Original Research Article

Research on value-added service system of cross-border e-commerce logistics enterprises based on optimization model

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Abstract: Cross-border e-commerce presents a rapid development trend, cross-border e-commerce also promotes the development of cross-border logistics, but the cross-border logistics in our country is lagging behind, can not meet consumer needs and adapt to the current cross-border e-commerce development model. In this paper, starting from solving the problem of "the uncertainty of reverse logistics return and exchange", we further study the optimization of the value-added service system of cross-border logistics enterprises, improve consumers' overall satisfaction with logistics enterprises, and solve the path optimization problem of recycling and transportation process, so as to provide reference for logistics enterprises' recycling and transportation platform, and improve the value-added service system of logistics enterprises at the same time, Realize the coordinated development of economic benefits and social benefits.

Keywords: Cross-border e-commerce; Logistics enterprises; Reverse logistics; Logistics information visualization

1. Research and development status at home and abroad

Domestic research on cross-border e-commerce logistics focuses on the perceived behavior of logistics work, logistics reform and deepening, and the exploration of the influencing factors of international e-commerce transaction mode. Li Chuanfeng (2018) studied the logistics reform and deepening of cross-border e-commerce, and constructed a logistics model based on cross-border e-commerce. This paper focuses on five aspects, such as infrastructure, policy innovation, information technology, service upgrading and financial services, to explore the depth of cross-border e-commerce logistics reform. Lin Yijing (2020) believes that the most common major problem of cross-border logistics is poor coordination of supply chains[1]. Cui Yuehui et al. (2017) believe that cross-border logistics in China is faced with problems such as long logistics cycle, being in the initial stage of development, lack of cross-border logistics professionals and high risks[2]. Zhang Xiaheng et al. believe that the barriers hindering China's cross-border logistics mainly include high logistics costs, long transportation time and difficulties in returning and changing goods[3]. Xu Fu (2015) et al. believe that China's cross-border e-commerce logistics is mainly affected by trade, language, culture, policy and many other risks[4]. Wu Minzhen (2017) believes that there is an overall incoordination between cross-border logistics and cross-border e-commerce at present, and it is necessary to optimize the Internet management system to improve the integration efficiency of the two. In addition, cross-border logistics has high operating costs, long cycle and information tracking problems[5].Du Zhiping et al. (2018)[6] conducted an in-depth study on the operation mechanism of cross-border logistics alliance, analyzed the shortcomings of current literature on this content, and believed that further in-depth research could be conducted in terms of effectively improving alliance management ability, building cross-border alliance platform, and improving alliance stability. Wang Hui (2016)[7] studied the integrated development status of cross-border e-commerce and cross-border logistics, and pointed out such problems as poor overall coordination between cross-border e-commerce and cross-border logistics, lack of establishment of mutual trust system, and asynchronous development. Ben Youhong (2017)[8]analyzed the problems existing in the optimization and development of cross-border logistics mode and the feasibility of the optimization and development of cross-border e-commerce logistics mode, and pointed out the development path of cross-border logistics mode. At present, the research on reverse logistics of e-commerce enterprises in our country is not profound. Zhao Kai has studied the structure and operation mode of reverse logistics. He believes that Although reverse logistics brings costs to the company, it also brings strategic value to the company[9].

2. Model construction of reverse logistics return and exchange

Model construction: This model refers to the B2C e-commerce reverse logistics network model under the 3PL mode and the C2C e-commerce third-party reverse logistics network model for return and exchange, builds the logistics network model for reverse logistics of return and exchange, establishes the recycling point, recycling center and final processing plant, and assigns the recycling center with the functions of commodity identification, restoring the original appearance of goods, sorting, packaging, and re-delivery. The logistics network is equipped with a multi-object information interaction and sharing platform, and the receivers are determined to be merchants, new consumers, manufacturers and final processing plants, and other costs of recycling points, recycling centers and final processing plants are introduced to finally determine the cost model of the reverse logistics network for return and exchange of goods. Its equation is expressed as.

Objective function:

$$\begin{aligned} \min Z = & \sum_{k\in K}\sum_{j\in J} \times C_{kj}X_{kj} + \sum_{i\in I}\sum_{j\in J} \times C_{ji}X_{ji} + \sum_{j\in J} \times F_jY_j \\ & + \sum_{i\in I} \times F_iY_i + \sum_{h\in H} \times F_hY_h + \sum_{i\in I}\sum_{e\in E} \times C_{ie}X_{ie} \\ & + \sum_{i\in I}\sum_{f\in F} \times C_{if}X_{if} + \sum_{i\in I}\sum_{g\in G} \times C_{ig}X_{ig} \\ & + \sum_{i\in I}\sum_{h\in H} \times C_{ih}X_{ih} + \sum_{i\in I} \times Y_iW_i + \sum_{j\in J} \times Y_jW_j \\ & + \sum_{h\in H} \times Y_hW_h \end{aligned} \tag{1}$$

Constraints:

$$\sum_{j\in J} X_{kj} = R_k \quad \forall k \in K \tag{2}$$

$$\sum_{i\in I} X_{ie} = Q_e, \sum_{i\in I} X_{if} = Q_f, \quad \sum_{i\in I} X_{ig} = Q_g, \sum_{i\in I} X_{ih} = Q_h \tag{3}$$

$$\forall e \in E \quad \forall f \in F \quad \forall g \in G \quad \forall h \in H \tag{4}$$

In this model, Equation (1) is the objective function, which mainly includes the transportation cost from the original consumer area to the recycling point and the transportation cost from the recycling point to the recycling center. The cost of establishing the recycling point, the cost of the recycling center, the cost of the final treatment plant, the cost of transportation from the recycling center to the merchant, the cost of transportation from the recycling center to the new consumer area, the cost of transportation from the recycling center to the manufacturer, and the cost of transportation from the recycling center to the final treatment plant Transportation costs, other costs at the recovery point, other costs at the recovery center, and other costs at the final treatment plant were designed to minimize the total cost of the objective function.

Among the constraints, Equation (2) indicates that the quantity of goods received by the recycling point is equal to the quantity of goods sent from the original consumer area. Equation (3) shows that the total amount of transportation from the recycling center to C merchants, new consumers, manufacturers and final processing plants is equal to the amount of their respective goods received; Equation (4) is to ensure the delivery volume.

3. Examples and results analysis

3.1. Instance related data

Simulated data: variables and associated parameter assignments. In the model, it is assumed that the original consumer area is 8, the number of merchants is 8, the new consumer area is 8, the number of manufacturers is 5, and there are 8 recycling points, 3 recycling centers and 2 final treatment plants to choose from. The variables and related parameters were assigned by simulation: the number of returned goods in the original consumer area was assigned between 300 and 800; The other costs of the recovery point, recovery center and final treatment plant are 1600, 2900 and 1300, respectively, and the maximum treatment capacity is 1000, 3900 and 600, respectively. The cost assignment for establishing alternative recovery points ranged from 19000 to 31000. The cost assignment for the establishment of alternative recycling centers ranged from 180000 to 200000. The cost of setting up the alternative final treatment plant was 80000 and 86000 respectively. The unit transportation cost assignment range from the original consumer area to the alternative collection point is between 2-6. The unit transportation cost assignment from alternative recycling point to alternative recycling center ranged from 2 to 5. The unit transportation cost assignment of alternative recycling centers to merchants ranged from 3 to 6. The unit transportation cost assignment range from alternative recycling center to new consumer area is between 3-6. The unit transportation cost assignment of alternative recycling centers to manufacturers ranged from 4 to 6. The unit transportation cost assignment range from alternative recycling center to alternative final treatment plant is between 4 and 6. The number of goods received by C2C merchants ranged from 64 to 145. The commodity demand quantity assignment of the demand point in the new consumer area ranges from 16 to 82; The quantity of goods received by the manufacturer ranged from 17 to 83. The number of goods received by the alternative final processing plant is assigned between 17 and 50.

3.2. Analysis of optimization results

By substituting the numerical value into the objective function and constraints of the model, LINGO software was used to solve the problem, and the calculation results were obtained: the optimal solution of the total cost was 622378 yuan. According to the optimal value of the layout decision variables, it was known that the recycling points should be established at alternative sites 2, 3, 4, 5 and 6 of the recycling point, and the recycling center should be established at alternative sites 2 and 3 of the recycling center. The final treatment plant is established at the alternative site 1 of the final treatment plant, and the transportation volume is obtained as shown in Tables 1-6.

Combined with Tables 1-6, we can know the direction and quantity of commodity circulation from the original consumer area to the recycling point, the recycling point to the recycling center, the recycling center to the business, the recycling center to the new consumer, the recycling center to the manufacturer and the recycling center to the final treatment plant.

Cost comparison: The total cost of the existing reverse logistics is calculated in the newly constructed reverse logistics network. If the recycling point and recycling center are regarded as logistics transfer stations during the process of goods being transported from the original consumer to the merchant, the freight from the original consumer to the merchant can be regarded as equal to the freight of the existing reverse logistics.

Both logistics modes involve commodity identification, restoration of the original appearance of goods, sorting, packaging, re-delivery and other operations, waste goods also cost corresponding processing costs, so from the point of view of other costs, the two costs are equal. Therefore, the cost difference mainly exists in the recycling center and the merchant to send the goods to the new consumer, the manufacturer or the final disposal plant.

According to the above data, the total shipment volume is 4340 pieces, and the proportion of goods shipped to new consumers, manufacturers and final processing plants is 45%, and the corresponding number of goods is 1953 pieces. Because merchants enjoy different degrees of preferential treatment in express companies, and the weight of goods is different, and there may be some factors such as continued weight, therefore, Referring to the charge standard of major domestic express companies, even in extreme cases, assuming that the freight of each commodity has been as low as 5 yuan, the transportation cost of new consumers, manufacturers and final processing plants will be at least 4340*45%*5=9765 yuan. Lingo software was used to calculate the freight of goods from the original consumer area to the transit station (recycling center), plus other costs, totaling 33,780 Yuan; The freight from the transit station (recycling center) to the merchant is 8977 yuan. Since the proportion of merchants here is 55%, it needs to be converted back to 100% in the existing reverse logistics, and the required freight is 16321.82 yuan. Summing the above costs, the total cost of the existing reverse logistics should be at least 59866.82 yuan.

In the newly constructed reverse logistics network, excluding the construction costs of the recovery point, recovery center and final treatment plant in Equation (1), Lingo software is used to calculate the total cost of 52,517 yuan.

By comparing the total logistics cost of the two, it can be seen that even in the extreme situation where the average freight of each commodity has been as low as 5 yuan, the total cost difference between the two is still 59866.82-52517=7349.82 yuan. It can be seen that the newly built e-commerce third-party reverse logistics network can save at least 7349.82 yuan in logistics costs, and the proportion of cost reduction can reach at least 12.28%.

Table 1. Traffic volume from the original consumer area to the recycling point.

(1,2)	(2,6)	(3,5)	(3,6)	(4,3)	(5,5)	(6,2)	(6,4)	(7,6)	(8,4)	(8,5)
430	300	116	204	620	500	427	243	496	453	247

Table 2. Transportation volume from recycling point to recycling center.

(2,3)	(2,6)	(3,5)	(3,6)	(4,3)
857	620	1000	863	1000

Table 3. Traffic volume from recycling centers to C2C merchants.

(2,2)	(2,4)	(2,7)	(3,1)	(3,3)	(3,5)	(3,6)	(3,7)	(3,8)
294	309	90	321	256	304	288	231	294

Table 4. Traffic volume from recycling centers to new consumer areas.

(2,2)	(2,4)	(2,6)	(2,7)	(3,1)	(3,3)	(3,5)	(3,8)
120	174	84	123	176	141	103	164

Table 5. Transportation volume from recycling center to manufacturer

(2,2)	(2,3)	(2,5)	(3,1)	(3,4)
120	101	124	129	177

4. Conclusion

In the empirical analysis, we simulate the flow of goods between multiple consumer regions, recycling points, recycling centers, and final processing plants, taking into account transportation costs, facility establishment costs, and other costs in the processing of goods. Through the solution of LINGO software, the optimal solution of the total cost is obtained, and the transportation volume and cost structure of each link are analyzed in detail. The results show that the newly constructed reverse logistics network has obvious advantages in reducing the total cost compared with the existing model, and the cost reduction ratio reaches 12.28%.

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References

[1] Lin Yijing. Research on international logistics mode under the environment of cross-border e-commerce [J]. Business Exhibition Economy, 2022, (20): 100-102.

[2] Cui Yuehui, Yang Keyan. Logistics dilemma and Countermeasures in the development of cross-border e-commerce in China [J]. Modern Communication, 2017,40 (7): 76-77.

[3] Zhang Xiaheng, Ma Tianshan. China's cross-border e-commerce logistics dilemma and countermeasures [J]. Contemporary Economic Management, 2015, 37 (05): 51-54.

[4] XU Fu. Difficulties and Countermeasures of cross-border e-commerce Logistics in China [J]. Technology and Enterprise, 2015, 32(12): 1-2.

[5] Wu Minzhen. Deep integration of cross-border e-commerce and cross-border logistics in China. Journal of Shandong University of Agricultural Engineering, 2017, 34 (08): 122-123.

[6] Du Zhiping, Gong Xianglin. Research status of operation mechanism of cross-border logistics alliance at home and abroad [J]. China Circulation Economy, 2018, 32 (02): 37-49.

[7] WANG Hui. Dilemma and Countermeasures of cross-border e-commerce and logistics integration [J]. Business Economics Research, 2016, (01): 69-71.

[8] Peng Youhong. Research on logistics mode and development path of cross-border e-commerce in our country under the new normal [J]. Research of Business Economics, 2017, (01): 75-77.

[9] Zhao Kai. Reverse Logistics Cost, Strategic Value Analysis and System Construction of Chain Retail Enterprises [J]. Business Research, 2007, (03): 41-44.