ISSN 2579-7069

Construction of Enterprise Logistics Decision Model Based on Supply Chain Management

Korrakot Yaibuathet Tippayawong[1,*]

[1] *Center of Excellence in Logistics and Supply Chain Management, Chiang Mai University, Chiang Mai, Thailand*

(Received: September 14, 2023; Revised: October 12, 2023; Accepted: November 18, 2023; Available online: December 10, 2023)

Abstract

In the logistics decision-making of supply chain management, both professional logistics enterprises and enterprises that need to use the logistics system are pursuing efficient, low-cost, convenient and fast business model and effective management methods. Firstly, the paper analyzes the development background, importance, feasibility and necessity of supply chain management, and formulates the classification summary from customer relationship management, supplier relationship management and internal manufacturing process of supply chain. This paper analyzes the importance of supply chain management. Combined with the future development trend, the importance and urgency of theory and application are analyzed. Then it introduces the important relationship of logistics decision-making in supply chain management and its development status. In the study of logistics distribution optimization decision-making mechanism based on supply chain management, this paper establishes the optimization decision-making model, formulates the decision- making principles, analyzes and evaluates the decision-making conditions, and determines the logistics decision-making objectives.

Keywords: Logistics Decision-making, Supply Chain Management, Optimization Decision-making Model, Logistics Distribution, Principles in Supply Chain

1. Introduction

The concept of supply chain (SC) was put forward in the 1980s. In recent years, with the development of global manufacturing industry, the new mode of supply chain management has been widely used in various industries, and there is no unified definition [1]. Generally, supply chain is based on value chain theory. In every link of the supply chain, information communication, data exchange and work collaboration can achieve more efficient enterprise, the whole production, distribution, sales and service related activities, provide the operating system to shorten the cycle, reduce customer response time, reduce inventory, and improve enterprise profitability [2]. With the introduction of the concept of global supply chain management, people realize that there is considerable system engineering in the whole supply chain, from product design, raw material or component procurement, production planning and process organization within the factory, to marketing, product distribution and delivery to the end users, it involves the whole management framework of centralized procurement, centralized marketing control, centralized inventory management and distribution, as well as a series of cross regional laws, regulations, standardization and other issues [3].Other paragraphs are indented.

In the past 20 years, with the development of technology, especially the information technology represented by network, it has been widely used in production, circulation, consumption and other fields [4]. With the global economic integration and the formation of the concept of world factory, the importance of modern logistics is very prominent. Effective logistics management, reduction of material consumption and improvement of labor efficiency are known as another way for logistics enterprises to improve their income in addition to productivity [5]. The organization degree and level of modern logistics comprehensively reflect the comprehensive ability and social service level of a country or region, and become one of the important indicators to evaluate the economic advantages of a country or region [6]. Modern logistics includes transportation, storage, packaging, loading and unloading, recycling, circulation and modern information technology. The content of modern logistics management is extensive and profound. A correct

***Corresponding author: Korrakot Yaibuathet Tippayawong (yaibuathet@chiangmai.edu.ph)**
DOI: https://doi.org/10.47738/ijiis.v6i4.179

understanding of the functions, structures and organizational plans of various logistics subsystems is the fundamental guarantee for the optimization of the logistics system and the overall optimization of the supply network [7].

Distribution is the combination of "distribution" and "delivery" with transportation as the carrier. As far as "distribution" is concerned, it realizes the scientific allocation of goods through optimized decision-making. As far as "delivery" is concerned, it realizes the location transfer of goods through transportation. Therefore, "distribution" is the optimized integration of transportation service function and modern logistics demand, and is the extension of transportation system in function. In addition, "distribution" is supplemented by a variety of other value-added services, such as picking, sorting, packaging, segmentation, circulation processing, assembly, loading and so on [8]. The more successful logistics models in China are Jingdong and Shunfeng. They have a common feature, that is, the warehouse and distribution center into one [9]. Therefore, in the logistics decision-making based on supply chain management, the selection of distribution center is the core of decision-making model. For a logistics distribution enterprise, due to the large investment in the construction of the distribution center itself, the cost of demolition and relocation after completion is very high. Therefore, once the address is determined, a relatively stable distribution route of the logistics enterprise will be formed in a certain period of time, which will determine the distribution cost of the whole enterprise and affect the enterprise benefit [10].

2. Literature Review

2.1. Evolution of Supply Chain Management

The concept of the supply chain emerged in the 1980s as a response to the evolving landscape of the global manufacturing industry [11]. Over the years, supply chain management has become a pervasive practice in various industries, yet a universally accepted definition remains elusive. Rooted in value chain theory, the supply chain emphasizes the efficiency gained through information communication, data exchange, and collaborative efforts across every link of the chain [12]. This interconnected approach extends from production and distribution to sales and service activities, fostering a system that shortens cycles, reduces response times, minimizes inventory, and enhances overall enterprise profitability.

2.2. Global Supply Chain Management and System Engineering

The introduction of global supply chain management has unveiled the intricacies of system engineering within the entire supply chain. This encompasses the comprehensive management framework, involving centralized procurement, marketing control, inventory management, and distribution [13]. The realization of these complexities underscores the need for a holistic understanding of cross-regional laws, regulations, and standardization to address challenges in product design, procurement, production planning, and marketing.

2.3. Technology and the Information Age

The past two decades have witnessed a technological revolution, especially with the widespread adoption of information technology networks in production, circulation, and consumption [14]. As economies integrate globally and the notion of a world factory takes shape, the role of modern logistics becomes increasingly prominent. Modern logistics, encompassing transportation, storage, packaging, loading and unloading, recycling, circulation, and information technology, not only optimizes the logistics system but also serves as a key indicator of a country or region's economic advantages [15][16].

2.4. Logistics and Distribution: A Symbiotic Relationship

Distribution, as the amalgamation of "distribution" and "delivery," relies on transportation as its carrier. It achieves scientific goods allocation through optimized decision-making and location transfer through transportation [17][18]. Successful logistics models, exemplified by industry leaders like Jingdong and Shunfeng, highlight the integration of warehouse and distribution centers, emphasizing the pivotal role of distribution center selection in logistics decision-making [19][20].

3. Algorithm establishment

3.1. BP algorithm specific algorithm

Suppose that there are m neurons in the input layer, n neurons in the output layer and l neurons in the hidden layer of the three-layer BP neural network. The optimal number of hidden layer nodes l can be calculated according to formula (1)

$$L = \sqrt{m+n} + c \tag{1}$$

Multi objective approximation method of evaluation index. In this paper, we consider the decision problem of N indexes and M alternatives, that is, there are m known points in the n-dimensional objective space. In order to measure the advantages and disadvantages of the M points, we first define the ideal point f *, and then select the point closest to the ideal point from the m points as the optimal solution.

For output layer neurons, the input and output are the same. The operation characteristics of hidden layer node and output node are as follows,

$$net_{jk} = \sum_i w_{ji} O_{ik} \tag{2}$$

$$O_{jk} = f(net_{jk}) \tag{3}$$

Where k is the current input sample, w_{ji} is the connection weight from neuron I to neuron J, O_{ik} is the current input of neuron O_{jk} is its output. f is a non-linear differentiable non decreasing function, which is generally sigmoid type function

$$f(x) = \frac{1}{1+e^{-x}} \tag{4}$$

Let the network output error be:

$$E_k = \frac{1}{2}\sum_j \left(y_{jk} - 0_{jk}\right)^2 \tag{5}$$

Here's yjk and Ojk is the expected output and the actual output of neuron J respectively. Suppose $E_k = \sum E_k$ is the sum of the output errors of all samples in the whole training set. The weight debugging formula is as follows:

$$\Delta_k W_{ji} = \eta \delta_{jk} O_{ik}, \eta > 0 \tag{6}$$

Where, $\Delta_k w_{ji}$ is wjiThe adjustment value of Ji, η is the learning rate, or step size. If J is the output neuron of the network,

$$\delta_{jk} = \left(y_{jk} - O_{jk}\right) f'(net_{jk})$$

3.2. Multi index decision evaluation

In a standardized decision problem with n indices, the distance between any scheme AI and the ideal point(1,1,…,1)1 × n distance is

$$S_i = \sum_{j=1}^{n} W_j \,.\, (r_{ij} - 1)^2 \tag{8}$$

In the formula, the weight square of the j-th index.

For K and 1, if:

$$S_1\{S_1 = \sum_{j=1}^{n} W_j \,.\, (r_{1j} - 1)^2\} \geq S_k\{S_k = \sum_{j=1}^{n} W_j \,.\, (r_{kj} - 1)^2\} \tag{9}$$

The set Ω of alternative ordered pair (k, 1) is Ω = {K, 1} and alternative K is better than 1}, if s_ 1≥S_ k. Then the order of the approximation method is consistent with the ordered pair (k, 1), that is, the degree of consistency is zero. Otherwise, the order of the approximation method is inconsistent with the ordered pair (k, 1), and the degree of inconsistency depends on $S_k – S_1$. The order pair (k, 1) inconsistency is as follows:

$$(S_1 - S_k) = \begin{cases} 0 \; when \; S_1 \geq S_k \\ S_k - S_1 \;\; when \; S_i > S_k \end{cases} \tag{10}$$

Then $(S_1–S_k)$=max[0, $S_k–S_1$]. the sum of all the ordered pair inconsistencies in Ω is obtained, then the total inconsistencies G

$$G = \sum_{(k,1)\epsilon\Omega}(S_i - S_k)^+ \tag{11}$$

When the order pair is consistent with the order pair, B is minimal and G > B. In order to avoid the trivial solution of the problem, a positive number h is introduced, and G > b is changed to G-B = H

$$G - B = \sum_{(k,1)\epsilon\Omega}(S_1 - S_k)^+ - \sum_{(k,1)\epsilon\Omega}(S_1 - S_k)^- = \sum_{(k,1)\epsilon\Omega}[(S_1 - S_k)^+ - (S_1 - S_k)^-] \tag{12}$$

$$h = \sum_{(k,1)\epsilon\Omega}[(S_1 - S_k)] \tag{13}$$

In this way, the square of the index weight is W_j can be obtained by solving the following linear programming problems

Take $Zk1$ is the inconsistency degree of ordered pair (k, 1) sorted by index approximation method

$$Z_{k1} = \max[0, (S_1 = S_k)] \tag{14}$$

There are:

$$S_1 - S_k = \sum_{j=1}^{m} W_j . (r_{1j} - 1)^2 - \sum_j W_j . (r_{1j} - 1)^2 \tag{15}$$

Open:

$$\sum_{j=1}^{m} W_j \cdot (r_{ij} - r_{kj})^2 - 2 \times \sum_j W_j \cdot 1 \cdot (r_{ij} - r_{kj}) \tag{16}$$

3.3. Transportation rationalization and optimization

prove the efficiency of logistics management, it is necessary to continuously improve the optimization and upgrading of logistics management information system, new transportation route plan, establish flexible transportation and circulation network, and effectively track the goods of various means of transportation. At the same time, improve the transaction quality, improve the implementation quality of logistics operation instructions, grasp the requirements of customer service from the overall perspective, greatly improve customer satisfaction, improve the efficiency of payment collection. The economic pressure of enterprises can alleviate the pressure of enterprises caused by large transaction costs in the whole logistics process. Second, in view of the core competitiveness of enterprises, we should make use of the purchasing power and cargo control ability of logistics companies to obtain lower freight quotations from transportation companies or other logistics service providers, so that the transportation units can realize and reduce costs. At the same time, we should strengthen cooperation with other enterprises, make rational use of unit mass and unit volume in the process of logistics transportation, reduce costs and make enterprises obtain more benefits. Finally, it is necessary to strengthen the logistics function, through the integration effect of the supply chain, form all aspects of dealers, circulation enterprises and customers, and carry out comprehensive management through the supply network.

4. Modeling Method

The mixed integer programming method can be used to model the vehicle scheduling problem

$$C = \min\left(\sum_{i,j,k}(O_{ijk} t_{ij} \mu) + \sum_1^n P_i(t_i)\right) \tag{17}$$

The constraint conditions are as follows:

$$\sum_{k=1}^{m} X_{ik} = \begin{cases} m, i = 0 \\ 1, i = 1, \dots, n \end{cases} \tag{18}$$

$$\sum_{i=1}^{n} I_i X_{ik} \le L_k \in K \tag{19}$$

$$\sum_{i=1}^{n} O_{ijk} = \sum_{j=1}^{n} O_{ijk,} \forall k \in K \tag{20}$$

$$S_0^k + \sum\sum O_{ijk}(t_{ij} + S_i) \le S_R^k, \forall i,j \in G_0, k \in K \tag{21}$$

$$t_i + S_i + t_{ij} - M(1 - O_{ijk}) \le t_j, \forall i,j \in G_0, k \in K \tag{22}$$

Where: u is the operating cost per unit time, including vehicle cost and personnel cost. $pi(ti)$ As a penalty function, in order to meet the customer's time requirement, the time ti is the set of all vehicles, k = 1 ,…,m{};Gk customer collection for vehicle service, $G0$ is all nodes composed of distribution center and customer point, $G0 = G \cup \{0\}$, where $\{0\}$ represents the distribution center; ti is the time when the vehicle arrives at customer I; t_{ji} is the driving time of the vehicle from customer I to customer J (constant); l_i is the demand of customer I (constant); Lk is the maximum loading capacity of the vehicle (constant, depending on different models); si is the residence time of the vehicle at customer I (constant); Sk is the departure time of vehicle K; k is the required return time of vehicle K (constant); m is a very large positive number (constant).

5. Evaluation Results and Research

The weekly cost forecast data and delivery cycle are shown in Table 1. It can be concluded from table 1 that the total cost of strategy 2 and strategy 3 tends to be the same, which is 6% lower than strategy 1. The service level of delivered water balance shows that strategy 2 is 19% higher than strategy 1, and strategy 3 is 3.9% higher than strategy 1.

Table 1. Total cost and delivery cycle of a month

Week	Total cost			Delivery cycle (days)		
	Strategy 1	Strategy 2	Strategy 3	Strategy 1	Strategy 2	Strategy 3
1	156984	154879	165421	1.31	1.10	1.56
2	176843	154792	159745	1.15	1.10	1.21
3	190215	165487	164851	1.61	1.10	1.06
4	165249	170641	174230	1.01	1.10	1.14
Average value	172322	161449	166061	1.27	1.10	1.24

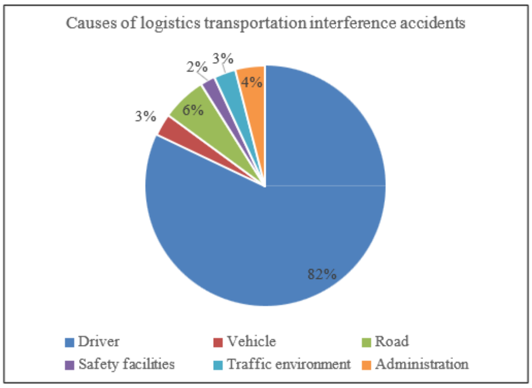

Figure 1. Main causes of interference accidents in logistics transportation

This paper investigates the analysis of all kinds of interference accidents in the transportation process of a logistics enterprise in recent five years, and finds that the causes of the accidents are no more than the lack of perfect coordination of people, vehicles, roads, environment and management in time and space. Among them, the factor of road interference accident mainly refers to the motor vehicle drivers of logistics enterprises. The survey shows that drivers' misjudgment of road information leads to 82% of all transportation accidents. Vehicle operation, road traffic safety design is not perfect, traffic environment, such as weather, logistics scheduling personnel management account for a small part, but the enterprise in the logistics decision-making time should also consider all the influencing factors, make perfect countermeasures.

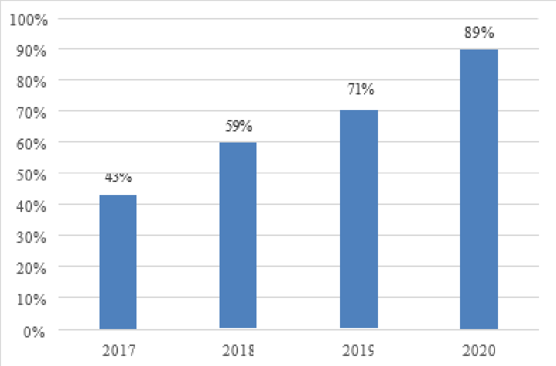

Figure 2. The logistics decision-making situation of an enterprise using data visualization software in recent four years

In this paper, when investigating and analyzing the influencing factors of enterprise logistics decision-making, we noticed that one of the related factors of enterprise logistics efficiency rising in recent years is data visualization operation software for logistics decision-making. According to the visualization is a very important research topic of computer science and technology, it is the use of computer technology to deal with massive and complex data, data results generated in daily life and production will be transformed into graphics or images to show to the information receiver, and human-computer interaction processing theory of a theoretical method and technology. Enterprises need to deal with a lot of data when building logistics decision-making model. The flexible use of data can more clearly analyze the development of the industry. Data visualization analysis can help enterprises improve the efficiency of management decision-making. The construction of enterprise logistics decision-making model based on supply chain management should keep up with the trend of the times and use high and new technology, so as to obtain competitiveness in the era of information explosion.

6. Conclusion

With the continuous development of global economic integration and the continuous improvement of supply chain management theory, there are few recent literatures on Supply Chain Management Based on enterprise logistics, but its necessity has always affected the construction of enterprise logistics decision-making model. In the process of pursuing rapid and new trends in enterprise development, various problems often occur, even under immature consideration, resulting in enterprise losses. Many enterprises' logistics is difficult to move forward under the cover of new technology. Only by ensuring the effectiveness of the current decision-making, new technology is the icing on the cake. In this paper, through the research on the development of enterprise logistics decision-making model based on supply chain management, the multi index decision-making evaluation and vehicle scheduling model are proposed, and the experimental investigation is carried out. By analyzing the logistics cost and transportation cycle under different decision-making models, the optimal decision-making model is found. With the aggravation of international competition, supply chain management has become the key for enterprises to obtain market competitiveness in the future, which puts forward higher requirements for logistics management, making the modern logistics distribution in the supply chain environment emerge as the times require. Based on the advanced concepts and methods of supply chain management, such as system management and collaborative decision-making, this paper studies the core theory and method of building material decision-making model, which greatly enriches and enriches the results of qualitative analysis.

7. Declarations

7.1. Author Contributions

Conceptualization: K.Y.T.; Methodology: K.Y.T.; Software: K.Y.T.; Validation: K.Y.T.; Formal Analysis: K.Y.T.; Investigation: K.Y.T.; Resources: K.Y.T.; Data Curation: K.Y.T.; Writing Original Draft Preparation: K.Y.T.; Writing Review and Editing: K.Y.T.; Visualization: K.Y.T.; The author has read and agreed to the published version of the manuscript.

ISSN 2579-7069

7.2. Data Availability Statement

The data presented in this study are available on request from the corresponding author.

7.3. Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

7.4. Institutional Review Board Statement

Not applicable.

7.5. Informed Consent Statement

Not applicable.

7.6. Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper

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