Hindawi
Advances in Mathematical Physics
Volume 2022, Article ID 4518388, 11 pages
https://doi.org/10.1155/2022/4518388

Research Article

Comprehensive Evaluation Method of Supply Chain Logistics System Quality Based on 3D Image Processing Technology

Dan Xu [1] and Jiasheng Qi [2]

[1] *School of Management, Nanjing Audit University Jinshen College, Nanjing, Jiangsu 210046, China*
[2] *School of Intelligent Manufacturing, Nanjing University of Science and Technology Zijin College, Nanjing, Jiangsu 210046, China*

Correspondence should be addressed to Dan Xu; xudan@naujsc.edu.cn

Received 1 September 2022; Revised 23 September 2022; Accepted 26 September 2022; Published 12 October 2022

Academic Editor: Miaochao Chen

With the rise of manufacturing informatization, many transactions are conducted on the Internet, but the final form of transaction completion is the transaction of actual products, which makes the logistics industry emerge as the times require. How to achieve the optimal allocation scheme and the fastest efficiency in the supply chain has become an urgent problem to be solved. This paper considers the characteristics and advantages of 3D image processing technology, describes the characteristics of 3D image processing supply chain (SC), and analyzes the channels that 3D image technology affects SC. Combining the respective characteristics of fuzzy theory and grey theory, the two theories are combined to develop strengths and circumvent weaknesses to form grey fuzzy theory. Comprehensive evaluation of supply chain logistics capability can achieve better evaluation results. The application of grey theory in this chapter includes constructing the factor set of the evaluation index system and determining the weight matrix of the factor set with the game method. The grey fuzzy evaluation weight matrix (i.e., single index evaluation result) is determined with the grey theory, and the fuzzy comprehensive evaluation result is finally calculated. This paper studies the supply chain logistics capability evaluation and optimization system from the aspects of system analysis, system function module design, and system architecture design and analyzes the overall goal, demand, feasibility, system business process, and data flow of the system construction. At the same time, this paper designs the supply chain logistics capability evaluation and optimization system and shows some functional interfaces. It is of great significance to improve the responsiveness, total inventory level, total cost level, supply chain performance, agility, and flexibility of the supply chain in the new environment.

1. Introduction

The competition in the 21st century will not be between enterprises, but between SC. Those supplier enterprises with unique advantages will become the object pursued by large enterprises [1]. The traditional reliability analysis method for system SC generally refers to the reliability calculation of its SC model, among which the calculation theory based on model tree is becoming more and more mature, but it is difficult to simplify it. Because the components in the system SC are uncertain, other reliability calculation methods are also difficult to apply in the SC reliability calculation [2]. 3D image processing technology can optimize the design and produce customized parts on demand. As this technology can digitize the complex processing process, it has the advantages of high precision, high speed, and low cost [3]. In the mass manufacturing of manufacturing industry, traditional subtractive manufacturing technology has always been based on production, standardization, and extensiveness. However, with the continuous improvement of people's material and cultural level, customers prefer to have personalized products. The extensive application of 3D image processing technology will change the production mode of traditional subtractive manufacturing technology before, and its unique advantages of personalized customization, environmental protection, energy saving, convenience, and high efficiency have changed the production mode of traditional manufacturing. Personalized customization will soon become the mainstream in future manufacturing [4].

The development of the new environment requires that the SC not only pay attention to products but also to the needs of users. The process of creating benefits is based on product flow. Improving product mobility in the SC to improve agility and flexibility is an effective means to improve the performance of the SC under the current environment [5]. Logistics energy, which exists in a specific logistics system, exists in the whole process of receiving, processing, refining, transporting, and delivering orders and goods. It is the response speed, customer's demand, cost, and guarantee of order realization punctuality and reliability [6]. Logistics operation ability refers to the ability to optimize resource utilization by means of management plan, organization, and control, in order to improve efficiency and reduce costs [7]. Compared with static logistics element capability, logistics operation capability is a dynamic capability formed on the basis of static capability. Compared with other capability viewpoints, the SC logistics capability has its own characteristics: the formation factors are more complex, the capability exists in every link of logistics activities, and the organization and management capability of logistics management can affect the functions of the entire logistics system [8].

With the rapid growth of logistics service outsourcing and the continuous improvement of its integrity and complexity, logistics service providers need to continuously penetrate into the upstream and downstream fields such as production and sales to meet the changing needs of logistics end customers. On this basis, the logistics service supply chain (LSSC) model that integrates the functions of each stage of logistics service has evolved [9]. Today, with the great change of production mode and the rapid intensification of commercial competition, the service quality provided by logistics service SC enterprises to customers, the relationship with customers, and the benefits obtained by serving customers are increasingly becoming the key factors for logistics service SC enterprises to improve profits [10]. Collaborative logistics takes cooperation and collaboration as the premise, combines advanced technology, focuses on personalized service, efficiency, and collaboration among enterprises, and creates a collaborative logistics information system that fully shares logistics resources and obtains on demand, so as to promote the collaborative operation of all links in the SC and the collaborative operation among enterprises. In order to solve the problems of high complexity of product structure, long manufacturing cycle, and high cost of early mold development, 3D image processing technology has been widely applied and studied. If the response process of the SC is regarded as a flow, in the whole flow of the SC, the production time of customers' demand products accounts for 5% of the total flow time, while it takes 95% of the total flow time to deliver the produced products to customers. This change from "internal audit" to "external view" has prompted the logistics service SC managers to make subversive changes in the logistics service SC from the aspects of management concepts, management methods, and management means. Only by penetrating the realization of customer value into all aspects of daily management of enterprises and actually implementing it in market behavior can logistics service SC enterprises achieve sustainable development and maintain long-term advantages in the industry.

The research innovation lies in constructing the performance evaluation index system of logistics service supply chain based on customer value. Combining the respective characteristics of fuzzy theory and grey theory, combining the two theories to develop strengths and circumvent weaknesses to form a grey fuzzy theory to comprehensively evaluate the logistics capability of the supply chain can achieve better evaluation results. Extract the data of logistics capability, logistics cost, logistics processing capability, and logistics innovation capability of supply chain enterprises. The data is preprocessed, and the logistics capability is optimized and evaluated by combining the model data form of optimization analysis and evaluation analysis. This paper studies the results of the empirical analysis and puts forward countermeasures to improve the overall performance of the logistics service supply chain, so as to achieve the optimal allocation scheme and the fastest efficiency in the supply chain.

2. Related Work

Supply chain management is no longer a closed and lonely way to deal with business activities such as procurement, production, and sales of enterprises. Instead, it regards suppliers, producers, distributors, and consumers as an organic whole and harmonizes the information flow, logistics, and capital flow of all members through collective goals. Production planning and control under supply chain management take more uncertainty and dynamic factors into account, so that enterprises can react quickly to market changes. The traditional production planning decision-making mode is a centralized decision-making, while the decision-making mode under the supply chain management environment is distributed, group decision-making. In the traditional production planning decision-making mode, the information of planning decision-making comes from two aspects, one is demand information, and the other is resource information. Information diversification is the main feature of supply chain management. In essence, supply chain management is based on the concept of cooperation and win-win, transforming the demand of the final consumer into the collective activities of all participants, improving the quality of cooperation among many enterprises, and maximizing the overall benefits. At present, there are many researches related to SC management in China. In order to carry out targeted research, the author collected and combed the relevant research literature and found that the research results mainly include the research on green SC management, the research on supplier evaluation index system, and the evaluation method of supplier selection.

Yang and Liu believe that big data technology is the basis of SC collaborative decision-making. As far as big data is concerned, they combine SC collaborative mechanism with collaborative theory and game theory to explore the significance and realization process of SC collaborative mechanism

[11]. Agrawal and Pal created the selection method and implementation process of collaborative management and control system for the first time based on the company's resolution operation mode, resource allocation, crisis assessment, and benefit contract [12]. Entezaminia et al. believe that "ability" refers to the ability and talent, which is the means for the main body to accomplish the set goals. Therefore, they believe that logistics is an enterprise or a SC, and in order to accomplish its logistics goals, it uses its own skills and talents, which is also an indicator of comprehensive evaluation and analysis [13]. Ju et al. first defined the concept of logistics capability and at the same time analyzed the characteristics of SC logistics capability in China's social industry environment and thought that SC logistics capability embodied several different main aspects [14]. Tu et al. quantitatively estimated the potential impact of 3D image processing technology on the global SC [15]. Yu et al. put forward a system and custom production is completely customer-centered, providing customers with 3D image processing services [16]. Bai et al. obtained the supplier evaluation criteria and corresponding weights by using analytic hierarchy process and considered that the supplier evaluation factors were delivery, quality, facilities, technical capability, financial status, management, discipline, and response in order of importance [17]. Liu et al.'s research shows that on the one hand, 3D image processing can improve the efficiency of SC by timely manufacturing and eliminating waste. On the other hand, customized production of 3D image processing is helpful to implement the production-to-order strategy [18]. Wang analyzed the definition of logistics capability. She believed that logistics capability is the ability of an enterprise to acquire and utilize various internal and external resource elements and to deliver the required items of users to the destinations required by users [19]. Woo et al.'s research and development starts from different kinds of SC and determines the capability elements that have a great impact on their benefits through the characteristics of various SC. They also summarize the calculation methods of each element [20].

3. Methodology

3.1. Basic Theory of SC Capability. Supply chain is a management concept and content that has been concerned by entrepreneurs in recent years. It is precisely because of the keen attention, research, and discussion of the theoretical and business circles that people generally believe that it is a very abstract and academic topic. In fact, the content of supply chain is something we may encounter every day. To be more precise, it should be attributed to a kind of management experience. It is just that there are different priorities in different industries. Logistics capability refers to the operational capability of an enterprise in the process of creating economic value and social value to design logistics plans, carry out logistics activities, and control the logistics process with the help of certain measures and schemes. The measurement object of logistics capability is the entire process of enterprise logistics activities. In addition to product distribution and transportation capabilities, it also covers external resource acquisition capabilities, internal materials, and semifinished product management capabilities. From the perspective of constituent elements, the logistics capability elements of the supply chain are divided into tangible and intangible parts. The logistics capability encountered in the actual work is tangible, while the intangible elements refer to the enterprise's equipment processing capacity, warehousing capacity, etc.

In the current academic circles, the research on customer value is very rich, and the research directions are roughly divided into two categories. The second type is to take the enterprise as the evaluation subject and the customer as the evaluation object. The enterprise conducts in-depth research on the relative importance and contribution value of the customer, so that the enterprise can provide products, services, and solutions for customers with different values in order to maximize long-term benefits. Here, collaborative logistics is the focus of research. The realization of collaborative logistics mode of supply chain based on cloud manufacturing needs to be based on a certain business scale. Only when the purchase, inventory, and delivery of logistics have an appropriate scope can we share data and resources as the basis, promote the integrated control and collaborative delivery of products, and reduce the cost of SC system. The SC system adopts the collaborative logistics form based on cloud manufacturing, which requires full sharing of the manufacturing news of suppliers, the demand news of manufacturers, the delivery news of cloud platform, the in-transit news of trucks, etc. Therefore, the Internet and information system are very important to realize the collaborative logistics mode of SC. Research fields related to SC management pay attention to enterprise SC management. To sum up, SC management mainly refers to fully coordinating the internal and external resources of enterprises and, according to customers' diversified consumption needs, treating each process in the SC as a virtual enterprise interface management problem, in which each enterprise is a main body in the virtual enterprise alliance, and the internal management problem of enterprise alliance is SC management. Generally speaking, the logistics system, while accepting all kinds of resources outside the system, uses some basic functions to assemble these resources in various ways and then uses certain ways to turn the assembled resources into output systems. A subset of each assembly mode of the logistics system is shown in Figure 1.

At present, many of them take the typical three-stage SC as the research object. The premise of SC capability analysis is SC system, and the analysis in this paper is based on the typical H-stage SC, analyzing its logistics system structure, which includes suppliers, manufacturers, and distributors, with the SC logistics system of manufacturing industry in the economic society as the typical representative, as shown in Figure 2.

The research background of SC logistics capability is the research of SC management and logistics management. This paper will analyze and define the connotation of SC logistics capability through comparative analysis with SC management, logistics management, logistics, and capability. Since the logistics service integrator is at the core of the logistics

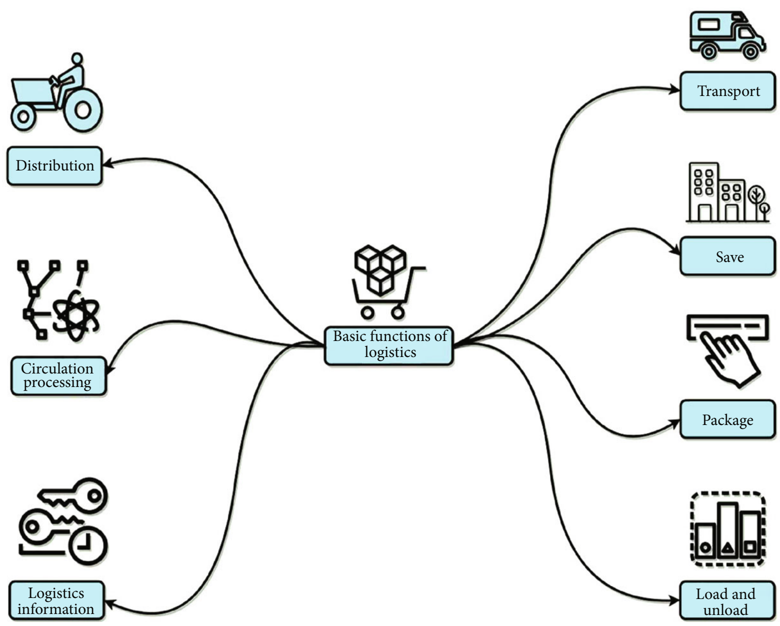

FIGURE 1: Basic functions of logistics system.

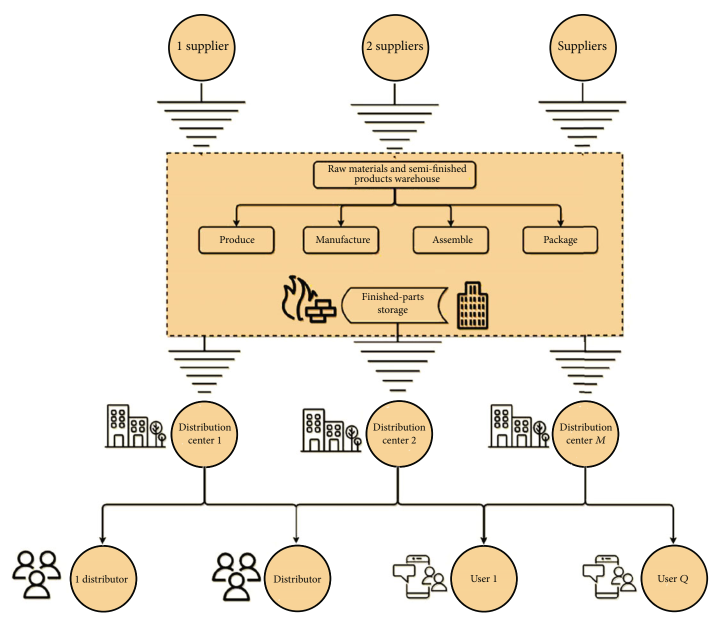

FIGURE 2: Supply chain logistics system structure.

service SC, it is generally assumed by enterprises with strong financial support, strong information processing capability, good industry reputation, capable of personalized customization, integration and networking, and a certain scale of logistics services. Logistics service providers are a collection of many logistics service providers. A single enterprise generally only undertakes one or several types of logistics business, such as logistics transportation, logistics warehousing, and logistics consulting, and its service scope is limited. Logistics service consumers include not only individual consumers but also various enterprises that need logistics services, such as manufacturing enterprises and catering enterprises.

Under the cloud manufacturing mode, this transfer process can be divided into e-commerce cloud, logistics cloud, and customer cloud, forming cloud services from e-commerce to customers. The business ability of e-commerce cloud can be realized through its favorable rating and credibility. The ability of e-commerce to comprehensively utilize customer demand, product varieties, and logistics channels has formed its advantages in business ability. The degree of standardization of the payment platform under supervision and the security of information provide necessary guarantees for customers to purchase. Logistics enterprises reduce their operating costs by increasing the

Table 1: Comparison of cloud manufacturing systems and logistics services.

Characteristic	Cloud manufacturing system	Logistics service
Resource reorganization	Cloud manufacturing system can intelligently reorganize information according to users' needs to meet their individual needs.	Logistics services can recombine logistics resources to form personalized logistics services according to the needs of customers.
Resource virtualization	The cloud manufacturing system virtually encapsulates manufacturing resources and capabilities in the cloud platform, and users can obtain them on demand through the terminal.	The logistics platform virtually encapsulates logistics information and resources in the cloud platform, and customers can obtain corresponding logistics services according to their own needs.
Payment on demand	Pay as you go according to your needs.	Customers pay according to the logistics services they receive.

number of distribution centers, expanding their scale, and sharing commodity information and infrastructure. Optimize its transportation path, improve transportation efficiency, and form a logistics cloud that cooperates with e-commerce. When obtaining goods, customers will comprehensively consider the accumulated cost of product purchase and logistics and the convenience of purchase compared with physical stores. And form the final online shopping satisfaction with the service experience. Comparing the collaborative logistics service of SC with cloud manufacturing system platform, it is found that there are many similarities between collaborative logistics service and cloud manufacturing, as shown in Table 1.

As shown in Table 1, it is imperative to build a SC collaborative logistics cloud platform based on cloud manufacturing with reference to the cloud manufacturing system platform, SC integration, and logistics network. The SC collaborative logistics cloud platform is a network-based and highly shared logistics cloud service platform. The platform virtually integrates logistics resources and supplier product information into the cloud to form a virtual logistics resource cloud pool and encapsulates it according to customer requirements, bringing more efficient, low-cost, and high-quality personalized logistics services to users. In addition, you can also create functional modules under the platform to focus on the whole process of enterprise production and operation, including site selection, transportation and distribution, loading and unloading, and storage.

3.2. Design of Logistics Information Collection Software Based on Mobile Phone Platform. The distributed cluster database system is composed of multiple computers, and any of these computers can be placed in a single place. Because any computer in the system has a complete database, each computer has its own database. Even in different places, as long as computers are connected through the network, a complete large database can be formed. For the distributed cluster system, the system is a database as a whole in terms of logic. The database has the following three properties: consistency, integrity, and security. These three properties are used to control and manage the logic as a whole. The shared data is managed uniformly by distributed cluster servers. However, if it is a nondatabase processing operation, it can be completed through the client. The logistics information collection system based on mobile phone platform uses the image processing technology of digital and English characters and puts forward a convenient and safe solution. The staff of the logistics company use the mobile phone equipped with logistics information collection software to take pictures of the local goods list and process the photographed images with the identification software in the mobile phone to extract the information such as the location and current time of the goods and then send them to the database of the logistics head office through SMS. Finally, the head office sends the circulation information of the goods to the customers' mobile phones in real time, so that the customers can know the circulation of the goods conveniently. With the progress of science and technology, the pixels of mobile phone cameras are getting higher and higher, and the resolution of images taken by mobile phone cameras is higher, which is beneficial to feature extraction of mobile phones. Although the image pixel standards adopted by mobile phones are different, the mobile phone images of various pixel standards are used in the same way. First, the color image is grayed, and then processed by binarization, smoothing, denoising, thinning, normalization, etc. This makes a good job for the next step of image information extraction of goods list. In the handwritten character image preprocessing module, the video image input by the camera is first collected, and the software can automatically detect the image area range. Then, the collected color image is subjected to black-and-white binary processing, and a single word is marked with a rectangular box in the image display window. Then, the image preprocessing is performed on the single word, and the image features are extracted. Image preprocessing includes smoothing, denoising, thinning, and normalization introduced in Chapter 2. The image preprocessing flow is shown in Figure 3.

After 3D preprocessing, the mobile phone extracts the features of the captured 3D by using the feature extraction methods introduced above (moment center feature, pixel distribution feature, discrete Fourier feature, and line feature value) and finally gets an 82-dimensional feature vector. Thus, 82-dimensional feature vectors are obtained. And it is convenient for the identification of the 3D identification module. After preprocessing the 3D image, the mobile phone uses the feature extraction methods introduced earlier (moment center feature, pixel distribution feature, discrete

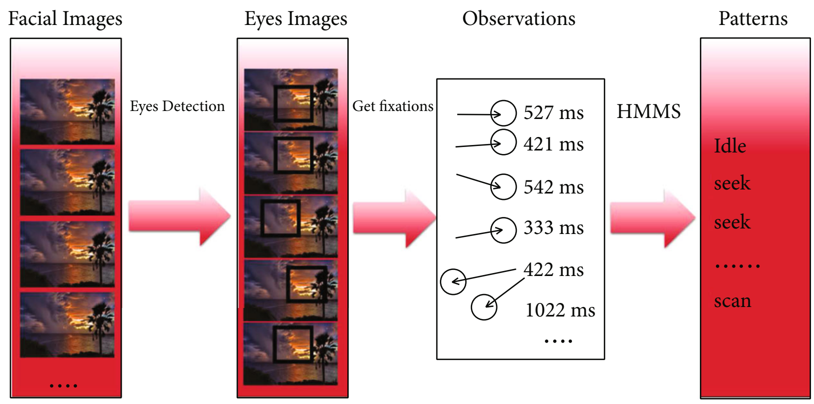

Figure 3: Flow chart of image feature extraction.

Fourier feature, and line feature value) to extract the features of the captured 3D and finally gets an 82-dimensional feature vector. Thus, 82-dimensional feature vectors are obtained. And it is convenient for the identification of the 3D identification module. Different classifiers corresponding to the same feature from different angles map the feature to the decision space, so it is possible to comprehensively reflect an object by combining different features and different classifiers, thus obtaining a better classification result.

Assume that the original image is $F(x, y), x = 1, 2, \cdots, M, y = 1, 2, \cdots, N$ and the normalized image is $G(i, j), I = 1, 2, \cdots, I, j = 1, 2, \cdots J$.

Geometric moments of general two-dimensional functions are defined as

$$M_{mn} = \iint_{x,y\in\Omega} x^m y^n f(x, y) dxdy. \quad (1)$$

In formula (1), M_{mn} is the original lattice of image $(m, n)(m, n = 0.1, \cdots)$, which can be regarded as the projection of image $f(x, y)$ on a set of basis functions, and this moment has translation invariance.

The character image $f(x, y)$ is divided into $\Omega_i (i = 0, 1, \cdots, 15)$ areas of 4×4, assuming that the sum of black dots in each area is $A(i)$ and the black dots in the largest black dot area and the smallest black dot area are $A_{\max}$ and $A_{\min}$, respectively. Then,

$$A(i) = \sum_{(x,y\in\Omega_i)} f(x, y), \quad (2)$$

$$A_{\max} = \max_{i\in(0.15)} A(i), \quad (3)$$

$$A_{\min} = \min_{i\in(0.15)} A(i). \quad (4)$$

Take $F_s = ((A(i) - A_{\min})/(A_{\max} - A_{\min}))(s = 2, \cdots, 17)$ as a set of features with values between [0,1], which reflects the distribution characteristics of black spots in sample 1 to $f(x, y)$.

Fourier transform is widely used in pattern recognition to extract features, which not only has translation invariance but also can describe the image boundary. Image $f(x, y)$ is a binary matrix point set with P rows and Q columns. Its corresponding two-dimensional discrete Fourier transform can be defined as

$$G(u, v) = \frac{1}{\sqrt{PQ}} \sum_{u=0}^{P-1} \sum_{v=0}^{Q-1} f(x, y) \exp\left[-j2\pi\left(\frac{ux}{P} + \frac{vy}{Q}\right)\right]. \quad (5)$$

Type $u = 0, 1, \cdots, P - 1$; $v = 0, 1, \cdots, Q - 1$, expressed by matrix:

$$[G] = \begin{bmatrix} G(0,0) & G(0,1) & \cdots G(0, N-1) \\ G(1,0) & G(1,1) & \cdots G(1, N-1) \\ \cdots & \cdots & \cdots \\ G(M-1, 0) & G(M-1, 1) & \cdots G(M-1, N-1) \end{bmatrix}. \quad (6)$$

And the large-value coefficient of $G(u, v)$ is concentrated in the low-frequency region, that is, around the upper left, upper right, lower left, and lower right corners of the matrix. In this experiment, $P = Q = 16$, 32 modulus values of discrete Fourier transform are selected and extracted from the above four low-frequency regions as feature vectors.

3.3. Evaluation Model of Two-Level SC of 3D Image Technology. Consider establishing a two-level SC of 3D image processing composed of 3D image processing technologists and manufacturers, and analyze the decision-making and profit issues of the two-level SC of 3D image processing. Since the SC conditions of various industries will vary according to the actual situation of the industry, the SC logistics capacity of each industry will show its own characteristics due to the difference in SC conditions; for example, the SC logistics capacity of hataocao industry pays attention to the safety assurance ability, the power coal SC pays attention to the relative stability of the power coal SC logistics capacity, and the SC logistics capacity of traditional manufacturing industry pays attention to the integrity. However, there are commonalities in the logistics capacity

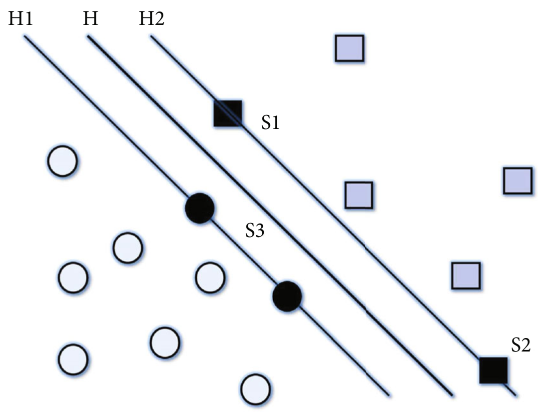

Figure 4: Optimal classification surface.

under the structure of the SC logistics system, which is determined by the commonalities of the SC of various industries. In the distributed control SC, each member enterprise in the SC first cares about its own profit and then pays attention to the overall profit of the SC. In the SC supervision, the secondary chain composed of suppliers and producers must meet the application conditions of Stackelberg game, and both suppliers and producers pay attention to their own profits. Support vector machine is derived from the concept of optimal classification hyperplane, which is the extension of classification hyperplane. Consider the two-dimensional two-class separable case shown in Figure 4.

The circular ("O") sample and the square ("□") sample are linearly separable, and we can see from the figure that there are many linear functions that can completely separate the two types of samples, not only H but also many others, so we will not cite them one by one here.

The so-called optimal classification line is the general form of the linear classification function in the dimensional space which is $g(x) = w \cdot x + b$, and the classification surface equation is

$$w \cdot x + b = 0. \tag{7}$$

Normalize the classification function so that both types of samples meet $|g(x)| \geq 1$, that is, $|g(x)| = 1$ of the samples closest to the classification plane, so that the classification interval is equal to $2/\|w\|$. Therefore, to maximize the classification interval is to make $\|w\|$ or $\|w\|^2$ minimum. If it is required to classify all samples correctly, it must meet the following requirements:

$$y_i[(w \cdot y) + b - 1] \geq 0, \quad i = 1, 2, \cdots, n. \tag{8}$$

Thus, the classification plane that satisfies the above conditions and minimizes $\|w\|^2$ is the optimal classification plane.

According to the general theory of reliability design, $\Phi(X) = 0$ can be set as the limit state of the system as the system stability criterion. Among them, $X = \{X_1, X_2, X_3, \cdots\}$ can be set as qualified and unqualified according to the discrimination requirements of system response and can be calculated:

$$Z^m = \{X : \varphi(X) < 0, X \in R\}, \tag{9}$$

$$Z^r = \{X : \varphi(X) > 0, X \in R\}, \tag{10}$$

wherein

$$\varphi^m = \{Z^m, Z^y, m \in 1, 2, \cdots, \gamma \in 1, 2 \cdots N\}, \tag{11}$$

$$\varphi^y = \{Z^y, \gamma \in 1, 2 \cdots \}. \tag{12}$$

If the system completes the response calculation and gets the system response data, according to formula (12), if $P > 1$, relative to $\forall X \in \{X = 1, 2 \cdots X \in R\}$, all $\varphi(X) > 0$, all the system responses exist in the safety zone and there is no failure probability, which proves that the system structure is reliable: when $P < 0$, for $\forall X^l \in X_i^l$, all $\Phi(X) < 0$, then At $0 < P < 1$, aiming at $\forall X^l \in X_i^l$, it is proved that $\Phi(X) > 0$ and $\Phi(X) < 0$ have two possibilities, the system has reliability and unreliability, and the sample delivery value of P indicates the reliability probability of the system, that is, reliability. If the value is larger, the system is more reliable; if the value is smaller, the system is less reliable.

Similarly, formula (12) can be changed to obtain the failure probability:

$$\eta = 1 - p = \frac{\varphi^r - \varphi^m}{\varphi^r}. \tag{13}$$

Table 2: Nine-scale table of 0.1~0.9.

Scale value	Explanation
0.1	Indicator I is as important as indicator J
0.3	Indicator I is slightly more important than indicator J
0.5	Index I is obviously more important than index J
0.7	Indicator I is stronger and more important than indicator J
0.9	Indicator I is more important than indicator J
0.2, 04, 0.6, 0.8	Index I is compared with index J, and the result conclusion corresponds to the middle value of 0.1-0.9 scale

When the subordinate relationship between the upper and lower levels of each index is determined, it is necessary for the expert group to judge the relative importance of each level according to the evaluation information of the evaluation index established in this paper. The quantitative judgment method is 0.1~0.9 nine-scale method, as shown in Table 2.

The fuzzy vector $a_{ij}^k = (l_{ij}^k \quad m_{ij}^k \quad u_{ij}^k)$ means that the k expert compares the index $1i$ with the index to get the judgment result of importance. Among them, m_{ij}^k is the actual score of the expert's judgment on the relative importance of the evaluation index, and l_{ij}^k and u_{ij}^k, respectively, correspond to the minimum and maximum values of the relative importance score of the evaluation index.

According to the operation properties of triangular fuzzy numbers,

$$M_1 \oplus M_2 = (l_1, m_1, u_1) \oplus (l_2, m_2, u_2) = (l_1 + l_2, m_1 + m_2, u_1 + u_2), \tag{14}$$

if

$$M_i = (l_i, m_i, u_i), M_i^{-1} = \left(\frac{1}{u_i}, \frac{1}{m_i}, \frac{1}{l_i}\right). \tag{15}$$

After normalizing $d_n(x_i^t)$, you can wait until the weight of each index:

$$w_h^t\left(x_h^t\right) = \frac{d_i x_i^t}{\sum_{i=1}^{n} d_i\left(x_i^t\right)}, \tag{16}$$

where x_i^t is the t index of layer i and w_h^t is the weight obtained by ranking t index levels in layer $t-1$ in layer h, which is the index weight of the required solution.

4. Result Analysis and Discussion

From the current research, the quantitative analysis of SC logistics capacity is mostly based on a specific field or industry. The comprehensive evaluation methods used in the research mainly include fuzzy AHP, AHP, and fuzzy comprehensive evaluation methods. Each evaluation method has its own advantages and disadvantages and scope of application. On the other hand, the focus of the grey system theory is to process some fuzzy and indistinct information and determine the nature of things through the feature changes between different levels. This method can be seen from the beginning, but the accompanying problem is low resolution. In this paper, considering the respective characteristics of fuzzy theory and grey theory, combining the two theories, developing their strengths and avoiding their weaknesses, and forming a grey fuzzy theory to comprehensively evaluate the logistics capability of SC can achieve a better evaluation effect. The application of grey theory in this chapter includes constructing the factor set of evaluation index system, using gambling method to determine the weight matrix of the factor set, using grey theory to determine the grey fuzzy evaluation weight matrix (i.e., single index evaluation result), and finally calculating the fuzzy comprehensive evaluation result. Regardless of the distance and cost from the source point to the delivery point, suppose a company has five user demand points, and the delivered goods are a product, and design a site selection scheme to determine from the five user demand points that the goods must be delivered to each demand point. According to the proposed five dimension balanced scorecard of supply chain, this paper has selected different key performance indicators as the performance evaluation indicator set of dynamic supply chain. On the premise of meeting the demand, ensure the fixed cost of establishing the distribution center at the selected location, and the total cost of transportation expenses flowing through the distribution center is the lowest, as shown in Table 3.

Table 3: Distance from distribution center to users.

Distance (km)		Alternative distribution center				
		1	2	3	4	5
User/demand point	1	0	65	85	100	101
	2	62	81	32	125	123
	3	88	95	0	100	105
	4	98	125	102	0	28
	5	102	130	105	33	0

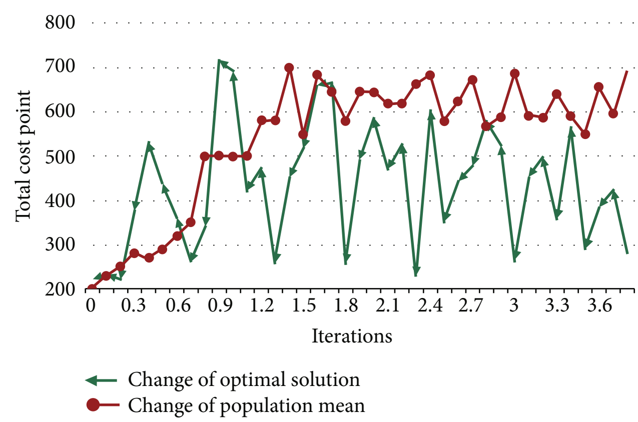

Figure 5: Iterative results of the algorithm of the distribution center location calculation example.

The calculation example is solved by genetic algorithm. The variation of the optimal solution/mean value with the number of iterations is shown in Figure 5.

It can be seen that when the number of iterations is 60, the total cost has reached the optimal value, with the minimum value of 1260 yuan, and the distribution is also the demand point 3 among the demand points.

The business of SC capability evaluation and optimization system includes system users logging in to the system. After the identity information is verified, the logistics capability optimization module and the logistics capability evaluation module can be used to analyze the SC logistics capability. The analysis results can be obtained by using operational research methods, heuristic algorithms, and grey fuzzy theory, which can provide decision-making basis for system users, as shown in Figure 6.

The logistics capability evaluation and optimization system takes the typical H-level supply chain as the research object. The structure of the logistics system includes suppliers, manufacturers, and distributors (including end customers). The inflow data includes the logistics capacity data sheet of suppliers, distributors, and retailers. This paper extracts the data of logistics capability, logistics cost, logistics processing capability, and logistics innovation capability of commonly used supply chain enterprises. The data is preprocessed, and the logistics capability is optimized and evaluated by combining the model data form of optimization analysis and evaluation analysis.

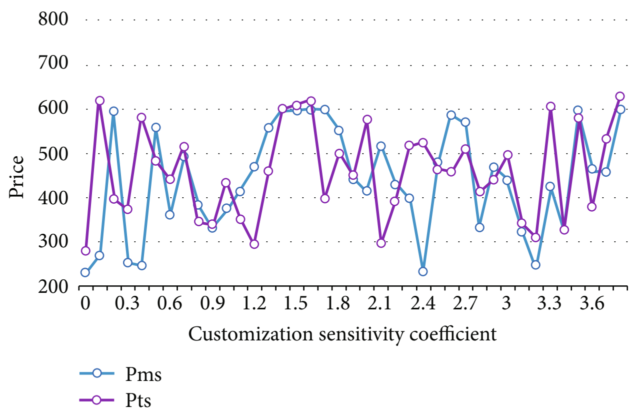

FIGURE 6: The influence of customer customization sensitivity coefficient on price under the SC of 3D image processing technology.

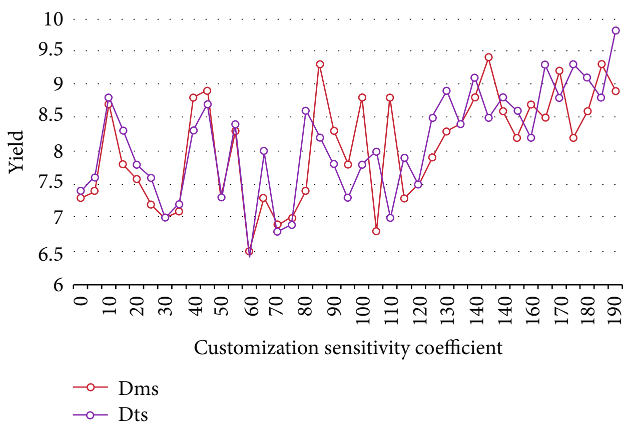

FIGURE 7: Influence of customer customization sensitivity coefficient on output under the SC of 3D image processing technology.

Figure 7 shows the effect of the customer customization sensitivity coefficient on the output of the two models. It can be observed from the figure that the output of the two models increases with the increase of the customer customization sensitivity coefficient. When the customized sensitivity coefficient of the customer is less than Δ 2, the output in the technician-dominated model is greater than that in the manufacturer-dominated model. When the customized sensitivity coefficient of the customer is greater than Δ 2, the output in the manufacturer-dominated model is greater than that in the technician-dominated model.

As can be seen in Figure 8, in the two models, the price of 3D image processing products decreases with the reduction of the cost-saving coefficient. The price of 3D image processing products in the manufacturer-led model is always not less than that in the technology provider-led model. When the cost-saving coefficient is larger, other conditions remain the same, the production cost decreases, and the manufacturer does not change the price of 3D image processing products, which can increase the income of unit 3D image processing products. However, the enterprise pursues profit maximization. In order to make more profits, it

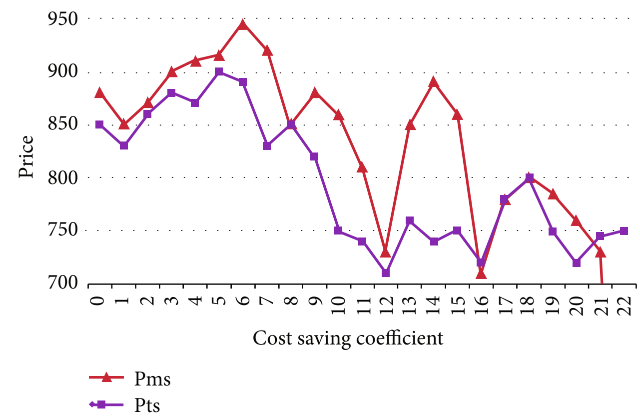

FIGURE 8: Effect of cost-saving coefficient on price under the SC of 3D image processing technology.

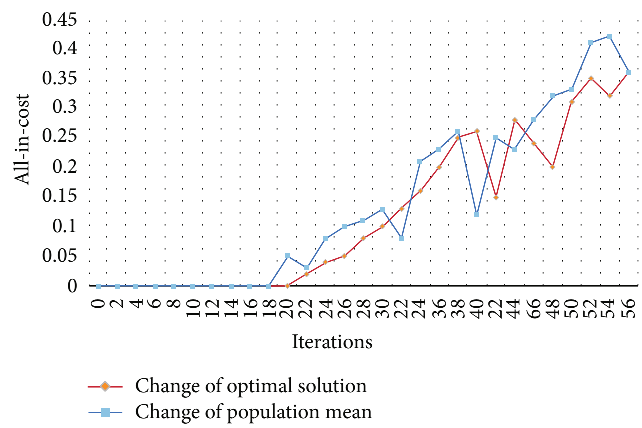

FIGURE 9: Distribution center location optimization results.

will choose to lower the product price and attract more customers.

In Figure 8, it can be observed that no matter how the cost-saving coefficient changes, the profit obtained by the technologist in the technologist-led model is always not less than that in the manufacturer-led model. Therefore, manufacturers will choose to fight for or give up the dominant power according to the situation, while technology manufacturers will always actively fight for the dominant power in order to make greater profits.

After calculating the subjective weight, objective weight, and comprehensive weight of all indicators, this section will calculate the comprehensive value of performance evaluation of logistics service SC, solve the evaluation values of all levels of indicators in turn, and analyze the results in detail. Similar to the evaluation module, the logistics capability optimization module can add, modify, and delete logistics nodes, routes, and networks to the optimization algorithm and also pays attention to the forward-looking and expansibility of the evaluation and optimization system. By calling genetic algorithm to optimize the distribution and location, the optimization results are obtained. The interface of example calculation results is shown in Figure 9.

Through the above analysis, we can find that in the logistics service SC dominated by company C, we attach great importance to the improvement of our own business capability and internal link control. For example, we strive for excellence in service quality at any stage, spare no effort to expand market share, and increase investment and customer income, but there is still much room for improvement in customer relations.

The logistics process cooperation of parts suppliers is based on the general SC cooperation of the industry. Among them, purchase, manufacturing, and delivery are important processes of the SC centered on the value chain. First, the collaborative process of SC logistics has been changed. The supplier handles the purchase, preparation, manufacturing, and real-time delivery according to the assembly of the manufacturer provided by the SC collaborative logistics cloud platform. Second, the supplier connects with the supplier above through the collaborative logistics system, eliminating the persistent planning originally sent to the superior supplier. The supplier manages the inventory in the corresponding parts manufacturing. Finally, professional intermediate logistics companies will realize more and more business services and create appropriate supplier control and evaluation models. On the whole, the SC management is attributed to the strategic management of enterprises, so in the SC management, the problem itself should be analyzed based on the strategic development of enterprises. The development of SC management covers the ideas of enterprise management in content and specifically includes the contents of enterprise culture shaping, organizational strategic management, technology development and utilization, performance management, and other fields under the guidance of business ideas. Therefore, the integration of supplier management in company A under the green SC and the introduction of its information support system, technology development, and performance management must conform to the company's future management strategy. It can be seen that information management is one of the very important contents of SC management, and the foundation of information management mainly lies in the construction of information platform. Therefore, under the green SC, company A should focus on the comprehensive sharing of SC information. The SC logistics capability evaluation and optimization system is constructed from the aspects of system analysis, system function module design, and system architecture design. The overall objective, demand analysis, feasibility analysis, business process, and data process analysis of the system construction are described, respectively, and the overall design and subsystem design of the system are carried out. Relevant enterprises in the logistics SC need to devote special energy to collecting and sorting out the feedback information in these channels and study the mathematical relationship between the number of customers and customer feedback, dig out the real needs and ideas of customers, formulate targeted solutions and respond to them in time, and at the same time examine and improve their own service mechanisms and processes. Compare the correlation between the growth of economic indicators such as corporate profits and market share and this investment, discuss the weak links reflected and formulate corresponding solutions, and output a comprehensive summary with guiding significance to point out the direction for future investment.

5. Conclusions

With the rapid development of e-commerce and logistics industry, the competition between enterprises has evolved into the competition between SC. The SC logistics capability is one of the main bottlenecks to improve the performance of the SC, which fundamentally determines the logistics performance of the whole logistics activity process in the SC and its impact on the overall competition of the SC. Creating value for customers is an important condition for enterprises to survive and develop. Therefore, this paper proposes to study the performance evaluation of logistics service SC from the perspective of customer value, which has certain theoretical and practical significance for promoting the service level of logistics service SC and improving the overall performance level of logistics service SC. The performance evaluation method of logistics service SC based on customer perspective is proposed. A performance evaluation method of logistics service SC based on customer perspective is proposed. Taking the collaborative logistics system as the core, it organically combines the actual needs of users, product information of suppliers, and platform operators. Users' needs can be quickly responded by suppliers, thus providing a collaborative working environment for the next product distribution, thus realizing SC integration. The combination of 3D images and software needs further research, development, and implementation. However, there is a lack of research on the results of empirical analysis, and it is necessary to propose targeted countermeasures and suggestions to improve the overall performance of the logistics service supply chain. Further analysis and supplement are needed in the future.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of 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.

References

[1] Q. Peng and Y. Wang, "Study on the path of three-chain integration of the logistics service industry in Zhengzhou," *Mathematical Problems in Engineering*, vol. 2022, no. 8, Article ID 7465152, p. 3, 2022.

[2] H. Zhan, X. Zhang, and H. Wang, "Influencing factor modeled examination on internet rural logistics talent innovation mechanism based on fuzzy comprehensive evaluation method," *PLoS One*, vol. 16, no. 3, pp. 4–9, 2021.

[3] H. Jiang, "A amethod for selecting optimal minimum break point set based on evaluation of protection comprehensive importance," *Electrical Engineering*, vol. 12, no. 3, pp. 5–8, 2019.

[4] J. Chen, "Single-value neutrosophic cosine measure for evaluation of port logistics competitiveness," *Journal of Intelligent and Fuzzy Systems*, vol. 39, no. 3, pp. 4–7, 2020.

[5] G. Li, L. Li, T. M. Choi, and S. P. Sethi, "Green supply chain management in Chinese firms: innovative measures and the moderating role of quick response technology," *Journal of Operations Management*, vol. 66, no. 7-8, pp. 958–988, 2020.

[6] C. Zhou, W. Xia, T. Feng, J. Jiang, and Q. He, "How environmental orientation influences firm performance: the missing link of green supply chain integration," *Sustainable Development*, vol. 28, no. 4, pp. 685–696, 2020.

[7] T. Suryanto, M. Haseeb, and N. H. Hartani, "The correlates of developing green supply chain management practices: firms level analysis in Malaysia," *International Journal of Supply Chain Management*, vol. 7, no. 5, p. 316, 2018.

[8] H. Qihao, "Risk evaluation of green agricultural products cold chain logistics from the perspective of ecological economy," *Journal Of Environmental Protection And Ecology*, vol. 22, no. 5, pp. 2232–2240, 2021.

[9] Z. Xu, A. Elomri, L. Kerbache, and A. el Omri, "Impacts of COVID-19 on global supply chains: facts and perspectives," *IEEE Engineering Management Review*, vol. 48, no. 3, pp. 153–166, 2020.

[10] D. Mao, F. Wang, Z. Hao, and H. Li, "Credit evaluation system based on blockchain for multiple stakeholders in the food supply chain," *International Journal of Environmental Research and Public Health*, vol. 15, no. 8, p. 1627, 2018.

[11] J. Yang and H. Liu, "Research of vulnerability for fresh agricultural-food supply chain based on Bayesian network," *Mathematical Problems in Engineering*, vol. 2018, Article ID 6874013, 17 pages, 2018.

[12] T. K. Agrawal and R. Pal, "Traceability in textile and clothing supply chains: classifying implementation factors and information sets via Delphi study," *Sustainability*, vol. 11, no. 6, p. 1698, 2019.

[13] A. Entezaminia, M. Heidari, and D. Rahmani, "Robust aggregate production planning in a green supply chain under uncertainty considering reverse logistics: a case study," *International Journal of Advanced Manufacturing Technology*, vol. 90, no. 5-8, pp. 1507–1528, 2017.

[14] Y. Ju, H. Hou, and J. Yang, "Integration quality, value cocreation and resilience in logistics service SC: moderating role of digital technology," *Industrial Management & Data Systems*, vol. 15, no. 5, pp. 2–24, 2020.

[15] M. Tu, M. K. Lim, and M. F. Yang, "IoT-based production logistics and SC system - part 2: IoT-based cyber-physical system a framework and evaluation," *Industrial Management & Data Systems*, vol. 118, no. 1, pp. 9–15, 2018.

[16] L. Yu, D. Liu, and N. Xu, "Special aquatic products supply chain coordination considering bilateral green input in the context of high-quality development," *International Journal of Foundations of Computer Science*, vol. 15, no. 13, pp. 1–26, 2022.

[17] C. Bai, S. Kusi-Sarpong, H. Badri Ahmadi, and J. Sarkis, "Social sustainable supplier evaluation and selection: a group decision-support approach," *International Journal of Production Research*, vol. 57, no. 22, pp. 7046–7067, 2019.

[18] W. Liu, Z. Liang, and Z. Ye, "The optimal decision of customer order decoupling point for order insertion scheduling in logistics service SC," *International Journal of Production Economics*, vol. 175, no. 5, pp. 20–23, 2016.

[19] M. Wang, "Assessing logistics capability for the Australian courier firms," *International Journal of Logistics Systems and Management*, vol. 37, no. 4, pp. 576–589, 2020.

[20] Y. B. Woo, S. Cho, J. Kim, and B. S. Kim, "Optimization-based approach for strategic design and operation of a biomass- to-hydrogen supply chain," *International Journal of Hydrogen Energy*, vol. 41, no. 12, pp. 5405–5418, 2016.