Analysis of the Mystery in Warehousing Management: Taking SF Storage as an Example

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Abstract. From the perspective of the whole logistics industry, warehousing management, as an essential branch, has created enormous benefits for the logistics industry. The emergence and development of intelligent warehousing have had a profound impact on the traditional warehousing industry. This paper discusses the importance of warehousing management in the logistics industry, taking SF as an example to describe how modern intelligent warehousing management is carried out and taking this enterprise as an example to study the present situation and problems of warehousing management in China. Finally, combining these problems will improve our warehousing and put forward constructive suggestions for SF's development. This paper focuses on storage allocation in warehouse management and the future development direction of SF Express. SF Logistics, which is studied in this paper under the blessing of intelligent warehousing and advanced warehousing management, adopts the research method of in-depth analysis of cases, which has particular specific theoretical value and application value on how to improve the core technology of warehousing in China.

Keywords: Warehousing Management, Storage allocation, SF future intelligent storage.

1. Introduction

Warehousing refers to using warehouses to store unused goods, which is contemporary detention in transferring goods between supply and demand [1]. The warehousing management industry has played an essential role in China's economic development, and its existence can reduce storage costs and market risk [2]. However, due to the short development time of China's logistics, with the rising labor costs of China's warehousing industry, land use is difficult and expensive, and financing is difficult and costly, the profit level is not high, and the profit level continues to decline [3]. The research contents of warehousing management are divided into the selection of warehousing facilities, warehousing business management, warehousing planning, and warehousing operations, among which the most critical research contents are the following four aspects: layout and location of warehousing outlets, determination of warehouse-scale, inventory control and management, and optimization of warehousing system. SF's warehousing network is composed of self-operated warehouses and franchised warehouses. According to the positioning differences of the production, circulation, and consumption end, a nationwide warehouse network resource layout of "combining light with heavy" is formed, forming an efficient, flexible and complementary warehousing network. SF has independent intellectual property rights in the warehousing system, automation equipment R&D capability, warehousing planning, and design capability, and realizes digitalization of workforce, production capacity, operation, and end-to-end visualization through the digital transformation of warehousing, which helps business planning, business decision-making, and risk warning, effectively reducing costs and increasing efficiency; Improve the efficiency by studying the integration and cooperation of various automation equipment; Through the dynamic algorithm and automatic engine, the resource model and strategy are built to realize the dynamic optimal scheduling and allocation of task priority. With the blessing of scientific and technological capabilities, SF Storage Network cooperates with SF Net and other SF Eco-businesses to meet the different needs of customers in various sub-sectors and provide multi-scenario and end-to-end intelligent supply chain solutions for industry customers. Through the research of warehouse management combined with SF Logistics, this paper hopes to promote a new round of warehouse management development, improving the development quality and profitability.

2. Literature review

With the advent of the global epidemic and the continuous development of China's logistics industry, the strategic importance of warehousing in logistics has become increasingly significant. It has become one of the sectors with the highest economic value in logistics. The primary defects of our warehousing management are as follows: the information level of warehousing management is insufficient, the professional warehousing management talents are lacking, and the logistics warehousing management concept is backward [4]. Gao Guangli believes that the development trends of our warehouse management include: manual and mechanized storage stages, automatic storage stages, and intelligent storage.

Based on the above research, there is enormous room for developing China's warehouse management. This study thinks that we can establish a model of a finished goods warehouse plus an e-commerce warehouse, integrate multi-scenario equipment, operate independently, and promote the progress of warehouse management from aspects of the warehouse design and management and the allocation of storage locations in the warehouse such as the optimization of the whole supply chain.

3. Case analysis

3.1 Case description

SF Express is a domestic express logistics integrated service provider headquartered in Shenzhen. After years of development, it has initially established the ability to provide customers with integrated logistics solutions, which provide logistics services at the distribution end and extend to the production, supply, sales, and distribution links at the front end of the value chain. Starting from consumer demand, it uses data as traction and extensive data analysis and cloud computing technology to provide customers with a package of warehousing management, sales forecast, comprehensive data analysis, and financial management. The industry has always said that there are two logistics in China, one is SF, and the other is others.

SF warehousing is an intelligent warehousing system based on hardware equipment research and development, artificial intelligence technology application, business planning and design as the core, and digital warehousing operation as the guarantee. It relies on a professional operation management level, advanced system management ability, and excellent integrated warehousing and distribution network to provide customers with experienced and high-quality services. SF's warehousing network is composed of self-operated warehouses and franchised warehouses. According to the positioning differences of the production, circulation, and consumption end, a nationwide warehouse network resource layout of "combining light with heavy" is formed, forming an efficient, flexible and complementary warehousing network. SF has independent intellectual property rights in the warehousing system, automation equipment R&D capability, warehousing planning, and design capability, and realizes digitalization of workforce, production capacity, operation, and end-to-end visualization through the digital transformation of warehousing, which helps business planning, business decision-making and risk warning, effectively reducing costs and increasing efficiency; Improve the efficiency by studying the integration and cooperation of various automation equipment; Through the dynamic algorithm and automatic engine, the resource model and strategy are built to realize the dynamic optimal scheduling and allocation of task priority. With the blessing of scientific and technological capabilities, SF Storage Network cooperates with SF Net and other SF Eco-businesses to meet the different needs of customers in various sub-sectors and provide multi-scenario and end-to-end intelligent supply chain solutions for industry customers. Use SF warehouse resources; The average square meter of the warehouse can store 268 pieces, and the utilization rate of the warehouse is 75%. Turnover days are temporarily calculated as 30 days.

3.2 Warehouse separation method

One of the advantages of SF Logistics in the warehousing industry is its warehouse-dividing method when making solutions for customers, which can create enormous benefits for customers. Take the following question as an example: How should SF solve a customer's request to warehouse all its industries?

First, the customer's delivery methods are divided into two categories: Zhuhai delivery and warehouse delivery; Zhuhai to warehouse, customer, JD.COM; Distribute to customers by the warehouse. The following picture shows the current business model of this enterprise. The demand is mainly concentrated in Jiangsu, Zhejiang, South China, and Beijing. There is a particular demand around other provincial capitals.

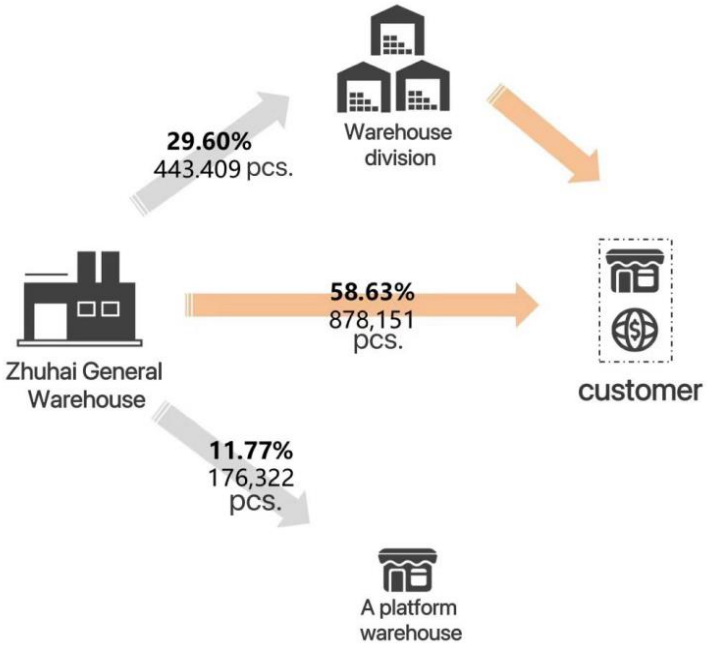

Fig. 1 The business model of SF

After SF analyzes the customer's current situation, it uses warehouse-dividing methodology to analyze the customer, that is, using data mining modeling method to analyze various influencing factors such as cost, timeliness, transportation resources, etc., and solve the optimal warehouse-dividing result. First of all, the first point of the warehouse-dividing methodology is to clarify the data source and to determine the customer's demand data, timeliness requirements, cost accounting methods, distribution resources, and storage resources. Then, the data is preprocessed. The general steps are data cleaning and data conversion. Data cleaning methods generally include missing value processing and abnormal value processing. The data conversion analyzes transportation resources and delivery timeliness through the disguised form of known data. The third step is also an essential part of the warehouse-dividing methodology: analysis and modeling. Finally, the model results are obtained.

Figure 2 is the assumption of warehouse separation based on the warehouse separation methodology. According to the warehouse-dividing hypothesis and the warehouse-dividing methodology, the warehouse-dividing scheme is finally worked out for customers. According to the best total cost and timeliness, SF recommended the seven-warehouse plan (including Zhuhai) for this customer; Seven warehouses are Zhuhai, Chengdu, Ezhou, Nanjing, Beijing and Shenyang. The figure below shows warehouses' distribution and demand heat diagrams, all distributed in the heat-concentrated area.

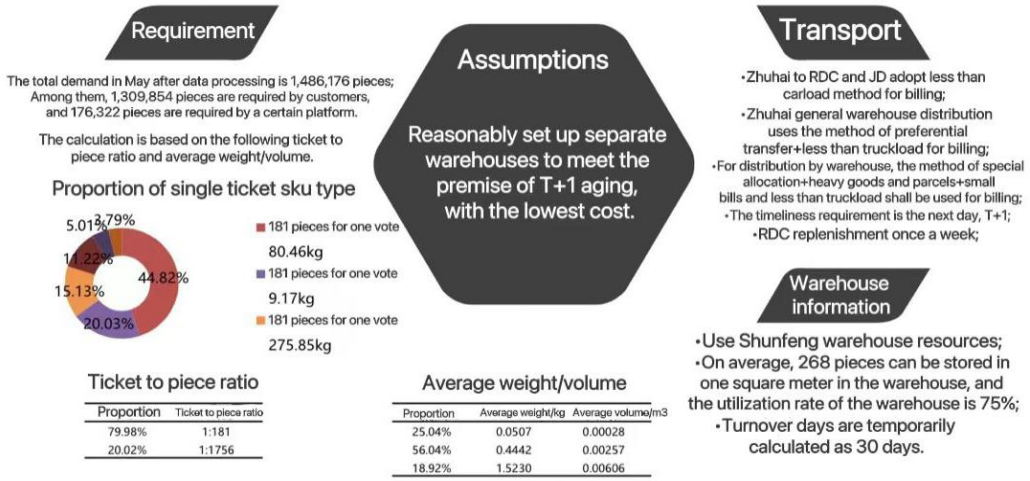

Fig. 2 The assumption of warehouse separation

The total cost of the first scheme is relatively low, but the gap between the rate of T+1 timeliness and that of the second scheme is still relatively large. It can be seen that the improvement in work efficiency is still reasonably significant after the extreme warehouse separation. Although the efficiency of Scheme 2 looks pretty high, it is risky for smaller enterprises, so it may not be suitable to apply Scheme 2. For enterprises with large volumes and an urgent need to establish a good image in consumers' minds, it is ideal for Scheme 2 because although the cost is high, in this kind of enterprises' minds, the importance of the enterprise's wind evaluation should be ranked before the price. Note: T+1 prescription means that T is the trading day and if T+1 is the first working day after the trading day. In the logistics industry, the achievement rate of T+1 prescription can directly reflect the logistics level of the enterprise.

3.3 Intelligent warehouse management

$$r_{ij} = \frac{\text{Number of orders containing item i and item j}}{\text{Total Orders}}$$

$$x_{ik} = \begin{cases} 1, & \text{Commodity i is stored on shelf k} \\ 0, & \text{Otherwise} \end{cases}$$

$$\max \quad z = \sum_{k \in Q} \sum_{i \in P} \sum_{j \in P} r_{ij} x_{ik} x_{jk}$$

$$\sum_{k \in Q} x_{ik} = 1; \quad i \in P$$

$$\sum_{i \in P} x_{ik} \leq g; \quad k \in Q$$

$$x_{ik} \in \{0, 1\}; \quad i \in P, k \in Q$$

Fig. 3 The algorithm

With the advent of the information and intelligence era, the traditional warehouse can't keep up with the development of the times, and SF has applied the intelligent warehouse under the choice of the times. Storage allocation scheme is a critical factor that directly affects the working efficiency and picking cost of the smart warehouse. According to the historical order information, the correlation degree between commodities is defined, and the mathematical model of the intelligent warehouse storage allocation problem is established to maximize the sum of correlation degrees between items on the same shelf. By comparing and analyzing the storage allocation results obtained by the

algorithm with the random storage allocation results, it can be seen that the storage allocation scheme obtained by the heuristic algorithm based on commodity correlation degree is 30.08% less than that of the random storage allocation scheme, as shown in figure 3 [6].

Since its appearance, AGV's intelligent warehouse has attracted the attention of large e-commerce companies at home and abroad. Amazon and other large enterprises have successfully applied the AGV-based innovative warehouse system to warehouse management and greatly improved order-picking efficiency. At present, some intelligent warehouse systems adopt the random storage allocation strategy of bound goods combination; according to the historical order information, the order and goods are bound to form a fixed goods combination at first. Then the repaired goods combination is used as the storage unit to randomly allocate storage places in the shelves with free storage places (211. Because there are many kinds of historical orders (and many historical orders are sent out of the warehouse with a low frequency), many different types of goods combinations are formed after the orders are bound with goods. Because each kind of goods combination needs to occupy at least one storage location, the storage mode of goods combinations is formed by binding historical orders as storage units inevitably need to occupy many shelves (storage locations). The storage allocation strategy given in this paper takes items as storage units. Because the types of things are far less than the types of combinations, the number of shelves can be significantly reduced according to the storage allocation strategy given in this paper. In addition, this paper considers the correlation between items when allocating storage and stores the items with high correlation in one shelf as much as possible, so it can effectively reduce the times of transporting frames during order picking, reduce the picking cost, and improve the picking efficiency [7].

Based on the existing storage allocation theory, strategy improvement and practical application analysis are carried out. The main contributions to the model method are as follows: (1) While considering the COI coefficient of materials for storage allocation, by classifying the correlation between materials, the maximum distance constraint is introduced into the storage allocation of higher-ranking materials, and the COI coefficient and the maximum distance are considered in the objective function, to achieve more optimization of material storage; (2) Due to the limited scale of solving this kind of problem by commercial software, this paper proposes an approximate algorithm, which can effectively obtain the optimal solution or approximate solution of the problem. (3) Distinguish the correlation differences among materials, and apply different strategies to allocate storage space. The feasibility and effectiveness of the methods are verified by example analysis. Because of the diversity of storage space allocation strategies, this study also provides ideas for follow-up scientific research [8].

A warehouse model suitable for multi-AGV scheduling is designed to aim at the logistics warehouse system. The regional division realizes the rational allocation of resources in the warehouse model: plan shelf layout, warehousing workstation, and charging station. The warehouse management system has an inventory function and warehouse data management. When the warehouse management system puts in the warehouse, WMS generates a receipt document to iWMS or directly scans the material code manually. W MSI dispatches AGV to carry empty shelves or shelves with the same kind of goods to the inbound and outbound warehouse area according to calculation, manually places interests on the shelves, inputs the product quantity, and AGV carries the frames back to their original positions. WMS warehouse management system automatically updates the inventory data [9].

3.4 For recent development projects and advanced equipment of SF Storage

SF has chosen South China Warehouse as the main warehouse, so it has established a new storage park in South China: address of the general entrance of the park: is Pis Anshan Logistics and Storage Park, Dalingshan, Dongguan. Warehouse type: two-story flat high-standard ramp warehouse, with a height of 9 meters on the single floor; Total warehouse area: 130,000 m (4 warehouses); Southern warehouse area: 82769m (finished products+e-commerce); Operating unit: SF Express; Location of express transportation: 16 kilometers (about 20 minutes) from Huawei South Base ((Songshan Lake))

to 50km kilometers (about 52 minutes) from Shenzhen Airport Road; Total investment of the planned project (5-year contract period): total investment of 500 million yuan (RMB); Equipment investment: RMB 150 million. The equipment of this project adopts automatic three-dimensional warehouse (AS/RS) storage+shuttle library of multi-directional shuttle bus+goods-to-people sorting+ distribution, review and packing system+automatic cross-belt sorter, which considerably significantly reduces intermediate links; It can realize the coexistence of goods delivered to people and parallel warehouses, realize flexible and automatic production, deliver goods when they leave the warehouse, and realize the integrated design of warehouse distribution, storage, sorting and distribution. This project can significantly improve the work efficiency of SF warehousing and create immeasurable economic benefits.

3.5 3C Logistics

3C E-commerce Logistics Distribution System (3CLD) is a logistics management and distribution software system developed based on Internet technology of B/S archITecture. By effectively integrating the logistics chain with IT technology, it helps 3C Company to automate its operation, and informatization and assist managers in business analysis, gradually changing from transactional IT to analytical IT, and finally forming a supply chain decision database, which provides strong support for managers' business decisions. In forward logistics, suppliers deliver parts to factories, factories have features into products to retail outlets, and customers buy 3C products at retail outlets [10].

4. Conclusion

China's warehousing is still in a slow development stage, and the latest AGV intelligent warehouse and the mastery of warehousing information are still in the initial step. China still has unreasonable warehousing conditions, such as inadequate or surplus warehousing conditions, unbalanced warehousing structure, and low warehousing profits. Let us continue to develop in the direction of intelligent warehousing and informatization, vigorously develop the scientific research strength of warehousing, strengthen the core competitiveness of China's warehousing system, keep pace with foreign companies such as Wal-Mart and Amazon, and gradually improve China's international warehousing position.

As the leading logistics enterprise in China, SF Express believes that in this era of surging networks and paramount traffic, we should focus on developing an e-commerce business in the 3C industry. The supply chain of the 3C industry is characterized by global distribution, multi-warehouse operation, extensive layout, and quick product change. The sector requires high-tech technology, so SF should invest much money to support it and build an intelligent automation system. After that, we will focus on the value-added industry of 3C reverse logistics distribution. Currently, the typical reverse business of express delivery in the 3C industry is maintenance return, south industry return, and consumer complaint return; In the future, the reverse company of express delivery in the 3C industry will increase: scrap recycling and trade-in. In this process, some personalized third-party logistics services can also be added.

Customized service of third-party logistics means that the third-party logistics enterprises comprehensively use logistics service means to meet various needs of customers according to enterprise technology, facilities, and resources and provide targeted services such as transportation, warehousing, processing, packaging, distribution, and logistics information to different customers. Personalized service is more flexible and targeted than traditional third-party logistics service. Its characteristic service and detailed service provided according to the diverse needs of other customers is the highest level of interpretation of "customer satisfaction." Personalized third-party logistics service is developed based on diversification and specialization of logistics services. Only customers can demand and produce personalized service content among the three ranges of regular service, value-added service, and high-end third-party logistics service. This is the only way for third-party

logistics to enhance the competitiveness of enterprises and achieve joint development with customers. And investigate and improve the satisfaction of the third-party logistics. Customer satisfaction degree of third-party logistics refers to the feeling state of satisfaction or dissatisfaction formed by the comparison between customers' perception of logistics service and customers' expected service value. Put, customer satisfaction CSD= customer's actual perception of service/customer's expected service value. If customer satisfaction is CSD>1, it means that customers are delighted; If the customer satisfaction is CSD=1, the customer is satisfied; If the customer satisfaction CSD<1 is less than 1, it means that the customer is not satisfied; And the more significant the CSD value, the more comfortable the customer is, and the smaller the CSD value, the more dissatisfied the customer is.

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