The Optimization and Cost Analysis of E-commerce Logistics Network based on EPC

Liu Chang
Lanzhou University of Arts and Science Lanzhou, Gansu, 730010, China

Abstract
The purpose of the paper is to research on optimization and cost analysis of E-commerce logistic network based on EPC under the One Belt and Road Initiative background. The research mainly focuses on the follow problems: B2C enterprise self-built logistics system network topology structure, the regional logistics distribution central locations, logistics node agglomeration, B2C enterprise supply chain integration of logistics and customer service etc. The paper designs e-commerce logistics network topology, and constructs two stage model of B2C e-commerce logistics network optimization, the first phase of the model is commonly used in economics based on gravity model, the distance function between node and node is to distinguish the regional ensemble scheme, which is determined by the B2C electricity supplier logistics network construction cost and the maintenance of various factors construction, to determine the position of connection scheme of B2C regional electricity supplier logistics center. The result of the experiment which took a B2C e-commerce company as an example shows that the model is effective.

Keywords: Network optimization, Electronic commerce, Logistics cost, EPC, One Belt and Road

1. Introduction
B2C e-commerce enterprises in the logistics network optimization based national and regional logistics network optimization research, carried out specific research work from the following two aspects: one is according to the two study content, the design of specific B2C e-commerce logistics network topology, internal network topology consists of three layers of logistics nodes in the supply center regional logistics distribution center and city distribution center; secondly, based on the comprehensive consideration of the design of logistics network topology based elements existing in the logistics system (Li, 2014), the two stage optimization model of B2C e-commerce logistics network, determine the node of the first stage model of regional agglomeration scheme according to the distance factor of online shopping orders, logistics nodes and function based on the relationship between the second stage model of electricity supplier logistics network of B2C, the establishment of project logistics network B2C enterprise cost The factors determine the type of the enterprise; third, the improved genetic algorithm is used to solve the model, and the simulated annealing algorithm and the genetic algorithm adaptive control strategy algorithm are used to group regeneration and convergence (Ai, 2016; Falahatip, 2015).

Logistics distribution center location, as an important place of work, plays a vital role in the development of logistics industry. Due to the logistics distribution center, transportation tools, goods transport tools, logistics distribution systems, customers and other components in the correct position of the distribution center, improve the level of logistics services, reduce logistics costs, optimize the entire logistics system plays an important role. With the rapid development of China's logistics industry in recent years, more and more enterprises pay close attention to the joint logistics distribution center. Logistics distribution center location is a multi-functional circulation hub with paper products storage, cargo handling, distribution processing, equipment, transportation as the main function. It can improve the level and efficiency of logistics operation and reduce the cost of colleague. Therefore, the reasonable and reasonable location of logistics distribution center is the inevitable result of fierce competition in the market economy (Wang, 2015; Chen, 2015).

To sum up, in order to adapt to the rapid development of e-commerce, the establishment of logistics distribution system level of e-commerce has become a top priority. To solve the problem of logistics distribution center location of distribution center, the effective operation will contribute greatly to the whole logistics system, the corresponding growth rate and improve economic efficiency, but also prompted me to optimize the operation mode and the structure adjustment of national economy to promote the development of e-commerce industry has an important role.

In fact, in the past few years, the research on the location problem under e-commerce has important theoretical and practical significance. Most researchers in this field focus on qualitative analysis rather than quantitative analysis, which takes the lowest logistics cost as the target, but has little effect on the time efficiency. To solve this problem, with the rapid development of e-commerce, it has brought new demand for logistics distribution; especially the needs of customers more satisfied with the service time, the expansion and in-depth study of the problem of warehouse location, increasing the time cost, taking into account the many suppliers, customers, business and logistics (Chen, 2017; Chang, 2015).
In this research, the positioning of warehouses and DC is of interest. In fact, in the past few years, the growth of the scale of production and the reduction of transportation costs has attracted the attention of DC. DC is considered to be the ability to connect an enterprise to a customer and a supplier. In order to reduce transportation costs, improve operational efficiency and logistics performance, evaluation and selection of the appropriate warehouse and distribution center is one of the most important decision-making issues in the distribution industry.

2. Epc model and algorithm

Supply chain management (SCM) includes materials / supply management from basic raw material supply to final product. SCM focuses on how companies leverage suppliers’ processes, technologies and capabilities to improve their competitive edge. This is a management concept, by bringing trade partners together to achieve the common goal of optimization and efficiency of 3, thereby expanding the traditional dividend enterprise activities. Supplier selection and performance evaluation have been one of the most important issues in SCM system. In the past few decades, the knowledge discovery and data (KDD) of human effort to achieve great potential can be considered as the basis of multidisciplinary and emerging research fields of data mining (DM). The value of raw data usually depends on the ability to extract higher level information (Chen, 2017; Liu, 2016).

Information is useful for decision support, exploration, and better understanding of phenomena that produce data. DM uncertain associations are used for unknown patterns. It summarizes data from artificial intelligence, machine learning, neural networks, bioinformatics, image segmentation, character recognition, operations research (OR), market research, and supply chain management (SCM). It is of great significance to study the decision process optimization of SCM system. We deal with the cluster framework proposition of the SCM system to obtain an objective function for each cluster in the general SCM. The Forrester effect, also known as the "bullwhip effect", represents the consequences of inconsistent decisions in business processes. The resulting order volatility has a variety of consequences for the supply chain (SC).

The event driven process chain (EPC) method is used to model the process optimization. EPC is a concept based on stochastic network and Petri net (directed graph based workflow modeling), which can provide some model display tasks and responsibility chain disruption, and impair the ability of the company to optimize the process. We use EPC to simulate the business process of enterprise SCM, and experience the formal semantic behavior of EPC.

Thus, the basic vector equation that related to the input and output complex envelopes will be written as (Delgado, 2015; Eijck, 2008):

\[ X^{(1)}(k) = \sum_{i=1}^{k} x^{(0)}(i) \]  

(1)

Variable \( x^{(0)} \) has the original data series \( x^{(0)} = [x^{(0)}(1), x^{(0)}(2), ..., x^{(0)}(n)] \), with a 1-AGO order to generate an accumulated generating sequence \( x^{(1)} = [x^{(1)}(1), x^{(1)}(2), ..., x^{(1)}(n)] \).

It means that charm quality attributes over time will gradually become the desired quality, and finally becoming a basic quality.

\[ \frac{dx^{(1)}}{dt} + \alpha x^{(1)} = \mu \]  

(2)

In the equation, \( \alpha \) and \( \mu \) are parameters. \( \mu \) is the control. Solution of the differential equation as follows:

\[ x^{(1)}(k + 1) = x^{(0)}(1) - \frac{\mu}{\alpha} e^{-\alpha} + \frac{\mu}{\alpha} \]  

(3)

Among them, \( \frac{\mu}{\alpha} \) and \( \mu \) is the approximate solution of equation (2), according to the least squares method to obtain:

\[ \begin{bmatrix} \frac{\mu}{\alpha} \\ \mu \end{bmatrix} = (B^T B)^{-1} B^T Y \]  

(4)

\[ Y_s = \begin{bmatrix} x^{(0)}(1) \\ x^{(0)}(2) \\ \vdots \\ x^{(0)}(n) \end{bmatrix} \]  

(5)
Equation (5) is called GM (1, 1) model of response time function model, it is a specific equation for calculating GM (1, 1) model of gray prediction, this type do regressive reduction, and gray had predicted the number of columns in the original model:

$$x^{(0)}(k+1) = x^{(1)}(k) - x^{(1)}(k)$$  (6)

PSO particle optimization algorithm basic equation is as follows:

$$v_i^{n+1} = wv_i^n + c_1 x_i^n (P_i^n - x_i^n) + c_2 x_i^n (G^n - x_i^n)$$  (7)

$$x_i^{n+1} = x_i^n + v_i^n$$  (8)

so as to minimize the mean square error indicators:

$$E(X) = \frac{1}{2N} \sum_{p=1}^{N} \sum_{k=0}^{t_{k,p}} (Y_{k,p}(X) - t_{k,p})^2$$  (9)

Under the linear relationship, basic equation is shown in equation (2):

$$\partial_j (e_{ijkl} C_i^j t_i - \eta_{ik} C_i^j \phi) = 0$$  (10)

The linear differential equation can be expressed into the following simplified forms:

$$L(\nabla, \omega) f(x, \omega) = 0.$$  (11)

In which,

$$T(\nabla) = \begin{bmatrix} T_k(\nabla) & \tau(\nabla) \\ T_k'(\nabla) & -\omega(\nabla) \end{bmatrix}, \quad J = \begin{bmatrix} \delta_{ik} & 0 \\ 0 & 0 \end{bmatrix},$$

$$f(x, \omega) = \begin{bmatrix} \mu_k(x, \omega) \\ \phi(x, \omega) \end{bmatrix}$$  (12)

Consider an infinite situation, we have the equation (5) in the following:

$$L^0 = \begin{bmatrix} C^0_{ijkl} & e^0_{ijkl} \\ e^0_{ijkl} & -\delta_{ik} \end{bmatrix}$$  (13)

Consider the propagation, instead the equation (13) with the following form:

$$C(x) = C^0 + C^1(x), \quad e(x) = e^0 + e^1(x), \quad \eta(x) = \eta^0 + \eta^1(x), \quad \rho(x) = \rho_0 + \rho_1(x)$$  (14)

Then we have equation (15) to (18):

$$C^1 = C - C^0, \quad e^1 = e - e^0,$$

$$\eta^1 = \eta - \eta^0, \quad \rho_1 = \rho - \rho_0$$  (15)

The containing inclusions can be simplified into the following integral equation set:

$$f(x, \omega) = f^0(x, \omega) + \int_V S(x-x')(L^0F(y') + \rho_0 + \rho_2 \phi(R)T_{y'}f(y')) |S(y')dy'$$  (16)

The performance of business processes needs to be measured, such as continuous control, management and improvement of suppliers in the SCM system. Current measurement methods lack adequate metrics, which leads to another aspect of extended EPC to integrate information about the key performance indicators (KPI) provided by the SCM system. Research on data mining focuses on developing new algorithms, improving existing algorithms (using memory and processor improvements), and extending the application of existing algorithms to new applications. One of the business strategies of supplier in reducing logistics cost and improving business performance is classification problem. Benchmarking the suppliers within the same group is more effective for the supplier development process, the cluster features and objective functions can become the source of understanding the performance of suppliers in the same feature class. Therefore, it is necessary to extend a suitable method to cluster suppliers.

The revised supply chain network consists of several existing multi-product plants at fixed places, some candidate warehouses and DC at specific but undetermined locations, and a number of known customer zones, as showed in figure 1 each customer zone places demands for one or more products in this mid-term supply chain-planning problem. To improve the logistic distribution center under electronic for GDPE, some factors of general logistics distribution center location should be pay more attention in the process of selecting the location of logistics distribution and Long term electronic trading rules from stock. Figure 2 shows the scheduling result by using the fuzzy method of the average operator (PP).
Transaction mode exchange has the following features:

1. Electronic trading system focuses on the majority of buyers and sellers in the whole country or region, forming a unified big market, reducing intermediate links, broadening business channels, and ultimately reducing transaction costs, transaction gains and efficiency.

2. Avoid the risk of price fluctuation: the buyer can control the cost of raw materials and avoid the impact of the fluctuation of raw material prices on the production activities of enterprises. The seller can determine the product sales price in advance and lock the product production profit.

3. Strong financial supports. In order to solve the short term liquidity difficulties of plastic trading, the exchange introduced the settlement bank financing Guarantee Corporation, specializing in providing warehouse receipts pledged delivery, providing plastic providers and other services.

4. Credit guarantee. All electronic trading models can not only reduce the transaction costs of enterprises, but also provide the delivery of credit guarantees, avoiding debt disputes.

In reality, in addition to the cost and time, there are many other factors to consider, such as inventory costs, vehicle routing problems (VRP), public satisfaction, social benefits, the distribution center coverage and so on. Therefore, the next step is to concentrate on the establishment of multi-level logistics warehousing allocation mechanism under vehicle routing problem, and describe the selection model in detail.
3. Research and design of B2C e-commerce logistics network optimization

B2C e-commerce Regional Logistics Network is a very complex system, in order to promote the smooth progress of the study in this paper, the simplified system: 1 B2C sites in the market, each part of the three factors of online ordering based on sharing, online shopping orders and market share growth trend and industry development trend, the measure of business data in the past three year and industry data; 2. the industrial cluster effect of supplier constraints, positioning and supply center is relatively fixed, the supply center is restricted from suppliers around the sources of supply, supply center can only supply a variety of goods to the regional logistics distribution center, distribution center in the area of other goods supplier before direct supply, supply center general supply sales website the goods; 3. according to the city online shopping order size, set the appropriate logistics service standard, online shopping The greater the order quantity, the higher the level of urban logistics service, the stronger the efficiency of logistics distribution; 4. according to different orders for different types of online ordering goods classification. Orders have different storage costs and transportation costs. B2C e-commerce logistics network diagram is shown in Figure 3, B2C e-commerce supply center to determine the B2C e-commerce critical area logistics network planning RDC (regional distribution center location) relative position. Some suppliers send their goods to the B2C supply center, supply centers and commodities, so that the regional logistics distribution center can be concentrated into the B2C trunk transportation mode, and other goods suppliers will be transported to the B2C regional logistics distribution center directly.

Figure 3. B2C electricity supplier logistics network diagram

After the storage, sorting and packaging process of these goods, the regional distribution center is unified for each city distribution center to order the city distribution online, and complete the whole process of online shopping order sales. In the proposed topology, there are three main functions: 1. centralized storage and storage of commodity sales sites; centralized transportation route 2. warehousing of goods; 3. responsible for the supply and delivery of goods sales area website. The supply center is located by qualitative analysis, mainly has the following criteria: 1. the supply of goods supply center must be a website sales top 20% commodities; 2. the supply of commodity supply center must have industrial clusters, because the supply center position in the cluster position in industrial cluster 3 one must be able to meet the requirements of production capacity; regional sales order; 4. the supply center must be able to provide two different categories of goods. The stage of data processing: analysis of 1 business data and the information industry in various regions of the country, the top three are selected to satisfy the conditions of the logistics supply instead of 2 B2C points; determine the position of the center can provide a category more goods, if the alternative Festival established B2C supply center. RDC (regional distribution center) indicates that the B2C e-commerce Regional Logistics Distribution Center is the core link of B2C e-commerce logistics network. In the proposed topology, mainly has the following five functions: 1. centralized storage site of all kinds of goods; 2. all regional online shopping order information polymerization for centralized processing and storage; 3. according to the order information online shopping goods sorting and packaging; 4. to plug all the city distribution center's transportation order; 5. provide various related value-added services, such as the return. City-circle Distribution Center (China Center for Disease Control and prevention) called B2C e-commerce distribution center city, logistics nodes in the selection process has chosen the regional logistics center RDC logistics nodes, they serve as auxiliary degradation RDC regional
distribution. These nodes are at the bottom of the regional logistics network structure proposed in this paper. At the same time, the distribution of B2C into the CDC e-commerce city itself does not have the function of commodity storage or classification, but plays an indispensable role in the cohesion of the network. In the proposed topology, the main function of the logistics node layer has the following three items: 1, obtain orders from the RDC online shopping online shopping; make temporary custody of 2; 3, to B2C city logistics transport order, complete the online shopping website, online shopping last mile transport. According to the above logistics operation mode display, B2C e-commerce logistics network optimization program

4. Experiment result

The B2C e-commerce supply center is established around the supplier factory and adopts the traditional commodity warehousing logistics operation mode, that is, all suppliers will deliver the goods directly to the B2C supply center according to the orders of the B2C enterprises. The main advantage of this storage mode is to have the following items: centralized storage to play the scale effect, commodity direct B2C electricity supplier independent logistics after the completion of the production network, to ensure that the B2C site sales of goods supply, low cost operation and maintenance system. B2C electronic commerce and supply center transport goods distribution centers in different regions by means of transportation, which not only solves the problem of scattered transportation of existing goods, but also ensures the timeliness of goods transportation. The B2C e-commerce supply center model designed in this paper can effectively help B2C e-commerce enterprises achieve the goal of supplier integration. Figure 4 shows the schematic diagram of operation mode of B2C e-commerce supply center.

![Figure 4. Schematic diagram of operation mode of B2C e-commerce supply center](image)

From the above assumptions, the limited number of supply center and the location of the situation referred to as input, and only a relatively large number of commodity supply places, on the other hand, a high yield of the product can only be made by each regional distribution center a supply center for distribution, we can put the number of multivariate relationships between the center and the regional distribution is divided into one to many relationship is as follows: in each commodity supply center supply quantity of each conversion, the number of each commodity supply, each commodity has one or more sources, each source only belongs to a supply center, the connection between the regional distribution center and supply connection.

In the complex logistics network to obtain the optimal path is a complex dynamic problem, more difficult, so the enterprise made some simplifications: first of all, the connection to the existing node of logistics network, determine the optimal path node and the distance between them according to the historical data; secondly, there is no other existing network nodes connection, to determine the optimal path between two nodes and the distance using distance and path information of the third party logistics company. Thus, the distance matrix \( [12] \) between any RDC nodes can be obtained.

The area of the RDC storage area is a fixed value due to the fixed value of the aggregated area in the area of the order number of the online shopping order. E-commerce online shopping orders of the logistics service level is the core problem of e-commerce industry, proposed topology logistics service level is mainly reflected in the logistics and transport links in the RDC online shopping orders to CDC, can be interpreted as a CDC online shopping delivery order response time requirements RDC. Since the model is based on static data, it is
necessary to convert the dynamic response time to the static RDC service radius and convert it into the maximum departure distance within a certain time limit of RDC. CDC search area all logistics nodes within the region to downgrade, judge whether the RDC service in the CDC radius, if a node is not in the RDC service radius, then the cost penalty for CDC nodes will eventually total penalty cost to the total cost of service in service. The penalty cost schematic diagram is shown in figure 5.

![Figure 5. Schematic diagram of service penalty cost](image)

5. Conclusion

In this paper, B2C e-commerce enterprise as the research object, in the basis of optimizing national logistics network and regional logistics network optimization research, specific research work mainly includes the following three aspects: one is according to the two study content, we design a specific B2C e-commerce logistics network topology, including internal network topology the three layer function of logistics nodes in the supply center, regional logistics distribution center and city distribution center; secondly, based on the comprehensive consideration of the design of logistics network topology based elements existing in the logistics system, the two stage optimization model of B2C e-commerce logistics network, determine the node of the first stage model of regional agglomeration scheme according to the distance factor of online shopping order, logistics node function and based on the relationship between the second stage model of electricity supplier logistics network B2C, The establishment of logistics network B2C enterprise project cost factors determine the type of the enterprise; third, the use of improved genetic algorithm to solve the model, using simulated annealing algorithm and genetic algorithm adaptive control strategy for group regeneration and convergence. Finally, a set of B2C e-commerce logistics network optimization decision-making system is implemented, and a B2C e-commerce company is taken as an example to verify.

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