresh produce supply chains under the new retail model, with Freshippo as a representative case. Freshippo's integration of fresh produce with digital technologies has established it as a leader in the industry [2]. Leveraging cutting-edge digital applications, Freshippo has built an end-to-end fresh supply chain system, spanning from direct sourcing at production origins to final consumers. It exhibits robust collaborative capabilities across multiple facets, including precise demand forecasting, efficient inventory management, and rapid logistics distribution, setting a benchmark for the deep integration of fresh produce and digitalization in the sector [3].

By adopting a case study approach complemented by literature review and secondary data analysis, this study aims to analyze Freshippo's supply chain resilience mechanisms and propose optimization

strategies[2]., offering actionable insights such as establishing localized supplier partnerships to reduce sourcing risks, and learning from Freshippo's demand forecasting logic to improve inventory turnover which can be helpful for small and medium-sized fresh produce enterprises to enhance their resilience and align with the demands of new retail development. The findings are intended to drive high-quality advancements in the supply chains of the entire fresh produce industry. The pivotal role of supply chain resilience in mitigating risks such as market volatility, natural disasters, and public health emergencies underscores its importance for corporate sustainability.

2. Analysis of the Supply Chain Mechanism of Freshippo

2.1. Innovation of Freshippo's Supply Chain

As a benchmark enterprise in the fresh food retail sector, Freshippo has continuously consolidated its leading position in the industry by building a multi-dimensional and collaborative operation and management system. The foundation of its core competitiveness lies in the in-depth integration and innovative breakthroughs in supply chain efficiency and customer experience.

First, in the end-to-end fulfillment link, Freshippo has built a highly agile instant delivery system with the core service commitment of "30-minute instant delivery". With a digital order system as its core, the system can realize real-time connection with front warehouse pickers, sorting and reviewing staff, and delivery riders once a customer's order instruction is generated. By virtue of route optimization algorithms and time node management mechanisms, the entire process from order response, product picking, review and packaging to last-mile delivery is accurately compressed within 30 minutes [4]. This model not only efficiently meets consumers' core demands for "speed" and "freshness" of fresh food, but also builds an irreproducible differentiated service barrier.

Second, in terms of inventory management, Freshippo has innovatively implemented an inventory optimization model of "store-warehouse integration" [4]. This model breaks the physical barrier between stores and warehouses in traditional retail and implements integrated management of store shelves and warehouse inventory. Through real-time collection of product sales data and inventory dynamics via Internet of Things (IoT) technology, it truly achieves the visualization and precision of inventory information. At the same time, relying on the supply-demand matching mechanism driven by a digital platform, the system can conduct multi-dimensional data analysis and demand forecasting based on historical sales data, real-time order volume and regional consumption preferences, and dynamically adjust product purchase volume and inventory distribution [2]. This measure not only effectively reduces the waste rate of unsold products but also ensures the supply stability of hot-selling products, ultimately achieving the dual improvement of supply chain efficiency and customer satisfaction.

Through this unique supply chain innovation model, Freshippo has not only accurately responded to consumers' immediate needs and realized the refined management of inventory, but also greatly reduced resource waste, successfully establishing a benchmark example for the industry to learn from.

2.2. Analysis of Freshippo's Resilience Capability Dimension

The supply chain resilience of Freshippo is mainly reflected in four aspects. Firstly, there is a distributed warehouse network. Through the hierarchical layout of distribution center, regional central warehouses and city-wide large warehouses, the reliance on a single warehouse is broken. Even in the face of sudden situations in a local area, the surrounding warehouse resources can be quickly dispatched to ensure the regional stability and continuous performance of product supply. Currently, the distribution centers of Freshippo are mainly distributed in the communities of first- and second-tier core cities across the country, with an average service radius controlled within 3 kilometers, further shortening the distance from the warehouse to consumers [5]. At the same time, through the digital system, inventory is synchronized among all levels of warehouses to ensure that after the dispatching instructions are issued, the goods can be cross-warehouse transferred at the fastest speed.

The next is the multi-supplier backup mechanism. For core fresh food categories, a pool of primary and alternative suppliers is established. Diversified layouts are made for upstream production areas and processing manufacturers, enabling a quick switch of partners in case a single supplier is unable to supply due to natural disasters, production capacity fluctuations, etc., thus avoiding the risk of supply chain disruption. In addition, Freshippo will regularly assess the production capacity and quality control of alternative suppliers to ensure that they can quickly meet the supply standards when needed.

Meanwhile, the dynamic pricing algorithm makes intelligent adjustments based on real-time supply and demand data (such as inventory levels, order popularity, weather factors, etc.). While ensuring the freshness of the goods, it can balance the supply and demand relationship through reasonable price premiums, and also reduce the spoilage of expired products through time-limited discounts, thus ensuring the economic benefits of the supply chain and the turnover efficiency of the products. The algorithm sets different discount trigger thresholds according to the preservation period of the goods. For example, when seafood products are 24 hours away from their preservation period, the first discount will be automatically activated [6]. Moreover, the algorithm also combines users' consumption habits to precisely push discount information to users with different needs, thereby enhancing the promotional effect.

Finally, the flexible logistics scheduling system integrates its own delivery personnel, third-party transportation resources, and emergency delivery teams through a digital platform. It can dynamically adjust the transportation capacity based on peak order volumes, traffic conditions, etc. The rapid iteration of contactless delivery also requires Freshippo to continuously invest in technological research and development (such as intelligent pickup cabinets, upgraded route planning) and process optimization (such as contactless packaging standards, disinfection norms) to ensure the safety and timeliness of delivery in special scenarios. During peak order periods, the system can complete the scheduling and matching of third-party transportation resources within 10 minutes, quickly replenishing the delivery force. The intelligent pickup cabinets also support temperature zone storage, meeting the preservation needs of different categories such as fresh produce and cooked food, further enhancing the quality of delivery services [2].

2.3. Typical Case

During the COVID-19 pandemic in 2020, Freshippo took two main measures to actively respond. Firstly, relying on its three-level supply chain system that integrates closely with suppliers, offline stores and consumers, and combining direct procurement from planting bases and direct purchase from local wholesale markets, it effectively ensured the stable supply of fresh products and flexibly responded to the fluctuations in market demand during the epidemic. Secondly, Freshippo further deepened the online-offline integration (OMO) model by coordinating online applications and offline stores to provide special services for consumers. Consumers could either place orders conveniently through online platforms or meet their immediate shopping needs at offline stores. This model not only adapted to the changes in consumers' shopping habits under the epidemic situation, but also better met the public's demand for fresh products, while reducing their reliance on traditional physical retail [7].

The case of Freshippo during the epidemic period shows that the supply chain resilience of fresh food enterprises is not the result of strengthening in a single environment, but the collaborative outcome of supply chain stability and demand-side flexibility. Freshippo's approach to handling special cases also provides key insights for the industry. In the context of new retail, the construction of supply chain resilience needs to be based on digitalization as a link, integrating resources through innovative models such as "integrated warehouse and store" and "multi-source backup", while also addressing existing challenges in aspects such as "integrated store and warehouse" costs and quality control. Subsequently, enterprises can draw on its experience to further optimize resource allocation through the integration of digital and intelligent technologies, strengthen risk early warning, thereby enhancing supply chain resilience and adapting to the long-term development needs of new retail.

The aforementioned practices of Freshippo fully demonstrate the robustness and adaptability of its well-established supply chain system in dealing with extreme situations and emergencies.

3. Supply Chain Resilience Challenges and Bottlenecks

3.1. Internal Operational Challenges

Although Freshippo's supply chain has many advantages, it also faces many challenges internally. Firstly, the initial cost of integrating the store and warehouse is high. Freshippo's store locations are mainly concentrated in commercial areas with convenient transportation and economic prosperity. These areas have a large flow of people, which is conducive to attracting customers, but they also have the drawback of high rent. In addition, the integrated model of store and warehouse in Freshippo requires a larger store area, resulting in higher rent costs, especially during the initial stage of store construction when there is no scale effect, making it difficult to spread the costs. Freshippo adopts a "front store, back warehouse" design, although it improves the picking efficiency to a certain extent, it also leads to a significant increase in rent costs. After all, to meet the dual functions of store and warehouse, it is necessary to lease large and high-quality commercial areas, which imposes a great financial burden on the enterprise [5].

The second challenge of Freshippo supply chain resilience is the balance of product coverage. From the development layout of Freshippo, its stores are currently mostly concentrated in first-tier cities, with relatively fewer in second and third-tier cities. The product coverage in second and third-tier cities is relatively limited, which makes it difficult for many consumers' demands to be met. This, to a certain extent, restricts the market expansion and user group expansion of Freshippo [8].

Meanwhile, Freshippo has significant deficiencies in terms of fresh food quality control and loss rate management. During the operation process, the calculation of purchase volume is not precise enough. Moreover, there are differences in people's demand for fresh food in daily life and during holidays. This makes it difficult to precisely control the balance between demand and inventory. Fresh products are prone to spoilage and deterioration due to long storage time, which leads to huge losses. This not only affects the economic benefits of the enterprise but also has a certain negative impact on the brand image. In addition, fresh products have the characteristics of being perishable and having a strong timeliness. If there is a lack of more refined management in transportation and storage, the problem of high loss rate will be further exacerbated, increasing the difficulty of the enterprise in fresh food quality control [8].

3.2. External Risk Factors

External factors are also significant challenges that Freshippo needs to address. Firstly, extreme climate changes can easily cause supply chain disruptions. Extreme weather conditions such as heavy rain, drought, and typhoons can directly damage the production areas of fresh agricultural products, affecting their yield and quality. Moreover, such extreme weather can also interfere with transportation, leading to delayed deliveries. Freshippo adopts a direct-sourcing from the origin model, and its products need to be transported to various stores or central warehouses via road, rail, air, etc. For example, in the case of heavy snowfall, it may cause road icing, traffic congestion, or flight delays or cancellations, preventing fresh products from being delivered on time. This not only disrupts the normal sales rhythm of the stores but also, due to the extremely short shelf life of fresh products, leads to a decline in product quality and an increase in losses [9].

Secondly, the supply chain fluctuations of imported goods caused by geopolitical factors have a particularly significant impact on Freshippo. When geopolitical factors lead to traffic control, route changes, etc., the transportation methods relied upon by Freshippo for importing fresh produce will be disrupted. On one hand, this will increase transportation costs and reduce the company's profits; on the other hand, it will delay deliveries, affecting the timeliness and quality of the products and increasing losses. Moreover, geopolitical events such as economic sanctions and political changes may disrupt the stability of the supply chain. If there is conflict in the importing country or restrictions

imposed by the exporting country, some imported fresh produce of Freshippo may experience stockouts, impacting store sales and affecting consumer satisfaction. At the same time, the imbalance in supply and demand caused by geopolitical risks will lead to price fluctuations. If the purchase price increases and Freshippo maintains the original price, its profits will be damaged; if the price is raised, it may affect market share. Additionally, to address these risks, Freshippo needs to invest a large number of resources to restructure the supply chain, find new suppliers, and open new transportation channels. However, during the integration process of the new supply chain, there will be many uncertainties, reducing overall operational efficiency [10].

3.3. Vulnerability of Digital Dependence

In terms of data security and privacy protection, Freshippo has significantly exposed its vulnerability under digital dependency. In terms of data security, as a digital retail platform that heavily relies on cloud computing, the core data of Freshippo users, such as consumption records and geographical locations, are stored and processed in the cloud. If there is a lack of a comprehensive encryption mechanism and data integrity verification measures, these data are highly vulnerable to unauthorized access, malicious tampering, and data loss, which directly threaten the stable operation of the business and erode the foundation of user trust [11].

In terms of privacy protection, the platform has collected a vast amount of personal data from users during its operation. If there are loopholes in aspects such as access permission control, cross-system data transmission security, and data cross-border flow when complying with privacy regulations, it will lead to serious risks of user privacy being leaked or abused. This not only violates relevant laws and regulations such as the "Data Security Law" and the "Personal Information Protection Law", but also will cause irreversible damage to the platform's reputation, weaken user loyalty, and highlight the vulnerability of its digital dependence [11].

Therefore, in the future, Freshippo needs to prioritize data security and privacy protection as a strategic priority. Through technological upgrades and institutional improvements, it should systematically address data security vulnerabilities and establish a full-chain data protection system to effectively safeguard consumers' information and privacy.

4. Conclusion

This article focuses on the strategic development direction of the fresh agricultural product supply chain in the new retail era, and conducts research using Freshippo as a typical case. Freshippo has integrated fresh produce with digital technology to establish an end-to-end fresh produce supply chain system. It has created a highly agile real-time delivery system centered on "30-minute immediate delivery", innovated the "store-warehouse integration" inventory optimization model, and, in the dimension of supply chain resilience, it also possesses advantages such as a distributed warehouse network, a multi-supplier backup mechanism, a dynamic pricing algorithm, and a flexible logistics scheduling system. In the face of sudden situations like the pandemic, it demonstrates strong adaptability.

However, the supply chain of Freshippo also faces numerous challenges. In terms of internal operations, there are issues such as high initial costs for integrating stores and warehouses, uneven product coverage, insufficient control over fresh produce and loss rates, etc. In the external environment, extreme climate changes can lead to supply chain disruptions, and geopolitical factors can cause fluctuations in the supply chain of imported goods. At the same time, its reliance on digital technology has also exposed its vulnerability in terms of data security and privacy protection.

In the future, the fresh food industry should draw lessons from Freshippo's experiences and problems, continuously deepen the integration of digital technology and supply chain, optimize cost control, expand market coverage, strengthen quality control management, actively respond to external risks, and build a digital security defense line. This will promote the entire fresh agricultural product

supply chain to develop towards a high-quality direction, and enhance the industry's competitiveness and sustainable development capabilities in a complex and volatile market environment.

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