Decision-making of X Home Appliance Logistics Service Level

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Abstract. X company's home appliance logistics is currently facing the problem of service level decision-making. Therefore, this paper firstly constructs the decision-making model of logistics service level based on the composition of the company's logistics service chain, the operation mode of each link, the index system of logistics service level and the characteristics of home appliance logistics. Then, the paper quantifies the comprehensive logistics service level to be used in this paper and makes a regression analysis of the just-in-time delivery rate index and the transportation index. Finally, based on the historical data of the company, the decision-making simulation of logistics service level is made under the consideration of the on-time rate of terminal delivery and door-to-door delivery performance rate. The results show that to improve the delivery on time rate and door-to-door delivery performance rate in a certain range is conducive to the company's profit growth.

1. Introduction

In recent years, with the rapid development of e-commerce, online shopping of home appliances has become more and more common in People's Daily life. While the online shopping of home appliances is flourishing, it also promotes the logistics market of home appliances to become more and more broad.

X company is a third-party logistics company established in 2017. Its home appliance logistics service is targeted at the merchant side, and the service mode mainly includes warehousing and distribution combined services, integrated warehousing and distribution service is a logistics service chain composed of primary warehouse, trunk transportation, secondary warehouse and terminal distribution. From June 2018, the number of orders and customers related to the company's home appliance logistics showed a trend of decline or slow growth. Through investigation and analysis, it is found that the main reason for this phenomenon is that the level of logistics service can not meet customer demand. For third-party logistics companies, logistics service is the product they sell to the outside world, and the level of logistics service is the key factor affecting the company's revenue and profit. Too high or too low a level of logistics service will affect the company's profit by affecting the cost and market demand. Therefore, it is extremely urgent for X logistics company to reasonably decide the level of home appliance logistics service.

Therefore, this paper will be based on the service chain composition and actual operation of X home appliance logistics, and combined with the company's relevant historical data, the company's logistics service level decision-making analysis and research.

2. Literature review

Although home appliance logistics has existed for a long time in China, the current research on home appliance logistics is mostly on the reverse recovery logistics of waste home appliances and the distribution of home appliances, and the research on the logistics service of home appliances is relatively few.

Huang,[1]And Xu,[2]the optimal decision-making service and retail price are also obtained by using two-stage pricing method and Stackelberg game in two-channel. Ying Feng, Zhen Liu [3] and Jiamei Gu [4] studied the decision-making of logistics service level in the supply chain of third-tier fresh

agricultural products with supplier-led, third-party logistics companies and retailers as obedients.Wei He, Wei Liu, Aiping Cui [6] in the case of considering the impact of logistics service level on market sales, a three-level logistics service consisting of logistics service integrators, functional logistics service subcontractors and logistics service providers The decision-making of logistics service level is studied in the supply chain. Yunlong Yu, Tiaojun Xiao[5] Ying Feng, Yunlong Yu, Yanzhi Zhang, Hao Wu [7] studied the three-level supply chain composed of suppliers, logistics service providers and retailers, considering the market demand and freshness while being affected by the level of logistics services. Logistics service level decision problem. Jiang Lin[8]under the assumption that the product market sales by the third party logistics providers, the influence of the level of service, through the design of logistics service cost sharing mechanism, was studied by two rival manufacturer, a TPL logistics service and supply chain system composed of a retailer, and it is concluded that when the third party logistics service providers benefit maximum when the logistics service level. Wang li, Yong Wang [9]from the same perspective, the value of logistics service level when the profit of the third-party logistics service provider is maximized is obtained in the supply chain coordination problem.

Perspective, there are few literatures consider the characteristics of the service industry and service chain of logistics company, but this article is for the X company electrical appliances logistics to logistics service level decisions, so must to the service industry and company of service chain, considering this is the article is different from their biggest.

3. Construction of decision-making model for home appliance logistics service level of X company

This chapter will build the decision-making model of X company's home appliance logistics service level, and consider the composition characteristics of X company's logistics service chain. The warehouse and distribution shall be operated by itself, and the loading, unloading and handling outsourcing shall be involved in trunk transportation and warehousing activities, and the outsourcing unit price shall vary according to the operation characteristics of the contractor based on the service level provided by the contractor. The specific logistics service level evaluation index system of the company is shown in table 1.Everybody electricity because bulky, bulk realizes the characteristic that deliver goods to the door hard.

Table 1X home appliance logistics service level evaluation system table

Logistics dimension	Indicators	Note	Representative symbol
Primary warehouse	Time-in-time rate	The rate at which the first-class warehouse unloads and wares the goods according to the planned time	s_{j1}
	Originating production time rate	The rate at which the first-level warehouse will deliver the goods and load the goods according to the planned time	s_{j2}
Main transportation	On time arrival rate	Transportation vehicles arriving at the specified time point should reach the primary warehouse rate	s_{f1}
	Prompt departure rate	The rate at which the transport vehicle leaves the primary warehouse at the specified time	s_{f2}
	Order fulfillment rate	Delivery rate of goods from primary warehouse to secondary warehouse within planned time	s_{f3}
Level 2 warehouse	Timely receiving rate	The completion rate of unloading and warehousing the goods in the secondary warehouse according to the planned time	s'_{f1}
	Terminal production timeliness	The completion rate of delivery and loading of goods in the secondary warehouse according to the planned time	s'_{f2}

The end of the distribution	Cargo integrity rate	The rate at which goods are delivered completely to consumers who buy appliances	s''_{f1}
	Home delivery performance rate	The rate at which goods are delivered to designated locations by consumers who buy appliances	s''_{f2}
	On-time delivery rate	Goods in accordance with the agreed time to complete the delivery rate of consumer appliances	s''_{f3}

3.1 The Model Assumptions

1) In order to simplify the complexity of the paper model, due to the change of logistics service index value, the changed volume of business is assumed to be all provided by the original customer, and the type of goods in this link and the proportion of the volume of business are the same as the original.

2) The insured amount of the goods shall be paid in the form of maximum compensation when the goods are damaged.

3) X company shall bear all the damages of the goods.

4) All prices quoted by consumers at the time of purchase.

5) The special line transport vehicles are independent and cannot be used by each other.

6) Service price unchanged.

3.2 The Model Construction

3.2.1 The Symbol Definition

1) p_{if} is the price of type i goods per cubic meter under the premise of completing the service with secondary warehouse f, where i is the type of goods, $i = 1,2,\cdots, I$; f is secondary warehouse, $f = 1,2,\cdots, F$.

2) v_{kif} represents the business volume of type i goods sent by customer k to secondary warehouse f to complete the service.

3) $V_{\min i}$ represents the minimum measurement value of type i goods.

4) S represents the value of comprehensive logistics service level.

5) $V(S)$ represents the business volume when the comprehensive logistics service level value is *S*.

6) $Z(S)$ represents the coefficient on the level of integrated logistics service.

7) V_0 represents the volume of business under the current comprehensive logistics service level.

8) C_1 represents the warehouse operation cost per cubic meter of goods in the primary warehouse operation.

9) C_2 represents the daily fixed investment in the primary warehouse.

10) s_{ej} represents the expected logistic service level of the third-party company that contracts for the loading, unloading and handling operations of the first-level warehouse.

11) $s_{\min j}$ represents the minimum level of logistics service required by the company to the third party that contracts for the loading, unloading and handling operations of the first-level warehouse.

12) C_{tj} represents the unit contracting cost of the primary warehouse to a third-party company for loading, unloading, and handling operations.

13) λ_f represents the ratio of the quantity of goods transported to secondary warehouse f to the total quantity of goods.

14) s_{ef} represents the expected logistic service level of the company to the third-party company

that contracts the transportation operation from primary warehouse to secondary warehouse f.

15) $s_{\min f}$ represents the minimum level of logistics service required by the company for the third-party company that contracts the transportation operation from primary warehouse to secondary warehouse f.

16) C_{tf} represents the unit contracting cost of the transportation operation between primary warehouse and secondary warehouse f contracted to a third party company.

17) $C_{tf}^{'}$ represents the unit contracting cost of the secondary warehouse to a third-party company for loading, unloading and handling operations.

18) $s_{ef}^{'}$ represents the expected logistic service level of the company to the third-party company that contracts the loading, unloading and handling operations of the secondary warehouse.

19) $s_{\min f}^{'}$ represents the minimum level of logistics service required by the company to the third party that contracts the loading, unloading and handling operations of the secondary warehouse.

20) C_{1f} represents the warehouse operation cost per cubic meter of goods of secondary warehouse f.

21) C_{2f} represents the daily fixed investment of secondary warehouse f.

22) C_{3if} represents the distribution cost of type i goods per cubic meter delivered by secondary warehouse f.

23) C_{4i} represents the service guarantee price of type i goods purchased by consumers of home appliances.

24) C_{5i} represents the amount of punishment for each order that the deliverer fails to deliver type i goods.

25) v_i represents the volume of single cargo type i.

26) x_{if} represents the number of pieces of type i goods sent to secondary warehouse f.

27) u represents the calculation coefficient of cost of improving logistics service level.

3.2.2 Logistics service level decision-making model of X company

The profit model in this paper is composed of the revenue of warehousing and distribution combined services, primary warehouse cost, transportation cost, secondary warehouse cost, terminal distribution service cost and the cost of improving the comprehensive logistics service level, and takes the profit maximization as the goal and the index value of each logistics service as the decision variable. The specific model is as follows:

Constraints:

$$\begin{aligned}\max \pi = &\sum_k\sum_i\sum_f p_{if}V_{kif} - C_1\cdot 2\sum_k\sum_i\sum_f V_{kif} - C_2 - C_{tj}\sum_k\sum_i\sum_f V_{kif}\\ &-\sum_f\sum_k\sum_i \lambda_f C_{tf}V_{kif} - \sum_f(\sum_k\sum_i \lambda_f C_{1f}V_{kif} + C_{2f}) - \sum_f\sum_k\sum_i \lambda_f C_{tf}V_{kif}\\ &-\sum_f\sum_k\sum_i \lambda_f C_{3if}V_{kif} + \sum_f\sum_i (1-s_{f1}^{''})x_{fi}C_{4i} - \sum_f\sum_i (1-s_{f2}^{''})x_{fi}C_{5i} - ue^S\end{aligned} \tag{1}$$

$$V(S) = \sum_k\sum_i\sum_f V_{kif} \tag{2}$$

$$V(S) = Z(S)V_0 \tag{3}$$

$$S = S(s_{j1}, s_{j2}, s_{f1}, s_{f2}, s_{f3}, s_{f1}^{'}, s_{f2}^{'}, s_{f1}^{''}, s_{f2}^{''}, s_{f3}^{''}) \tag{4}$$

$$\sum_f V_{kif} = \begin{cases} V_{\min i}, \sum_f V_{kif} < V_{\min i} \\ \sum_f V_{kif}, \sum_f V_{kif} \geq V_{\min i} \end{cases} \tag{5}$$

Constraint (2) means that the total business volume is equal to the sum of the business volume of each customer sending type i goods to secondary warehouse f ;(3) represents the functional relationship between business volume and comprehensive logistics service level;(4) represents that the comprehensive logistics service level is a function of each logistics service index value as a decision variable;(5) means that when the customer sends type i goods to secondary warehouse f with a business volume less than the minimum measurement value, the minimum measurement value shall be calculated.

4. Simulation analysis on decision-making of home appliance logistics service level of X company

4.1 Simulation data processing for decision-making of home appliance logistics service level of X company

4.1.1 Parameter Setting

When the company makes a decision on the level of logistics service, it uses the experimental method to verify that it is likely to cause great loss and immeasurable consequences. Therefore, this paper will use the simulation method to make a decision on the level of X company's home appliance logistics service. In order to simplify the simulation process, and does not conflict with the company's service, this article will select a level of warehouse and transportation and distribution of two secondary warehouse composite services are simulated, and the selection of level 1 June 2018 Guangzhou warehouse the goods sent to Zhengzhou and xi 'an secondary warehouse related data as basic data, on June 1, the data used in the simulation decision-making for the logistics service level, concrete, such as in table 2.Cargo type select large cargo and large cargo, and use i =1 means large cargo, i =2 means oversized cargo; f =1 means Zhengzhou secondary warehouse, f =2 means Xi'an secondary warehouse. It should be noted that, since the values of the indexes used in the simulation are counted in percentage, in order to reflect the authenticity of the simulation, this paper counts the values of the indexes in percentage system during the simulation.

With the increase of logistics service level, the related business volume will also increase, but the demand of consumers in different regions is uncertain and has a certain randomness, so the Monte Carlo method will be selected for simulation in this paper. Parameters of non-decision variables in the model need to be set before simulation. p_{11} =563.00 yuan/m^3; p_{21} =835.00 yuan/m^3; p_{12} =600.00 yuan/m^3; p_{22} =850.00 yuan/m^3; $V_{\min i}$ =0.5m^3; C_1 =14.95 yuan/m^3; s_{ej} =95.00; $s_{\min j}$ =92.00;when $s_j \geq s_{ej}$, C_{tj} =11.26 yuan/m^3,when $s_{\min j} \geq s_j$, C_{tj} =7.51 yuan/m^3; s_{ef} =97.00; $s_{\min f}$ =94.00;when $s_1 \geq s_{e1}$, C_{t1} =142.10 yuan/m^3;when $s_{\min 1} \leq s_1 \leq s_{e1}$, C_{t1} =133.28 yuan/m^3;when $s_2 \geq s_{e2}$, C_{t2} =156.80 yuan/m^3; when $s_{\min 2} \leq s_2 \leq s_{e2}$, C_{t2} =145.78 yuan/m^3, $s_1^{'} \geq s_{e1}^{'}$, $C_{t1}^{'}$ =6.09 yuan/m^3;when $s_{\min 1}^{'} \leq s_1^{'} \leq s_{e1}^{'}$, $C_{t1}^{'}$ =4.06 yuan/m^3;when $s_2^{'} \geq s_{e2}^{'}$, $C_{t2}^{'}$ =7.95 yuan/m^3;when $s_{\min 2}^{'} \leq s_2^{'} \leq s_{e2}^{'}$, $C_{t2}^{'}$ =5.30 yuan/m^3; $s_{ef}^{'}$ =95.00; $s_{\min f}^{'}$ =92.00; C_{11} =7.99 yuan/m^3; C_{12} =8.33 yuan/m^3; C_{21} =147.00 yuan/day; C_{22} =137.20 yuan/day; C_{311} =49.00 yuan/m^3; C_{321} =61.50 yuan/m^3; C_{312} =54.64 yuan/m^3; C_{322} =63.70 yuan/m^3; C_{41} =1470.00 yuan/piece; C_{42} =2450.00 yuan/piece; C_{51} =49.00 yuan/order; C_{52} =73.50 yuan/order; u =2.5×10^{-36} .Consumer demand for home appliances is affected by a variety of factors, such as the local climate, consumers' own preferences, the price of home appliances, etc.,

which leads to consumer demand is uncertain, in order to facilitate the simulation calculation, this paper set the ratio of Zhengzhou in the overall business demand λ_1 obey U =(0.51, 0.65) evenly distributed, bulk cargo volume v_1 obey U =(0.46, 0.50) evenly distributed, the volume of super-large pieces of goods v_2 obey U =(0.50,0.88).Relevant literature points out the volume of business when the comprehensive logistics service level is $V(S) = Z(S)V_0$, according to the data characteristics of this paper, the relationship between comprehensive logistics service level and business volume is set as follows $V(S) = (S - S_0)^{\frac{1}{2}} V_0 + V_0$ According to the existing data V_0=575.95m^3. The quantitative weight of the logistics service level of the outsourcing handling and trunk transportation in this paper will use the original processing method of the company, that is, the two indicators involving the warehouse are 0.5; the timely rate of arrival, the timely rate of delivery and the order fulfillment rate of the trunk transportation The weights are 0.2, 0.2 and 0.4 respectively. With Zhengzhou secondary warehouse service under the premise of completion, per cubic meter of bulk type of goods service price.

Table 2 relevant data of goods sent from Guangzhou primary warehouse to Zhengzhou and xi 'an secondary warehouse in June 2018

Volume of business/indicators	On June 1	On June 2	…	On June 29	On June 30
Business volume	575.95	489.42	…	320.58	243.14
Guangzhou first - level warehouse timely rate	92.86%	92.83%		93.30%	92.76%
Guangzhou first level warehouse start - up production timely rate	93.21%	92.60%		92.36%	93.36%
…					
Xi 'an secondary warehouse timely receiving rate	94.89%	94.91%		95.19%	94.70%
Xi 'an secondary warehouse terminal production timely rate	94.87%	94.03%		94.12%	94.77%

4.1.2 Quantification of logistics service level

For the following simulation calculation, the comprehensive logistics service level needs to be quantified before simulation.

Before the quantification of the comprehensive service level, the influence data of each index on the business volume are obtained through the survey of 8 experts of X company. Among them, the data are obtained through the expert scoring method, with the highest score of 5 and the lowest score of 1. The higher the score, the greater the positive influence. Finally, the level of logistics service is quantified through the grey relational degree method. In the quantization process, the volume of business (the average volume of business in June) is the reference column, and the score of each index by experts is the comparison column. The specific original data are as follows:

Table 3 quantitative raw data of comprehensive logistics service level

Business volume and indicators/experts	1	2	3	4	5	6	7	8
Business volume	354	354	354	354	354	354	354	354
Guangzhou first - level warehouse timely rate	3	2	2	2	3	2	2	2
Guangzhou first level warehouse start - up production timely rate	3	2	2	2	3	2	2	3
To Zhengzhou secondary warehouse transport vehicles to the car timely rate	2	2	3	2	2	2	3	3
To Zhengzhou secondary warehouse transport vehicles timely rate	3	2	2	2	3	2	2	3
The order performance rate of transport vehicles to the secondary warehouse in Zhengzhou	3	4	3	4	3	4	3	3

The timely delivery rate of transport vehicles to xi 'an secondary warehouse	2	2	3	2	2	2	3	3
Timely delivery rate of transport vehicles to xi 'an secondary warehouse	3	2	2	2	3	2	2	3
Xi 'an secondary warehouse to transport vehicle order performance rate	3	4	3	4	3	4	3	3
Zhengzhou secondary warehouse timely rate	3	2	2	3	2	3	3	2
Zhengzhou secondary warehouse terminal production timely rate	2	2	2	3	2	3	2	2
Xi 'an secondary warehouse timely receiving rate	3	2	2	3	2	3	3	2
Xi 'an secondary warehouse terminal production timely rate	2	2	2	3	2	3	2	2
Zhengzhou delivery on time rate	4	4	5	5	5	4	5	4
Zhengzhou distribution of goods integrity rate	5	5	4	5	5	5	5	4
Zhengzhou home delivery rate	5	4	5	5	4	5	5	4
Xi 'an delivery on time rate	4	4	5	5	5	4	5	4

Before quantification, it is necessary to make the original data non-dimensionalization, calculate the difference sequence of the reference sequence and the comparison sequence, take the resolution coefficient, find the correlation coefficient $C_{mk}(t)$ and the correlation degree r_m between the indicators, and assign the weights of the indicators. The corresponding formulas are as follows:

$$X_m^{'}(t) = \frac{X_m(t)}{\max(X_m(t))}, m = 0,1,\cdots,l \tag{6}$$

$X_m(t)$ represents the mth column data value.

$$\Delta_m(t) = \left| X_0^{'}(t) - X_m^{'}(t) \right| \tag{7}$$

The minimum range difference $m = \min\{\min \Delta_m(t)\}$ and the maximum range difference $M = \max\{\max \Delta_m(t)\}$ are taken from all the difference sequences.

The value of ρ is in the range of 0 < ρ <1. After many verifications, it is easier to observe the change of the correlation coefficient when ρ=0.5. In this paper, ρ=0.5.

$$C_{mk}(t) = \frac{m + \rho M}{\Delta_{mk}(k) + \rho M}, k = 1,2,\cdots,n \tag{8}$$

$$\lambda_m = \frac{r_m}{\sum_{m=1}^{n} r_m} \tag{9}$$

The weight of each index calculated by the grey relational degree method is:

Table 4 quantitative index weight of comprehensive logistics service level

Indicators	Correl-ation	The weight
Guangzhou first - level warehouse timely rate	0.5000	0.0425
Guangzhou first level warehouse start - up production timely rate	0.5833	0.0495
To Zhengzhou secondary warehouse transport vehicles to the car timely rate	0.5833	0.0495
To Zhengzhou secondary warehouse transport vehicles timely rate	0.5833	0.0495

The order performance rate of transport vehicles to the secondary warehouse in Zhengzhou	0.6250	0.0531
The timely delivery rate of transport vehicles to xi 'an secondary warehouse	0.5833	0.0495
Timely delivery rate of transport vehicles to xi 'an secondary warehouse	0.5833	0.0495
Xi 'an secondary warehouse to transport vehicle order performance rate	0.6250	0.0531
Zhengzhou secondary warehouse timely rate	0.6667	0.0566
Zhengzhou secondary warehouse terminal production timely rate	0.5000	0.0425
Xi 'an secondary warehouse timely receiving rate	0.6667	0.0566
Xi 'an secondary warehouse terminal production timely rate	0.5000	0.0425
Zhengzhou delivery on time rate	0.7273	0.0618
Zhengzhou distribution of goods integrity rate	0.8636	0.0734
Zhengzhou home delivery rate	0.7954	0.0676
Xi 'an delivery on time rate	0.7273	0.0618
Xi 'an delivery cargo integrity rate	0.8636	0.0734

According to the weight, the comprehensive logistics service level can be calculated as:

$$S = 0.0425\, s_{j1} + 0.0495\, s_{j2} + \cdots + 0.0618\, s''_{21} + 0.0676\, s''_{22} + 0.0734\, s''_{23} \tag{10}$$

4.2 Logistics service level decision simulation and result analysis

Terminal distribution is the end that is closest to consumers. The quality of logistics service is largely determined by consumers' perception. Therefore, this paper will carry out decision-making simulation of logistics service level from the aspect of improving terminal distribution. From the original data, it can be seen that X company performs poorly in terms of timely delivery and door-to-door delivery performance, while performs well in terms of goods integrity rate. Therefore, this paper will conduct simulation research in terms of improving the delivery timeliness rate and door-to-door delivery performance rate.

In this paper, delivery timeliness rate and home delivery performance rate involved in two secondary warehouses in Zhengzhou and xi 'an are increased by 0.25 step, and the corresponding comprehensive logistics service level is simulated by 0.19 step. Simulation results are shown in the figure below:

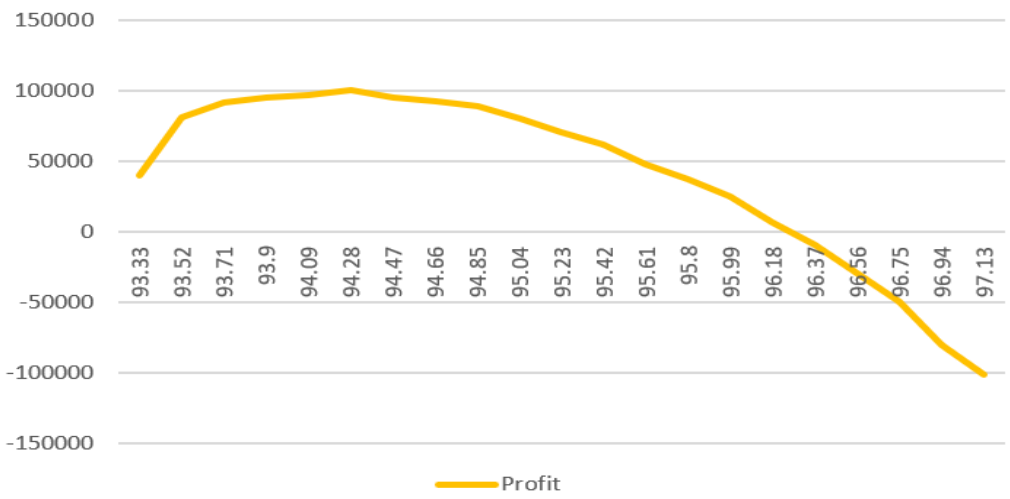

Figure 1 simulation diagram of logistics service level decision

It can be seen from the figure that when the comprehensive logistics service level increases due to the improvement of delivery timeliness and door-to-door delivery performance rate, the profit curve first increases and then decreases. When the comprehensive logistics service level is between 93.33 and 94.28, the profit becomes an upward trend, indicating that increasing the corresponding index value is beneficial to the company. When it was around 94.28and 95.80, the profit decreased, but the profit was still greater than the original value. When the value is greater than 95.80, the profit is less than the original value, indicating that the value of the comprehensive logistics service level is set in the region, which is not conducive to the company. This paper takes profit maximization as the goal,

so it takes the maximum profit as the decision-making basis of logistics service level. According to the simulation data, when the comprehensive logistics service level is 94.28, the profit is the largest, which is 100693.87 yuan and 2.54 times of the original profit of 39602.03 yuan.

5. Conclusion

The logistics service chain is a system consisting of a number of relatively independent logistics links. Reasonable determination of the logistics service level of each link does good to increasing the profit of an enterprise. This paper takes X company's home appliance logistics as the research object, and it considers the composition characteristics of the company's home appliance logistics service chain, the operation characteristics of each logistics link, the characteristics of the home appliance logistics, and the evaluation of the company's corresponding logistics service level in the processing of constructing the model. Besides, this paper combines the company's corresponding logistics service level evaluation system and the simulation method to study the logistics service level decision considering the delivery punctuality rate and delivery on-site compliance rate. Research shows that improving the delivery punctuality rate and delivery-to-door compliance rate within a certain range is conducive to the improvement of the company's profits for X company's home appliance logistics.

Reference

[1] Huang W , Swaminathan J M . Introduction of a second channel: Implications for pricing and profits[J]. European Journal of Operational Research, 2009, 194(1):258-279.

[2] Xu H , Liu Z Z , Zhang S H . A strategic analysis of dual-channel supply chain design with price and delivery lead time considerations[J]. INTERNATIONAL JOURNAL OF PRODUCTION ECONOMICS.

[3] Wei He, Wei Liu, Aiping Cui. Coordination of three-level logistics service supply chain considering the impact of logistics service level[J]. Journal of Shanghai Maritime University, 2014, 35(1): 41-48.

[4] Ying Feng, Jiamei Gu. Coordination of Supply Chain of Fresh Agricultural Products Considering TPL Leading Priority[J]. Systems Engineering, 2016(11): 112-118.

[5] Wei He, Wei Liu, Aiping Cui. Coordination of three-level logistics service supply chain considering the impact of logistics service level[J]. Journal of Shanghai Maritime University, 2014, 35(1): 41-48.

[6] Yunlong Yu , Tiaojun Xiao . Pricing and cold-chain service level decisions in a fresh agri-products supply chain with logistics outsourcing[J]. Computers & Industrial Engineering, 2017,111: Pages 56-66.

[7] Ying Feng, Wei Wu, Yunlong Yu. A Game Model of Diversified Supply Chain of Fresh Agricultural Products under Two-factor Horizontal Competition[J]. Operations Research and Management, 2016, 25(5): 102-109.

[8] Jiang Lin. Coordination Mechanism of Logistics Service Level Affecting Competitive Product Demand[J]. Mathematics in Practice and Theory, 2016, 46(3): 19-30.

[9] Wang Li, Wang Yong, Jiang Lin. Research on Supply Chain Coordination under the Influence of 3 PL Participation in Logistics Service Level[J]. Science and Technology Management Research, 2013(22): 205-209.