Simulation and Optimization of Warehouse System of Cold Chain Logistics Distribution Center Based on Flexsim

Kexin Sun*[1], Ning Cui[2]

[1]School of Liaoning Technical University, college of business administration, Huludao, Liaoning, 125105, China. E-mail is 1072821797@qq.com
[2]School of Liaoning Technical University, Public Administration and law School, Huludao, Liaoning, 125105, China. E-mail is yulin_2@163.com

Abstract. With the continuous development of economy, the number of cold chain logistics enterprises in our country continues to increase, and the demand and circulation of cold chain logistics food are also increasing year by year, and the cold chain logistics system is facing the main problem is the cost and the corrosion rate is relatively high, profit inequality. In order to solve the above problems, warehousing operation system and distribution center are one of the most important links in the process of distribution activities and warehousing operations. The efficient operation of the distribution and warehousing system is directly related to the efficiency of enterprise operation. This paper takes C cold chain logistics system as the research object. The cold chain logistics distribution center is a comprehensive logistics enterprise with multiple functions. The Flexsim simulation model was established based on the operation flow of vegetables, fruits and dairy products in the system and the current state of their storage. According to the simulation results, it is found that the warehousing operation process of the distribution center has some problems, such as too long waiting time, uneven work rate of employees and excessive damage of goods. According to the principle of FIFO and storage strategy, research and optimize the plan reasonably. According to the comparison and analysis of the output simulation results after optimization and before optimization, the storage waiting time has significantly decreased, the operator operation rate is relatively more balanced, and the number of unqualified products has been greatly reduced after reinspection, and the optimization results have increased the efficiency of the storage operating system and provided the direction for the future development of the enterprise.

Keywords: Distribution center, Flexsim simulation, Cold chain logistics, Fresh products

1 INTRODUCTION

Fresh cold chain food not only plays an important role in life, but also is in great demand in daily life. At the same time, with the increasing living standards of people, people's

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quality, diversity and freshness of food are also increasing. The distribution center is a logistics activity place mainly engaged in distribution activities accompanied by warehousing operations[1]. As one of the most important links in the whole logistics activity process of the distribution center, the efficient operation of the storage system directly affects the improvement of the operational efficiency of the enterprise, and is the key to improving the inventory turnover rate, reducing the number of cold chain food spoilage and reducing costs[2].

In recent years, many scientists at home and abroad have begun to study centralized distribution optimization, cold chain logistics optimization and inventory management optimization [3], mainly for the study of cold chain logistics theory. Li Zhenping et al. combined the order selection scenario of the "goods to people" warehousing system, studied the order batch selection problem of the automatic car storage and pick-up system [4], and established an integer programming model of the order batch problem with the goal of minimizing the number of box delivery. Compared with the batch results obtained according to the first-come first-served strategy, it is found that the sorting efficiency of order batch based on the paper model and algorithm is improved by about 25%-45%[5]. Considering the speed difference between unloaded and unloaded equipment and the total carbon emissions of the equipment under the combined operation[6], a three-dimensional path optimization model with dual objective optimal time and carbon emission cost was established for the combined operation, and the optimal solution of the model was obtained by using the mixed intelligent water drop algorithm, effectively reducing the carbon emission cost of the combined operation equipment. The three-dimensional space path is optimized to improve the efficiency of storage[7].

The innovation point of this paper is that in the process of investigating the warehousing operation of C cold chain logistics distribution center, it is found that the previous optimization implementation is based on human experience to carry out reform and optimization work, lack of sufficient objectivity, so that the problems in warehousing operations still exist[8]. Based on Flexsim simulation technology, which can directly reflect the characteristics of the location and situation of blockage and bottleneck in the system, this paper designs an optimization plan for the storage operation of C cold chain logistics distribution center and puts forward corresponding safeguard measures in combination with the principle of first-in-first-out of goods and the application of radio frequency technology while considering the personnel allocation and storage strategy[9]. It plays an important role in strengthening the management of cold chain logistics distribution center and improving the efficiency of cold chain logistics distribution[10].

2 C COLD CHAIN LOGISTICS DISTRIBUTION CENTER STORAGE STATUS DESCRIPTION AND SIMULATION

2.1 C Cold Chain Logistics Distribution Center Warehousing Introduction

C cold chain logistics distribution center is located in A city, the storage area is about 9000 square meters, about 75 meters wide, about 120 meters long, about 8 meters high.

The storage studied in this paper is mainly used by C cold chain logistics distribution center to meet the market demand in some areas of A city. The warehousing area of the distribution center is mainly composed of warehousing inspection area, sorting area, shelving area, room temperature area, refrigerated area, frozen area, return area, equipment storage area, maintenance room and office. The warehouse has a purchase port, two delivery ports, with a main channel and two sub-channels to facilitate the entry and exit of vegetables, fruits and dairy products.

2.2 Warehouse Operating System Flow

Warehousing is based on the storage and custody of goods, and the use of warehouses in the process of transportation from the production place to the consumption place.The facilities and equipment in the facility are the links of logistics activities such as inspection, storage, processing and packaging of good. Be stored in production, sales and supply play a role in connecting, maintaining product quality, speeding up commodity circulation, an important link to improve logistics efficiency.

(1) Warehousing Operation Flow

The warehouse operation process is mainly to receive and check products. First of all, after receiving the product warehousing notice, the staff will prepare for warehousing, receive the news of the enterprise system department, and receive the warehousing plan of platform, acceptance management, personnel and documents. Then start to receive the goods, goods acceptance, through the acceptance into the warehouse, the inspection fails to return the goods. The consignee shall carefully check the goods information with the consignor, handle the warehousing handover, and clarify the responsibilities of both parties. Warehousing handover mainly includes: inspection, return and other specific responsibilities, the number of final warehousing products. After, the handover personnel from both sides sign documents and manage them respectively. The contents of the handover procedures include: inspection, return of damaged goods, exact responsibility, and actual quantity of goods received.

(2) Manage the Process in the Library

After storage, cold chain foods are divided according to their types and characteristics, and then put on the shelf for storage. Warehouse management staff will regularly take stock and check the quantity and quality of goods on the shelves, and will deal with nonconforming products and complete inventory reports. Regular inventory can improve the utilization rate of inventory goods, reduce storage costs, and increase storage space. Replenishment is one of the important links of warehouse goods management. When the goods are out of stock, the purchasing department should be notified to contact the supplier to replenish the goods in time to ensure the normal operation of the warehouse.

(3) Outbound Operation Flow

The outbound operation process is the whole outbound operation process in which the warehouse manager, after receiving the outbound notice, prepares for the outbound work, selects and prepares the goods first, reviews the goods and labels and packages them again after receiving the shipment order, and finally sends the goods to receive the delivery notice.

2.3 Simulation Entity and Parameter Description

Before applying Flexsim software for simulation, the device types represented by each entity in the model are explained. Generator: To generate pallets or goods arrival, the warehouse arrives a batch of goods every half hour, and another generator is used to simulate the packing of goods. Processor: The goods are inspected and labeled, subject to the normal distribution of (10,2,0), and the loss of goods is 0.01. The verification time is 2 minutes and the labeling time is 10 seconds. Temporary storage area: temporary storage of goods, waiting area, do large capacity of 150; Disassembler: unpack the goods. The quantity of goods per carload in the warehouse of the distribution center meets the uniform distribution of U (360,500), that is, the average cargo per carload is between 360 and 500 pieces; The shelf is used to store goods, and the parameter setting has 10 layers. The length is 8 meters, the width is 2 meters, and the height is 1 meter. Forklift: Handling goods, each time can handle 8 goods, the speed is 1m/s; Operator: Manual operation of goods at 1m/s.

2.4 Warehouse Job Layout Model

According to the above introduction and description, the simulation model diagram of C cold chain logistics system distribution center is established, and its overall layout is shown as the following figure 1.

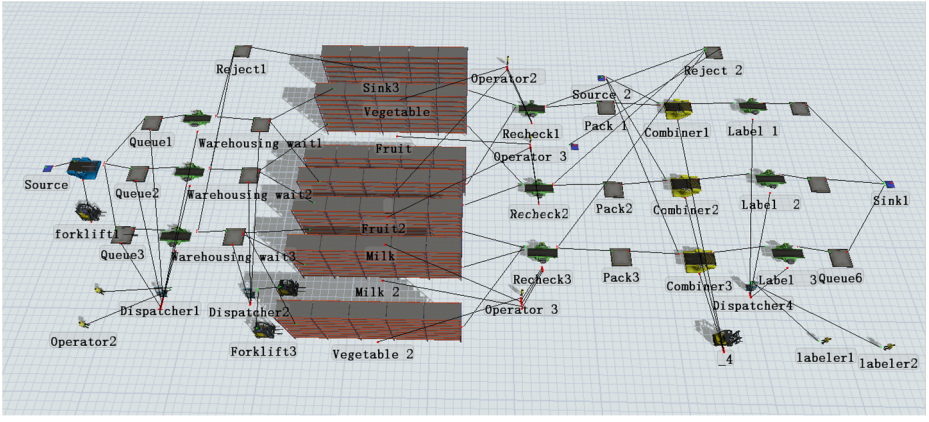

Fig. 1. Warehouse simulation layout diagram

2.5 Analysis of Simulation Result

The distribution center works for 8 hours a day, and the model runs for 7 days. Through the data generated after the model runs for a week, problems existing in the distribution center are analyzed. According to the Dashboard statistical report, it is found that: The waiting time for goods to be stored is too long, resulting in the accumulation of goods, the difference between the work and idle time of operators with different work contents is too obvious, and the number of unqualified goods after inspection is too large.

(1) Monitoring and Analysis of Waiting Time for Goods in Storage

The goods in the distribution center need the warehouse operator to specify the shelf location before warehousing, the impact of manual operation will inevitably reduce efficiency, resulting in too long waiting time phenomenon, long-term stagnation not only affects the freshness of cold chain food, but also brings negative effects on the normal operation of the enterprise. Its waiting time has exceeded 3100 seconds, and the simulation results are as shown in the figure 2 below:

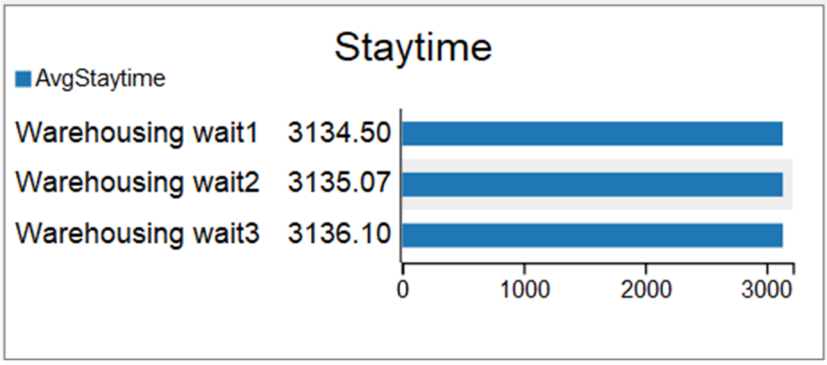

Fig. 2. Waiting time for goods to be stored before optimization

(2) Operator Working Status Detection

According to the simulation results, it is found that the idle rate of labeling operators and warehousing personnel is very high, and the work intensity of warehousing personnel is relatively high, so one labeller can be reduced, and the sorter can participate in warehousing work in idle time. The simulation results are shown in the following table 1.

Table 1. Warehouse operator operation rate

Operator	idle rate	Operation rate
Warehouse clerk 1	29.88%	70.12%
Warehouse clerk 2	38.32%	61.68%
Selector 1	73.39%	36.61%
Selector 2	70.86%	29.14%
Selector 3	68.42%	31.58%
Signer 1	86.49%	13.51%
Signer 2	99.16%	0.84%

(3) Monitoring the Quantity of Damaged Goods after Sorting

According to the test data d, the number of unqualified products is 31, and it can be seen that the damaged goods are about 3.5%. The increase in logistics cost of the distribution center is mostly caused by the excessive decay rate, so it is necessary to find the cause of damaged goods and reduce the loss of products after reinspection.

3 C COLD CHAIN LOGISTICS DISTRIBUTION CENTER STORAGE STATUS OPTIMIZATION AND ANALYSIS

3.1 Warehouse Operation System Optimization Scheme

With the development of information technology, the original operation mode is no longer the most suitable for the cold chain logistics distribution center, if the enterprise to improve the efficiency, it needs to make appropriate changes. Rf information acquisition technology is a scientific technology with high accuracy, short time and good at random storage planning. By adopting a FIFO operating model, most of the storage space can be freed up, while the accuracy can be improved by nearly 100%, and important inventory data can be automatically generated. In addition, emergency situations can be handled easily. Therefore, it can be applied in the interior of the distribution center. In order to solve the problem of long waiting time, this paper introduces radio frequency technology to cooperate with the company's distribution center management system to replace manual processing of goods information, which not only saves manpower, but also improves operational efficiency.

The parameters of the quality inspection device are set , the processing time is set, and the processing time after sorting is set to one minute. In order for the goods to achieve the principle of first in first out, the original rows and columns of the goods are set to random available rows and columns, and their maximum capacity is set to 400.

It is coded in the property box of the shelf parameters, so that the goods can be put in and out of the warehouse according to the first-in-first-out process. To trigger the coding, first of all, the original coordinate value of some goods is obtained, and then the number of commodity pickers is obtained by referring to the column and row of the goods. When encountering the goods with the same label, the same cycle matching process will automatically pop up. If you don't find the same then it's out of stock. Put it in a free location and set the coordinates. The Switch language is to set the storage location of the goods according to the position of the shelf.

The sorter's operation rate is very high, the labeler's operation rate is very low, and the warehouse clerk's operation efficiency is relatively low, so the work volume of personnel can be reassigned, and one labeler can be reduced, and other parameters are not changed. In order to ensure the authenticity and accuracy of the data, the running time of the model is still 216,000 seconds, the delivery of goods continues to obey the normal distribution of U(360,500), and the other parameters are set the same.

3.2 Analysis of Model Operation Results after Optimization

According to the optimized simulation results, the average waiting time is greatly reduced, and the time is controlled within 14 seconds, which solves the problem of overstocking of goods.

In terms of personnel utilization, the idle rate of inbound clerk 1 and inbound clerk 2 was 39.62%, that of inbound clerk 2 was 40.38%, that of sorter 1 was 39.62%, that of sorter 2 was 40.38%, that of sorter 3 was 41.51%, and that of signer was 73.13%. The

operator's work rate is somewhat improved, because its labelers themselves do less work and can do other work in their spare time.

After reinspection, the number of unqualified products was 12, and the damage rate of goods was reduced to about 2%, which improved the original problem of excessive quantity of unqualified products and was conducive to improving the warehousing efficiency of the distribution center. The simulation results are shown in the figure 3 below.

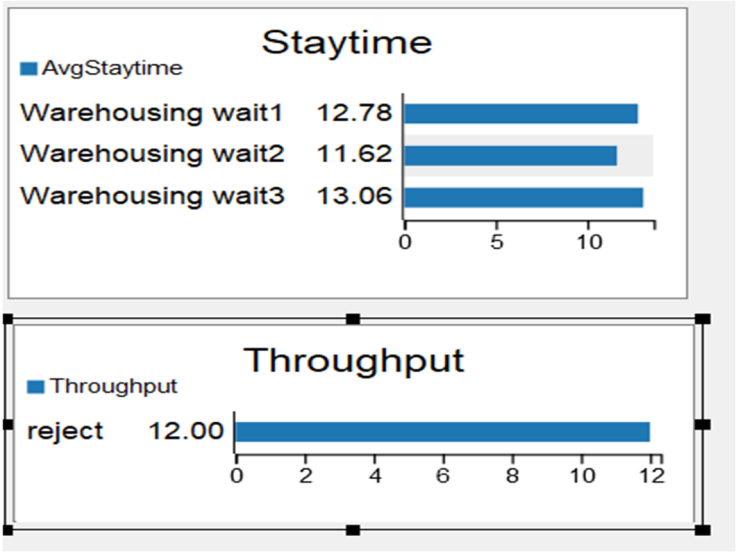

Fig. 3. Operation results after optimization

3.3 Safeguard Measures after Optimization of Warehouse Operation System in Distribution Center

The long-term development of enterprises is inseparable from a reasonable and effective business model, optimizing the cold chain logistics distribution center storage system, not only can improve the efficiency of business operations, but also can bring more benefits. However, the success of the optimization project cannot be separated from good security work, such as operation process, operation process, employee reward system and active cooperation of operators.

Companies can introduce more advanced equipment and reduce human intervention. This paper introduces the radio frequency technology in the operation of manual completion, submission of entry and consultation of commodity information and other operational processes, reduce the working time of employees, shorten the waiting time for warehousing. In the future, enterprises carry out intelligent management, automatic handling, lifting and other equipment, of course, these technical equipment and warehouse management system to achieve information exchange, effectively help the inter-

nal operations of enterprises, appropriate use of storage space, and better serve customers. The managers of the company must also develop corresponding reward and punishment systems. Reward diligent, capable and cooperative employees in the form of wages; Punish employees who do not cooperate with warehouse operation optimization. Strengthen performance evaluation, link it to attitude and operational efficiency, and mobilize employees. Let all employees know that the storage optimization of the cold chain logistics distribution center is a task that every employee must complete. After the goods are stored in the storage area, the temperature and humidity of the storage area should be checked regularly, and the quality of all kinds of goods should be checked to prevent the goods from being tampered with and polluting other good quality goods, causing damage to the goods. The implementation of the warehouse should be in accordance with the principle of first-in-first-out to avoid expired goods. Be careful when packing the goods outside the warehouse so as not to damage them. In addition, the packaging of perishable fruit and vegetable products should be selected with good air permeability and strong packaging, and dairy products should be selected with constant temperature packaging and refrigerated packaging.

4 CONCLUSION

With the increasing demand for cold chain agricultural products, the original storage operating system of the distribution center has been unable to meet the needs of the market. The application of Flexsim simulation technology to study the storage operating system of the current distribution center shows that the cold chain logistics distribution center has problems such as too long waiting time for storage, unbalanced operation of employees, and too many damaged goods. In this paper, the cold chain logistics system of agricultural products is optimized. The output results of the current operation model are analyzed and optimized. Compare the data indexes of the distribution center before and after optimization to ensure the feasibility of its program. Finally, the safeguard measures and methods after the implementation of the optimization plan are proposed to facilitate the long-term management and development of the cold chain logistics of agricultural products. The main conclusions are as follows: this paper establishes a simulation model according to the existing warehousing operation system, and draws the conclusion that the main problems affecting the warehousing efficiency are long waiting time, uneven personnel operation rate, and excessive quantity of unqualified products. To solve the above problems, Flexsim simulation software is used to optimize, and the data before and after optimization are compared and analyzed. It is concluded that the application of radio frequency technology, reasonable allocation of personnel work and first-in-first-out delivery strategy can improve the efficiency of warehousing operations. The feasibility of the optimization scheme is verified, and the occurrence of uncontrollable factors is avoided, which makes the model run in an ideal state. However, there are also some problems that have not been considered, such as the work of replenishment and the particularity of cold chain food, how to carry out better real-time monitoring, which will be the next research direction.

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