

Supply Chain Optimization of Zhejiang Agricultural Products E-Commerce Based on Internet of Things

Lina Zhai¹, Wanmin Ni^{1,2,3,*}, Shuyun Wang^{1,3}

¹ School of International Business, School of Innovation and Entrepreneurship, Zhejiang International Studies University, Hangzhou, China

² Digital Economy and Green Development Institute, Zhejiang International Studies University, Hangzhou, China

³ Cross-border E-Commerce Industry of Institute for International People-to-People Exchange (Cooperated with Ministry of Education, China), Zhejiang International Studies University, Hangzhou, China

*Corresponding author

E-mail: niwanmin@zisu.edu.cn

Abstract

In recent years, Zhejiang province has actively developed rural e-commerce to help eliminate poverty through a new channel of rural e-commerce. With the rapid development of the network, the sales of agricultural products have gradually shifted from the traditional offline trading mode to the online trading mode. Zhejiang is a big agricultural province, mainly with traditional agriculture. Under the background of the Internet economy, the development of fresh agricultural products e-commerce has become a new trend. Meanwhile, the efficiency of the supply chain has an important impact on the quality, safety, production and circulation efficiency of agricultural products. The emergence of the Internet of Things technology has also brought new opportunities to the e-commerce supply chain of fresh agricultural products. According to the basic theory of agricultural products e-commerce supply chain and the Internet of Things, case study was conducted to analyze the optimization of Zhejiang agricultural products e-commerce supply chain. Take Zhejiang province as an example, and references on the development of agricultural products e-commerce at home and abroad were collected and summarized, the development of agricultural products e-commerce in China and the application of agricultural products e-commerce under the Internet of things mode were discussed. Results showed that the development trend of Zhejiang agricultural products e-commerce and agricultural products standardization degree is not high. Taking Hema Xiansheng as a good example, the optimization scheme of e-commerce supply chain based on the Internet of Things technology was suggested.

Keywords: Internet of Things; Supply Chain Optimization; Zhejiang Agricultural Products E-Commerce; Countermeasures and Suggestions.

1. Introduction

With the rapid development of e-commerce, e-commerce transactions and business models are gradually transferred from offline to online. In this situation, the fresh agricultural products e-commerce supply chain based on the Internet of Things came into being [1,2]. Supply chain is composed of production, distribution and consumption links, and the information and capital flows are coordinated through the whole system. The traditional supply chain management theory is based on the bilateral relationship between

enterprises and customers to analyze the information flow and its performance within the enterprise organization. The supply chain model established under the Internet of Things (IoT) is based on the bilateral relationship between enterprises and customers to analyze the information flow and its performance within the enterprise organization. The supply chain model established under the Internet of Things is a new type of network economy in which enterprises, markets, customers and other parties jointly participate to realize the information transmission and sharing between customer demand and supplier supply. Therefore, it is of great significance to study the e-commerce supply chain of fresh agricultural products based on the Internet of Things.

In recent years, with the arrival of the "Internet +" era, the Internet of Things (IoT) technology and supply chain of agricultural products e-commerce based on IoT has rapidly developed in Zhejiang Province. From the point of view on supply chain, the IoT technology provides a new way for supply chain optimization of agricultural products e-commerce. The supply chain of agricultural product e-commerce based on IoT relies on modern information technology, modern logistics technology and equipment. The supply chain of agricultural product e-commerce based on IoT is a complex network composed of various node enterprises, which constructed based on modern information technology and combined with modern logistics technology and equipment. Real time information exchange is achieved through the Internet, thus forming a complete supply chain. Under the IoT technology, real-time collection and analysis of agricultural product logistics information through sensors can not only provide accurate, timely, and comprehensive logistics information, but also optimize logistics services based on customer needs. As a major agricultural province, Zhejiang Province has abundant agricultural product resources. With the development of the Internet, the sales channels of agricultural products are also undergoing tremendous changes. Meanwhile, the efficiency of agricultural product supply chain has a significant impact on their quality, safety, production, and circulation efficiency. The development of the Internet of Things (IoT) relies on information flow, logistics, capital flow and service flow. These elements will give full play to the role of the e-commerce trading platform, to promote better standardization, branding, and scale of agricultural products, to enhance the market competitiveness of agricultural products in Zhejiang Province.

This paper is focused on the IoT technology, the current development status of supply chain for fresh agricultural product e-commerce under the background of IoT technology was summarized, and the optimization strategies to promote sustainable development of fresh agricultural product e-commerce were suggested. It is of great significance to optimize the supply chain of fresh agricultural products by adjusting the agricultural structure of Zhejiang Province. At the same time, the optimization of supply chain for agricultural e-commerce in Zhejiang Province has an important practical role in further exerting the comparative advantages of Zhejiang agriculture and promoting the agricultural economic development.

2. Development of Agricultural E-commerce

2.1. Development of Agricultural E-commerce Abroad

The development of foreign agricultural e-commerce is relatively early, mainly in developed countries and regions, such as the United States (US), Japan, Australia and so on. Agricultural e-commerce in US started in the 1990s and matured after more than 30 years of development. Fresh agricultural products e-commerce has become an important channel for the circulation of agricultural products in the US. With the development of the economy, consumers are demanding more and more about food safety, the quality of fresh agricultural products on the e-commerce platform is also of high standard. The United States has established a perfect standard system for fresh agricultural products. Most consumers of fresh agricultural

products are in the middle class or the affluent, who have high requirements for the quality and freshness of the products. The United States uses developed logistics technology, which not only encourage the development of agricultural e-commerce, but also reduced the damage rate of the fresh agricultural products in the transportation, obtaining more trust from customers with the better quality of agricultural products [3, 4].

Fresh products e-commerce in Japan started in the mid-80s. With the development of agricultural logistics and cold chain technology, fresh products e-commerce began to grow explosively. The growth of fresh products e-commerce in Japan slowed down, but still maintained a relatively high growth rate after 2010. It is believed that use of Internet technology, supply chain, products and services, is the key to promote the healthy and smooth development of Japan's fresh agricultural e-commerce.

Australia is the world's largest agricultural producer and exporter. Australia has various types of agricultural products, including meat, poultry, fish, dairy products, fruits, vegetables and nuts, which have large markets all over the world. The Australian government attaches great importance to e-commerce of agricultural products and put more budgets on the operating expenses of agricultural products e-commerce and improvement of e-commerce websites for agricultural products. Meanwhile, the government also push forward the modernization of agriculture and the improvement of agricultural information technology facilities.

2.2. Domestic Development of Agricultural E-commerce

Fresh agricultural products are essential food on people's tables. Development of e-commerce, modern logistics, Internet of Things (IoT) technology and perfect supply chain will play an important role in bringing nutritious, healthy and green fresh produce to consumers' tables. Quality and quantity losses have significant impact on decision-making of fresh agricultural products e-commerce supply chain. Optimization of fresh agricultural product supply chain platform can refer to these five sub aspects, production and processing, product procurement, product transfer, product warehousing, and product sales. Efficient management of modern agricultural supply chains is an important way to improve the basic competitiveness of farms, and the benefits of the Internet of Things in supply chain management will determine the ultimate development direction of agricultural logistics information science [5, 6]. The joint participation of multiple entities such as farmers, government, third-party e-commerce platforms, and urban consumers, formed a smart chain for agricultural products, thus achieving the goal of information sharing [7,8].

The cold chain logistics of fresh agricultural products confront with problems such as multiple steps, complex processes, and multiple risk points in actual operation. These problems result in insufficient performance of the cold chain logistics system in ensuring the quality, safety, increase of added value, and reduce of circulation losses for the fresh agricultural products. Development of logistics for fresh agricultural products can focused on these six aspects, make integrated logistics plan, improve transportation capacity, strengthen the construction of corresponding agricultural and byproduct logistics infrastructure, improve the informatization, technology, and standardization level of the logistics industry, and vigorously develop agricultural and byproduct logistics enterprises.

There are multiple modes coexisting in China's fresh products e-commerce. The quality and safety of fresh e-commerce cannot be guaranteed, as there is no evaluation index system for quality and safety of the agricultural products. Meanwhile, the producing areas of agricultural products often associated with serious ecological pollution, combining with illegal use of chemical pesticides in the planting process, illegal and

excessive use of preservatives in the processing and packaging process, low detection capacity of pollutants for e-commerce platforms, and blind spots in government supervision. China's traditional oriental agricultural technology has been completely replaced by western agricultural technology mainly based on fertilizers and pesticides, and the development of e-commerce of fresh agricultural products will improve the quality and safety of agricultural products and promote the modernization of agricultural production chain management. The quality and safety of fresh agricultural products should be precisely controlled throughout the whole industrial chain from the procurement, production process, sales and market and other whole industrial chain for precise control; through the quality control standards to realize the precise control; on the basis of the practice of "one product, one policy" in Zhejiang, for each specific variety of agricultural products formulate corresponding quality and safety control strategies; utilize network platforms, artificial intelligence and big data technologies to establish agricultural product quality and safety key control system, to comprehensively improve the quality and safety control level of agricultural products to realize the precise control. In summary, fresh agricultural products e-commerce has a huge developing prospect, but there still remain many problems. To solve the current problems encountered in the development of fresh agricultural products e-commerce supply chain, measures focused on cold chain logistics, fresh agricultural products preservation, and the intellectualization of fresh agricultural products supply chain platform can be expected. Little was known about model optimization of fresh agricultural e-commerce supply chain under the background of the Internet of Things (IoT). In this paper, advances on development of agricultural products e-commerce under Internet of Things were investigated, the current developing situation of Zhejiang Province was considered, to discuss the optimization scheme for development of agricultural products e-commerce in Zhejiang Province, to better promote the economic development of agricultural products in Zhejiang.

3. Analysis on Supply Chain Problems and Models of Fresh Agricultural Products E-commerce in Zhejiang Province

3.1. Current Development Status of E-commerce for Fresh Agricultural Products

As essential necessities of life, fresh agricultural products are irreplaceable and play a crucial role in our lives. Especially in the period of the epidemic, due to the restrictions on public travel caused by epidemic prevention and control, the number of users in the fresh e-commerce industry has increased sharply, and orders have skyrocketed, resulting in rapid development of the fresh e-commerce industry. Data shows that the market size of China's fresh e-commerce industry reached 550.38 billion yuan in 2022, with an increase of 18.2% compared to 2021 (Fig.1). With the development of fresh e-commerce and the maturity of technology, users have developed the habit of purchasing fresh agricultural products online. The coverage of fresh e-commerce users will become even wider, and it is expected that the scale of the market for fresh agricultural products will reach 642.39 billion yuan by 2023.

3.2. Development of E-commerce for Fresh Agricultural Products in Zhejiang Province

In recent years, development of rural e-commerce has gained great attention in Zhejiang Province. Rural e-commerce was expected to be effective means to promote agricultural transformation and upgrading, to enhance the competitiveness of agricultural products, and increase farmers' income.

The "One Hundred Counties, One Thousand Towns, Ten Thousand Villages" project was carried out for deep implementation of rural e-commerce and turned out to achieve significant results.

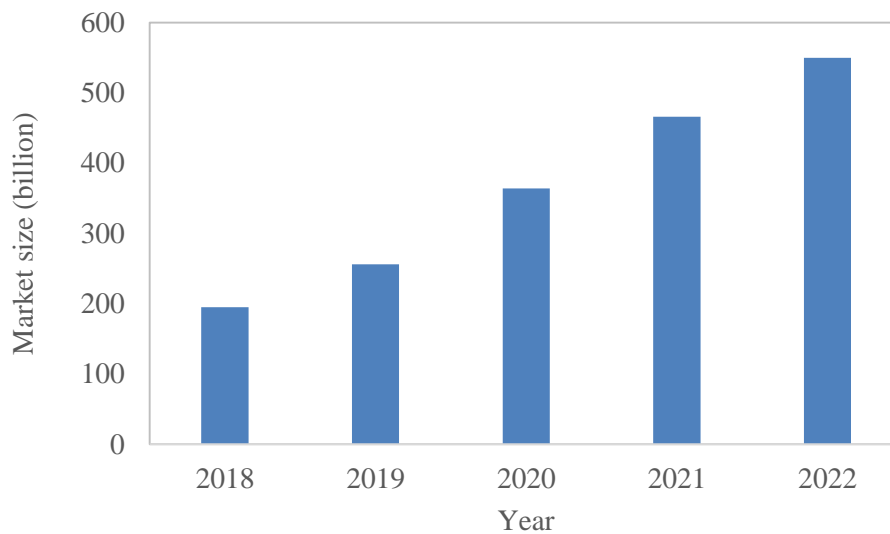


Fig.1 The market size of fresh e-commerce industry in China, 2018-2022

3.2.1. Optimization of the policy environment

The Government of Zhejiang Province have issued policy documents such as the "Implementation Opinions on Vigorously Developing Rural E-commerce" and "Implementation Opinions on Accelerating the Promotion of Rural E-commerce", making agricultural e-commerce a key task for the current and future periods. Different levels of the governments (city level, county or district level) have formulated and introduced a series of rural e-commerce policies, to actively support and promote the development of rural e-commerce.

3.2.2. Expanding of industry scale

In recent years, Zhejiang Province has continuously increased investment in agricultural infrastructure, and thus the network infrastructure of rural e-commerce has been continuously improved. By the end of 2022, there are 2,643 professional rural e-commerce villages and 367 rural e-commerce towns in Zhejiang province.

3.2.3. Innovation of network marketing

Various cities have actively explored new online marketing models and created a number of leading online marketing enterprises. For example, Alibaba Group has created a number of online marketing platforms with national influence such as "Tmall", "Taobao", "Tmall International" and "Yidatong". Taobao Characteristic Chinese (Taizhou) Pavilion, Shengzhou Jinyuechun Tea Co., LTD., Kaihua Longding Tea Co., LTD., and other characteristic agricultural products enterprises. To carry out e-commerce business through self-established e-commerce platform or cooperation with third-party e-commerce platform, a number of geographical indication agricultural products such as Anji white tea have achieved rapid development through the Internet.

3.2.4. Growth of online retail sales

According to the data in Fig.2, Zhejiang Province achieved online retail sales of 1,671.88 billion yuan in 2018, with a year-on-year growth of 25.4%; In 2019, online retail sales reached 1,973.0 billion yuan,

with a year-on-year growth of 18.4%. In 2020, Zhejiang Province achieved online retail sales of 2,260.81 billion yuan, with a year-on-year growth of 14.3%; In 2021, Zhejiang Province achieved online retail sales of 2,523.03 billion yuan, with a year-on-year growth of 11.6%; In 2022, Zhejiang Province achieved online retail sales of 2,074.21 billion yuan, with a year-on-year growth of 7.2%. Although the growth rate has slowed, online sales in Zhejiang Province have continued to grow.

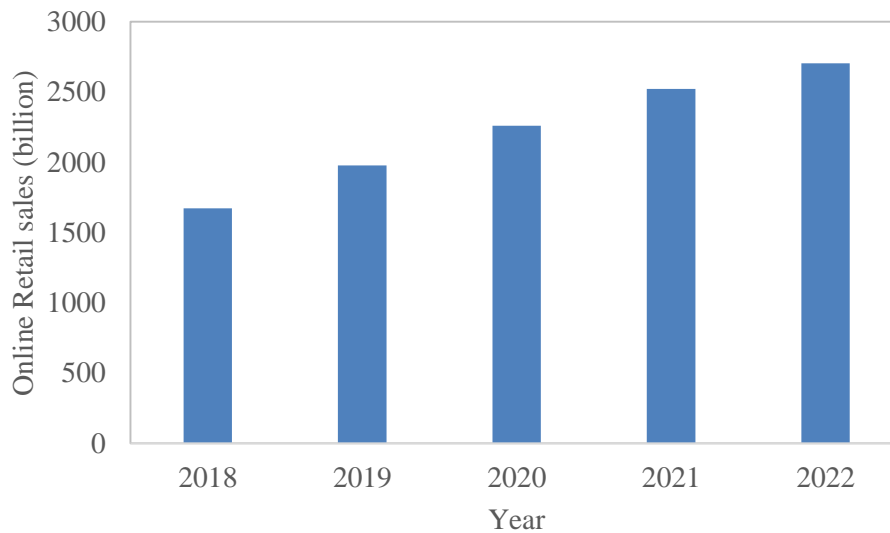


Fig.2 The online retail sales of Zhejiang Province in China, 2018-2022

3.3. Analysis of supply chain model of fresh agricultural products e-commerce in Zhejiang Province under the environment of Internet of Things

3.3.1. Application of Iot (Internet of Things)

(1) Perception layer application for Iot

Application of the Internet of Things for the e-commerce of fresh agricultural products mainly included the following three aspects: (1) The collection of agricultural product information through RFID electronic tags, and the identification, positioning and tracking of agricultural products through RFID tags; (2) Collect information such as quality, yield and environmental temperature of agricultural products through sensors and cameras, and realize real-time transmission of agricultural product information through network transmission technology; (3) Identify agricultural product information through RFID sensors and two-dimensional code labels, and upload the data to the server at the same time.

In the e-commerce mode, the whole process of monitoring and tracking of fresh agricultural products production, processing, transportation and sales can be achieved through the Internet of Things technology. The technology is mainly used in the following three aspects: (1) The application of RFID electronic tags on product packaging to achieve the collection of commodity information; (2) The use of RFID technology during transportation to monitor the logistics vehicles of fresh agricultural products; (3) The use of Internet of Things technology to achieve quality monitoring of fresh agricultural products [9, 10].

(2) Network layer application for Iot

Agricultural products e-commerce is a typical complex system. Agricultural products started from production to transportation and then to sales, each process can be regarded as a network node, these nodes are connected to form a complex network. The perception layer in the Internet of Things can be regarded

as a kind of wireless sensor network, which is composed of a large number of sensor nodes, each node is connected to the control center, and is connected to the adjacent sensor nodes through the wireless network.

The network layer is the most important part in the e-commerce system of fresh agricultural products. The network layer mainly includes three parts: mobile terminal, wireless sensor network and Internet. Mobile terminal refers to the users who can access the Internet through mobile phones, PDAs, smart phones and other devices, this part can be regarded as the most basic part of the network layer, it realizes the information acquisition and storage functions; Wireless sensor network is a self-organizing network composed of a large number of interconnected sensor nodes, even without the support of any wired network, it can also realize the collection, processing and transmission of information. Internet refers to the user computer network connected by the Internet, which is the most important and most widely used application form. For in the Internet of Things, wireless sensor networks, mobile terminals and the Internet are all built with application as the center and data as the center [11, 12].

At present, mobile terminals, wireless sensor networks and the Internet are widely used in the fresh agricultural products e-commerce system, because these three parts constitute a complete system, so these three parts should be effectively integrated to provide a full range of services for the fresh agricultural products e-commerce system.

(3) Intelligent layer application for Iot

With the rapid development of the Internet of Things, the integration of Internet of Things technology and agriculture has gradually become a development trend. E-commerce of fresh agricultural products, as an important development direction for future agriculture. Future agriculture is characterized by the use of Internet of Things technology to provide a safe, efficient, accurate, stable and controllable supply chain system for fresh agricultural products. This requires real-time monitoring of the production process of fresh agricultural products combined with the Internet of Things technology in the production process, so as to ensure the safety and controllability of fresh agricultural products in the supply chain. In the circulation of fresh agricultural products, the use of the Internet of Things technology can realize the intelligent monitoring and management of the whole process of fresh agricultural products from the field to the table. Use of RFID and other automation technology can help monitoring and controlling the growing environment of agricultural products, including the whole process of agricultural products from planting to the table; Through the computer information system platform, the information of farmers' planting, circulation and other links is comprehensively managed; Through the analysis and processing of environmental data in the process of agricultural products planting and circulation, the intelligent identification and management of fresh agricultural products are realized. Through the Internet of Things technology, the fresh agricultural products are positioned and monitored, so that the fresh agricultural products can realize intelligent scheduling in the whole supply chain; Through the analysis and processing of the data information based on the Internet of Things, real-time monitoring of the whole process of production, processing and circulation of fresh agricultural products is realized, so as to improve the quality and safety level of fresh agricultural products.

In summary, we find that Iot intelligent layer technology has a wide range of application prospects in fresh agricultural products e-commerce: (1) It can help farmers or enterprises realize real-time monitoring and management of the whole process from field to table; (2) It can improve the level of product quality and safety; (3) It can also help enterprises or farmers to achieve production and marketing docking.

3.3.2. Problems for the supply chain of fresh agricultural products e-commerce in Zhejiang Province

From the perspective of supply chain, the characteristics of fresh agricultural products are greatly affected by natural conditions, seasonal, regional and consumption habits, so it is difficult to form a stable sales market [1, 2]. At present, fresh agricultural products in Zhejiang Province mainly have the following problems in the e-commerce supply chain:

(1) Insufficient logistics system

Fresh agricultural products must go through multiple links from production to consumers' tables. In Zhejiang Province, the standardization of agricultural products is low, the logistics system is insufficient, and fresh agricultural products are easily affected by the weather and deterioration during transportation, resulting in large losses of fresh agricultural products in logistics links and high logistics costs.

(2) Low standardization level

Low level of standardization of agricultural products is one of the key factors restricting the development of agricultural products e-commerce in Zhejiang Province. At present, there are still large gaps in the production standards, quality standards and safety standards of fresh products in Zhejiang Province, and some products have not met the requirements of high-quality agricultural products, especially the standardization level of fresh agricultural products lags behind developed regions.

(3) Lack of safety traceability system

At present, most fresh agricultural products enterprises have not formed a complete product quality control system, and most enterprises cannot provide complete food safety traceability information, so that consumers cannot get safe and assured products; At the same time, due to the lack of food safety traceability system, the product quality cannot be guaranteed.

4. Case study and optimization scheme of fresh agricultural products e-commerce supply chain in Zhejiang Province

4.1. Hema Xiansheng (Freshippo)

Freshippo was chosen as an example, which is a new retail brand launched by Alibaba. Freshippo is the most commonly used fresh food online shopping platform by Chinese consumers, accounting for 49.82% of the fresh food e-commerce. According to the survey data of iiMedia Consulting, by the end of 2022, the top five fresh e-commerce platforms commonly used by Chinese consumers are: Freshippo (49.82%), Meituan Maicai (39.4%), Tiantian Youxian (32.8%), Benlai Shenghuo (32.5%), Tiantian Guoyuan (31.2%).

Freshippo was founded in 2015, is a modern company combining supermarket and experience store. Stores have been set up in Shanghai, Beijing, Shenzhen, Guangzhou, Chengdu, Hangzhou and other cities, and committed to provide consumers with a better shopping experience. The operating income of Freshippo has increased significantly every year since establishment.

With the continuous expansion of China's online and offline consumer markets, Freshippo has made remarkable achievements in smart supply chain, smart marketing and other fields with the pioneering development of "new retail" [13]. Through cooperation with many partners, Freshippo has opened up the fresh supply chain, logistics distribution, warehouse management and other links, and achieved the full chain coverage of goods from the origin to the hands of consumers with the model of "Internet + retail". In the traditional fresh supply chain, from the origin to the supermarket, and then to the consumer, in this process, it is difficult to monitor the whole process of fresh goods. However, the use of the Internet of Things technology can be in production, logistics, sales and other links, the whole supply chain real-time tracking and monitoring of the whole process, and the whole chain of data monitoring, so as to ensure the best vegetable quality, the fastest transportation speed and minimum consumption [14, 15].

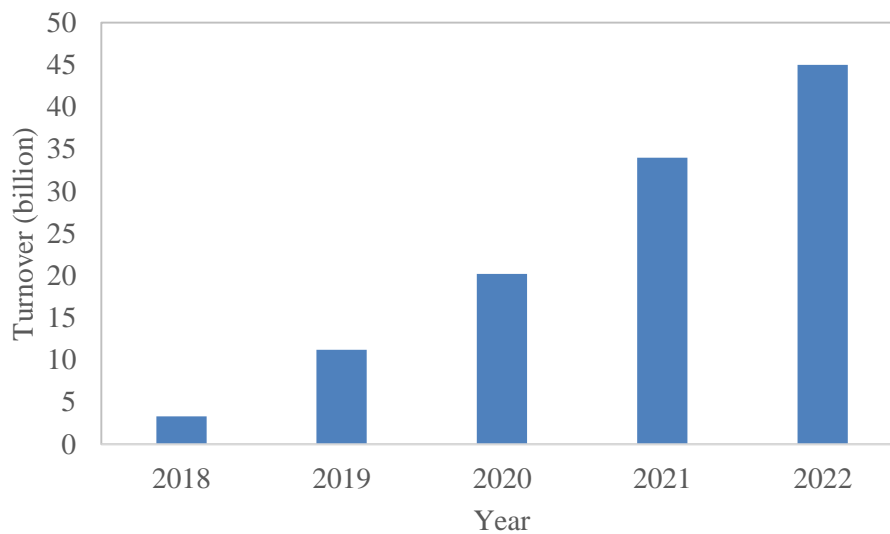


Fig.3 Turnover of Freshippo, 2018-2022

4.2. Application of Iot technology in Freshippo

4.2.1. Application in the production process

Freshippo has established an IoT smart vegetable base, using LoRa's Internet of Things technology, combined with various sensors and 24-hour monitoring, can realize real-time transmission of temperature, light, ultraviolet, relative humidity, PM2.5, pH value and other data to the base. Among them, the pH can be determined to determine the degree of soil alkalization and can be improved with microbial fertilizer; Strengthen the light monitoring in the greenhouse, remind the greenhouse film in the greenhouse, and replace it in time; If there is not enough moisture in the air, an automatic sprinkler system will be activated, to ensure the vegetables receiving the best care and service.

4.2.2. Application in the logistics distribution process

Freshippo mainly applies RFID technology in the logistics distribution. RFID technology is a non-contact automatic identification technology, which can realize the automatic management of goods, avoid the error caused by traditional manual operation, and effectively improve efficiency. The application of RFID technology in logistics distribution can effectively reduce the loss rate and improve the quality of service. In the specific application, there are mainly the following four aspects: First, use of RFID technology to achieve full contactless distribution. In the distribution process of Freshippo, RFID technology can be used to achieve the whole contactless distribution, consumers can get the express directly after purchasing the goods, in the last kilometer, the goods are sent to consumers through RFID technology. Second, the use of RFID technology to achieve real-time order tracking. In the distribution process of Freshippo, RFID technology can be used to achieve real-time tracking of orders, and consumers' order information can be passed to logistics enterprises through RFID tags. According to this information, goods can be sent to consumers faster and more accurately. Third, the use of RFID technology to achieve the standardization of logistics distribution. In the distribution process of Freshippo, in order to allow consumers to quickly get the goods, RFID technology can be used to achieve the standardization of logistics distribution, such as affixing RFID tags to the goods. Fourth, using RFID technology to achieve data sharing. In the distribution process of Freshippo, in order to better serve consumers, RFID technology can be used

to achieve data sharing, such as recording consumers' behavior through RFID tags, and later analyzing these data can better serve consumers.

4.2.2. Application in the storage process

In 2017, Freshippo introduced the Internet of Things technology into the fresh storage link for the first time. Use of RFID technology can realize quick scan, goods locating, and increasing the traceability of the goods, so as to realize the transformation from "people looking for goods" to "goods looking for people". In addition, in the storage link, the goods are quickly scanned and positioned through RFID technology, and the commodity information is sent to the background system to achieve real-time update of the commodity information. Therefore, the use of Internet of Things technology has realized the transformation from "people looking for goods" to "goods looking for people", improving logistics efficiency and the quality of goods. Freshippo launched an APP called " Freshippo Small Box" in early 2017, aiming to realize the full traceability of fresh products and managing fresh products. The use of the Internet of Things technology, the production of goods, transportation, warehousing, sales and other links of data and information to interconnect, and on this basis to achieve real-time monitoring. At present, " Freshippo Small Box" APP mainly provides traceability and quality supervision functions of raw ingredients. When consumers buy raw food ingredients, they can scan the traceability code on " Freshippo Small Box" to view the production information, transportation information, storage information, sales information, etc., to get the traceability information of the goods.

4.2.3. Application in the data operating process

Freshippo is backed by Alibaba, which can not only give customers a better shopping experience, but also protects their privacy. At the same time, with strong high-tech support, customers feel safe when paying, and then build customers' trust in merchants. The use of big data, Internet of things, automation and other technologies to establish a smart logistics platform, so that digital information can be shared among various business links, which can not only help enterprises timely inventory adjustment, avoid inventory overstock or shortage of goods, but also optimize operational efficiency, so that business activities become more efficient and transparent. Freshippo uses Alibaba cloud image database GDB to establish a product map knowledge engine, improve Freshippo's ability to provide product recommendation and guidance for customers, optimize product display, and improve product conversion efficiency.

4.3. Optimization scheme of supply chain for fresh agricultural products e-commerce in Zhejiang

For the optimization of the production process, the Internet of Things technology can realize the intelligent monitoring of the growing environment of crops, and automatically adjust the temperature, humidity, light and other parameters required for crop growth according to the actual situation of the growing environment, so that crops can grow in accordance with the best state. Using the Internet of Things technology, the growing environment of agricultural products can be remotely controlled, and various equipment in the agricultural production process can be remotely controlled through the Internet, so as to achieve the purpose of improving the output and quality of agricultural products [14].

For the optimization of procurement channel, with the continuous expansion of market scale and the increasing number of enterprises, more third-party e-commerce procurement channel and third-party fresh agricultural product procurement e-commerce procurement should be promoted. In addition, the purchaser can publish the demand online, the supplier receives the order through the channel, and the platform

summarizes the data for analysis, so as to recommend the best supplier to the demander, and the purchaser can finally purchase the best product. Enhancing the application of information technology in fresh e-commerce logistics can greatly improve distribution efficiency and reduce logistics costs. First of all, the application of the Internet of Things technology can collect logistics information, master the distribution route, distribution time and distribution quality information, so as to optimize the logistics route and shorten the logistics time. Secondly, the Internet of Things technology can collect data about fresh products and analyze their changes. In addition, the Internet of Things technology can also monitor the temperature and humidity of fresh products in real time, so that fresh products are always kept in a suitable environment, thereby reducing logistics costs and improving efficiency.

For the optimization of logistics distribution, the distribution process of fresh products is very complicated. Each step will have a high cost. In order to reduce costs, many enterprises will use Iot technology to improve logistics efficiency. In order to achieve the full life cycle management of fresh products, Iot technology can monitor every link in the logistics process. For example, the Iot can scan goods when they arrive at their destination and learn about their transportation by analyzing information such as their location, time, and temperature. When goods are found to be lost, damaged or deteriorated, the Internet of Things can immediately notify the relevant personnel to deal with it to avoid further expansion of losses.

For the optimization of warehousing function, the warehousing function is optimized on the basis of the Internet of Things to achieve the efficient and high-quality development of fresh e-commerce warehousing logistics. The use of Internet of Things technology to optimize the warehousing process, so that the efficiency of warehousing operations is higher, and the accuracy of picking operations is higher. Through the Internet of Things technology to carry out comprehensive management of fresh goods, can effectively control storage costs, reduce losses caused by insufficient inventory, improve the quality of fresh products. The Internet of Things technology is used to monitor the temperature, humidity, freshness and other indicators of fresh products in real time, achieve comprehensive monitoring of commodity quality, timely find problems and take measures to solve them, improve the quality of fresh products, enhance user satisfaction, and reduce the loss caused by slow sales to a certain extent.

In order to strengthen traceability management, real-time monitoring of all links in the entire process of agricultural products from production to sales is achieved through the Internet of Things technology, so as to ensure the quality and safety of fresh agricultural products. Specifically, it includes: using the Internet of Things technology to realize the quality inspection of every link in the production and processing process of agricultural products; The use of the Internet of Things technology to realize the automatic control of the key process parameters in the process of product production and processing; The use of the Internet of Things technology to achieve the product sales process of geographical location information and transportation time and other information records.

Acknowledgements

This research was funded by Department of Education of Zhejiang Province (Y202250450). The authors would also like to extend thanks to anonymous reviewers for the improvement of this paper.

References

- [1] Wang G, Zhang X, Gao Y F, et al. The Use of an Internet of Things Data Management System Using Data Mining Association Algorithm in an E-Commerce Platform [J]. *Journal of Organizational and End User Computing*, 2023 35 (3): 322553

- [2] Altaruri HHM, Nor ARM, Jaafar NI, et al. A bibliometric and content analysis of technological advancement applications in agricultural e-commerce [J]. *Electronic Commerce Research*, 2023, 10.1007/s10660-023-09670-z
- [3] Westland J C, Chen G Q, Ba S L. Special Issue: Chinese E-Commerce Introduction [J]. *Electronic Commerce Research and Applications*, 2013, 12 (5): 297-298.
- [4] Song Z T, Sun Y M, Wan J F, et al. Smart e-commerce systems: current status and research challenges [J]. *Electronic Markets*, 2019, 29 (2): 221- 238.
- [5] Zhang, X H. B2C E-Commerce Logistics Network Optimization Model [J]. *Journal of Global Information Management*, 2022, 30 (3), DOI10.4018/JGIM.20220701.oa7
- [6] Dong Z H. Construction of Mobile E-Commerce Platform and Analysis of Its Impact on E-Commerce Logistics Customer Satisfaction [J]. *Complexity*, 2021, DOI10.1155/2021/6636415
- [7] Lai J Y, Ulhas K R, Lin J D. Assessing and managing e-commerce service convenience [J]. *Information Systems Frontiers*, 2014, 16 (2): 273-289.
- [8] Szymanski G. Marketing Activities of Local Food Producers in E-Commerce [J]. *Sustainability*, 2021, 13 (16): 9406.
- [9] Prajapati D, Chan FTS, Chelladurai H, et al. An Internet of Things Embedded Sustainable Supply Chain Management of B2B E-Commerce [J]. *Sustainability*, 2022, 14 (9): 5066
- [10] Wei L, Ma Z Q, Liu M N. Design of reverse logistics system for B2C e-commerce based on management logic of internet of things [J]. *International Journal of Shipping and Transport Logistics*, 2021, 13 (50): 484-497.
- [11] Zhan H. Zhang X. Wang H W. Influencing factor modeled examination on internet rural logistics talent innovation mechanism based on fuzzy comprehensive evaluation method [J]. *PLOS ONE*, 2021, 16 (3): e0246599
- [12] Wang C X, Zhou T, Ren M H. Driving spatial network connections in rural settlements: The role of e-commerce [J]. 2023, 159, 103067
- [13] Heuer D, Brettel M, Kemper J. Brand competition in fashion e-commerce [J]. *Electronic Commerce Research and Applications*, 2015, 14 (6): 514-522.
- [14] Hoyer W D, Kroschke M, Schmitt B, et al. Transforming the Customer Experience Through New Technologies [J]. *Journal of Interactive Marketing*, 2020, 51: 57-71.
- [15] Li L L, Zeng Y W, Ye Z. E-commerce development and urban-rural income gap: Evidence from Zhejiang Province, China [J]. *Papers in Regional Science*, 2021, 100 (2): 475-494.