Hindawi
Security and Communication Networks
Volume 2022, Article ID 9786827, 1 page
https://doi.org/10.1155/2022/9786827

Retraction

Retracted: Logistics Service Supply Chain Model Applying Artificial Intelligence and Big Data Analysis

Security and Communication Networks

Received 10 November 2022; Accepted 10 November 2022; Published 22 November 2022

Security and Communication Networks has retracted the article titled "Logistics Service Supply Chain Model Applying Artificial Intelligence and Big Data Analysis" [1] due to concerns that the peer review process has been compromised.

Following an investigation conducted by the Hindawi Research Integrity team [2], significant concerns were identified with the peer reviewers assigned to this article; the investigation has concluded that the peer review process was compromised. We therefore can no longer trust the peer review process, and the article is being retracted with the agreement of the Chief Editor.

References

[1] L. Chen, Y. Zhang, and Z. Wang, "Logistics Service Supply Chain Model Applying Artificial Intelligence and Big Data Analysis," *Security and Communication Networks*, vol. 2022, Article ID 1575813, 12 pages, 2022.

[2] L. Ferguson, "Advancing Research Integrity Collaboratively and with Vigour," 2022, https://www.hindawi.com/post/advancing-research-integritycollaboratively-and-vigour/.

Hindawi
Security and Communication Networks
Volume 2022, Article ID 1575813, 12 pages
https://doi.org/10.1155/2022/1575813

Research Article

Logistics Service Supply Chain Model Applying Artificial Intelligence and Big Data Analysis

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Received 6 April 2022; Revised 11 May 2022; Accepted 19 May 2022; Published 21 June 2022

Academic Editor: Mohammad Ayoub Khan

The logistics service chain is a specialized service chain produced along with the continuous update and development of the logistics industry. It is an inevitable direction choice that is naturally formed when the degree of logistics specialization continues to increase. This paper aims to study how to analyze and study the logistics service supply chain model based on artificial intelligence and big data analysis, and describe the data mining algorithm. This paper puts forward the problem of logistics service supply chain, which is based on big data analysis, and then elaborates around its related concepts and algorithms, and conducts case design and analysis on supplier selection. The experimental results show that the customer satisfaction of supplier C has reached 86%, the accuracy rate of supplier D's logistics operations is as high as 90%, and the logistics transportation cost of supplier B is only 0.38 yuan/ton ∗ km. In the end, the three of them were selected as company Z's transportation suppliers.

1. Introduction

With the development of China's economy, the logistics service supply chain has gradually become an important branch of the service supply chain, and has attracted more and more attention from operators, which has become a major trend in the future development of the logistics industry. However, China's research on supplier management in logistics supply chain operation started slowly and developed rapidly, and some problems have gradually emerged. On the one hand, the lack of supplier management level in the logistics supply chain directly affects the overall operational efficiency and cost of the supply chain; on the other hand, the uncoordinated relationship between supply chain members increases the risk of the supply chain. How to improve supplier management level in supply chain operation has gradually attracted the attention of scholars and business managers.

With the continuous development of the logistics service supply chain, the application in various fields of life is becoming more and more popular, and the corresponding service level must be continuously improved. Company Z is a key member of the logistics supply chain, and there is a gap in the management of transportation suppliers. As a part of supply chain operation, the management level of Z company's transportation suppliers will directly affect the company's interests and the coordination chain of logistics services among its members. Therefore, Z company is committed to adopting practical and effective methods to effectively manage the transportation suppliers in the logistics service supply chain, so as to improve the operation efficiency of the supply chain and the overall service level.

The innovations of this paper are as follows. (1) This paper combines big data analysis with logistics service supply chain, introduces the theory and related methods of big data analysis in detail, and mainly introduces visual analysis and data mining. (2) In the face of logistics service supply chain, suppliers are selected. By evaluating the experimental results and comparing the data of five suppliers, it is concluded that C is a strategic supplier, B is a competitive supplier, and D is a general candidate supplier.

2. Related Work

Since artificial intelligence technology was proposed in the 1950s, human beings have been committed to making computer technology develop in a more and more intelligent direction. This is a comprehensive subject involving computer, cybernetics, linguistics, neurology, psychology, and philosophy. At the same time, artificial intelligence is also a discipline with strong vitality. It attempts to change human thinking and living habits, extend and liberate human intelligence, and will surely lead human beings to a new era of technological development. Hassabis believes that a better understanding of biological brains could play a crucial role in building intelligent machines. He investigates the historical interaction between the fields of artificial intelligence and neuroscience, and highlights current advances in artificial intelligence that are inspired by neurocomputing research in humans and other animals. Finally, he highlights common themes that may hold the key to advancing future research in both fields. However, his data is less [1]. Makridakis claims that the industrial and digital (information) revolution will bring about widespread changes that will also affect every aspect of people's society and life. His research concluded that those who use the Internet extensively and are willing to take entrepreneurial risks to turn innovative products/services into global business success stories will continue to gain a significant competitive advantage. The biggest challenge for society and business will be to harness the benefits of AI technology to provide enormous opportunities for new products, services, and massive productivity gains, while avoiding the dangers and headwinds of rising unemployment and wealth inequality. However, he is subject to greater subjective influence [2]. Rongpeng tried to highlight one of the most fundamental features of the revolutionary technology in the 5G era. However, in the face of increasingly complex configuration issues and emerging new service requirements, 5G cellular networks are still not enough if they lack complete AI capabilities. Therefore, he further introduces the basic concepts in AI and discusses the relationship between AI and candidate technologies in 5G cellular networks. Specifically, he highlighted the opportunities and challenges of leveraging AI to enable smart 5G networks, and demonstrated the effectiveness of AI in managing and coordinating cellular network resources. He envisions that AI-powered 5G cellular networks will make the acclaimed ICT enabler a reality. However, he did not give specific recommendations [3]. Liu attempts to provide a comprehensive review of artificial intelligence algorithms in rotating machinery fault diagnosis from both theoretical background and practical industrial applications. He starts with a brief introduction to different AI algorithms and then surveys the extensive literature on the industrial applications of these AI algorithms. Finally, he discusses the advantages, limitations, practical implications of different AI algorithms, and some new research trends. However, his experimental content is less [4]. Glauner begins with an overview of how NTL is defined and its impact on the economy. Next, he covers the fundamental pillars of AI relevant to the field. He then investigates these research efforts through a comprehensive review of the algorithms, features, and datasets used. He ultimately identified key scientific and engineering challenges in NTL detection and suggested how to address them. He believes that these challenges have not been adequately addressed in past contributions, and coverage of these challenges is necessary in order to advance NTL detection. However, his process is more complicated [5]. Caviglione L is designed to uncover malware using two detection methods based on artificial intelligence tools, such as neural networks and decision trees. To verify their effectiveness, he has implemented and tested seven covert channels on the measurement framework using Android devices. Experimental results demonstrate the feasibility and effectiveness of the method for detecting hidden data exchanges between colluding applications. However, his performance needs to be improved [6, 7]. Bui D T proposes and validates a new hybrid artificial intelligence method, called Particle Swarm Optimization Neuro-Fuzzy (PSO–NF), for spatial modeling of tropical forest fire susceptibility. In the proposed method, a neuro-fuzzy inference system (NF) is used to build a forest fire model, while particle swarm optimization (PSO) is used to study the optimal values of model parameters [8, 9]. He used the receiver operating characteristic curve, the area under the curve (AUC), and several statistical measures to evaluate the performance of the forest model. The results show that the proposed model performs well on both the training dataset (AUC = 0.932) and the validation dataset (AUC = 0.916). The usability of the proposed model is further evaluated by comparison with two benchmark state-of-the-art machine learning methods [10], Random Forest (RF) and Support Vector Machine (SVM). As the proposed model outperformed the two baseline models, he concluded that the PSO–NF model is an effective alternative tool that should be considered for modeling tropical forest fire susceptibility. His research results have reference value for forest planning and management in forest fire-prone areas. However, its application scope is limited [11, 12]. Lemley J reviews the current state of deep learning, explaining what it is and why it can improve the longstanding technique of traditional neural networks. Most importantly, explaining how to start applying deep learning to the own research activities to solve the old and new problems and build better, smarter consumer devices and services. However, his research is not novel enough [13, 14].

3. Big Data Analysis Methods

3.1. Concept Introduction

3.1.1. Artificial Intelligence. Artificial intelligence is a branch of computer science that attempts to understand the nature of intelligence and produce a new type of intelligent machine that responds similarly to human intelligence. Since the birth of artificial intelligence, the theory and technology have become more and more mature, and the application fields have been continuously expanded, which will definitely bring about the development and progress of human science and technology [15, 16].

Artificial intelligence is an information process that simulates human consciousness and thinking. AI is not human intelligence, but it can think like a human and is more likely to surpass human intelligence. Artificial intelligence is an extremely challenging science, and those working on artificial intelligence must understand computer education, psychology, and philosophy. In general, a major goal of AI research is to enable machines to perform complex tasks that normally require human intelligence.

3.1.2. Big Data. Regarding the concept of big data, it is generally believed that there are 4 Vs, namely, Volume, Variety, Velocity, and Value. The values of individual data in big data are often unstable and inaccurate, but conclusions drawn from large amounts of information are still valuable. At the current stage of development, it is almost impossible to give an effective and accurate definition of big data, and when a new technical concept is proposed, it usually needs to go through a process [17].

3.1.3. Big Data Analysis. Big data is not only a large amount of data, but also the analysis and processing of massive data. The useful information contained in these massive data can be obtained after processing. Currently, more and more socioeconomic and technological research fields include the application of big data and the basic characteristics of big data, such as quantity, speed, and diversity. Therefore, the method of analyzing big data becomes particularly important. It can be said that the key factor in determining whether the information is valuable is whether the analytical method is used correctly [18]. Big data analysis methods generally have the following five key aspects: visual analysis, data mining algorithms, predictive analysis capabilities, semantic engines, and data quality and data management.

3.1.4. Logistics Service Supply Chain. The logistics industry is a kind of service industry, and high-quality service quality is the only way to win market share. Today, when the idea of service has been deeply rooted in the hearts of the people, for some products, the comparison of service quality is even greater than that of the product quality. The role of services in promoting employment and enhancing the competitiveness of enterprises is constantly emerging. Modern logistics is a coordinated activity that integrates logistics, information flow, capital flow, people flow, and business flow.

The concept of supply chain originated from the concept of expanded production. The definition of supply chain in modern education management is that supply chain is a complete functional network chain structure. The key enterprises in this functional network chain structure control the flow of information, logistics and capital, and ultimately connect suppliers, manufacturers, distributors, retailers, and end users as a whole.

Intangibility, customer influence, indivisibility, heterogeneity, perishability, labor intensity of services in a service chain, and other characteristics are not available in a product supply chain. Since the service chain has the above-mentioned unique characteristics, this requires the service chain to have fewer structural layers. The standard structure is a functional service provider, and the way it works to provide customers with the overall service chain is mainly traction, which is a fully reactive supply chain [19].

3.2. Data Mining

3.2.1. Definition of Data Mining. The extensive research and application of data mining can be seen as the result of the natural evolution of information technology. As a multidisciplinary field, data mining can be defined in several ways [20, 21]. Even if the term "data mining" itself is explained, it does not quite cover the richness it contains. Strictly speaking, "data mining" in the industry is a broad concept, more precisely, it should be called "extracting knowledge from data" or "discovering knowledge from data". The narrow sense of "data mining" is only an essential step in the whole process of knowledge discovery. Regarding the concept of "data mining", the general concepts of this work will be used in a mature way throughout the work, and some specific steps mentioned in data mining will be emphasized.

The complete general process of "mining knowledge from data" is shown in Figure 1.

3.2.2. Data Mining Function. Data mining functions usually include four main modules: characterization and differentiation, frequent pattern mining, classification and regression, and clustering and outlier analysis.

A class of data mining tasks for predictive analytics includes classification and regression. Among them, the classification model is obtained by analyzing the training dataset (data objects whose class labels are known), and is used to predict the class labels of objects whose class labels are unknown. Several examples of derived models are shown in Figure 2, where 2(a) is the decision tree, 2(b) is the neural network, and 2(c) is the IF-THENG rule. In addition, it can be used to determine data distribution trends, that is, image adjustment and trend prediction problems. It is widely used in scenarios such as inventory analysis and organic population production.

Cluster-phase outlier analysis can be classified into the category of supervised character learning. Clustering tasks do not consider class labels when analyzing data objects, usually because there is no labeled class data in the dataset [22, 23]. Object clusters are created by grouping, as shown in Figure 3. Objects within clusters have higher proximity, while objects between clusters have lower proximity, and out-of-cluster objects are often referred to as extreme points. In general, extreme values are discarded as noise or extreme values in most data mining operations. However, in some application scenarios, such as fraud detection, extreme price analysis can be interesting. Outlier analysis, also known as anomaly mining, is often closely related to cluster analysis methods.

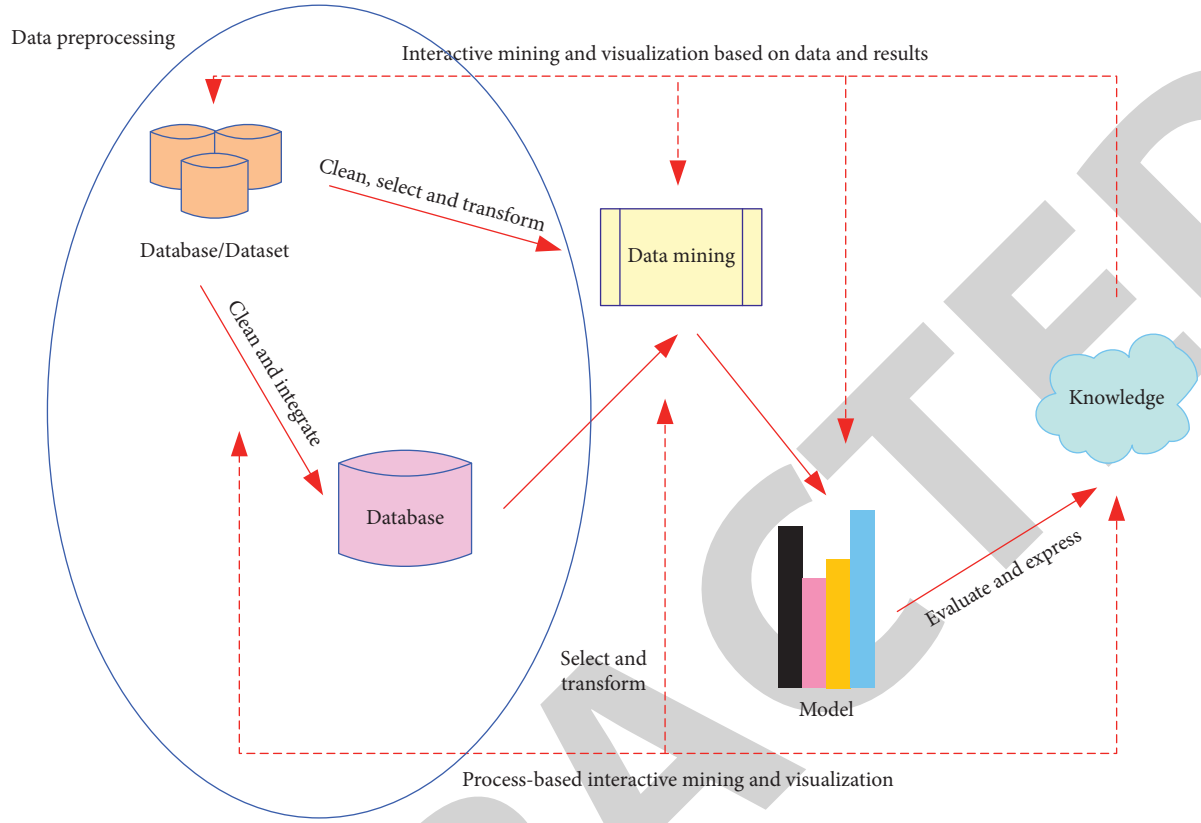
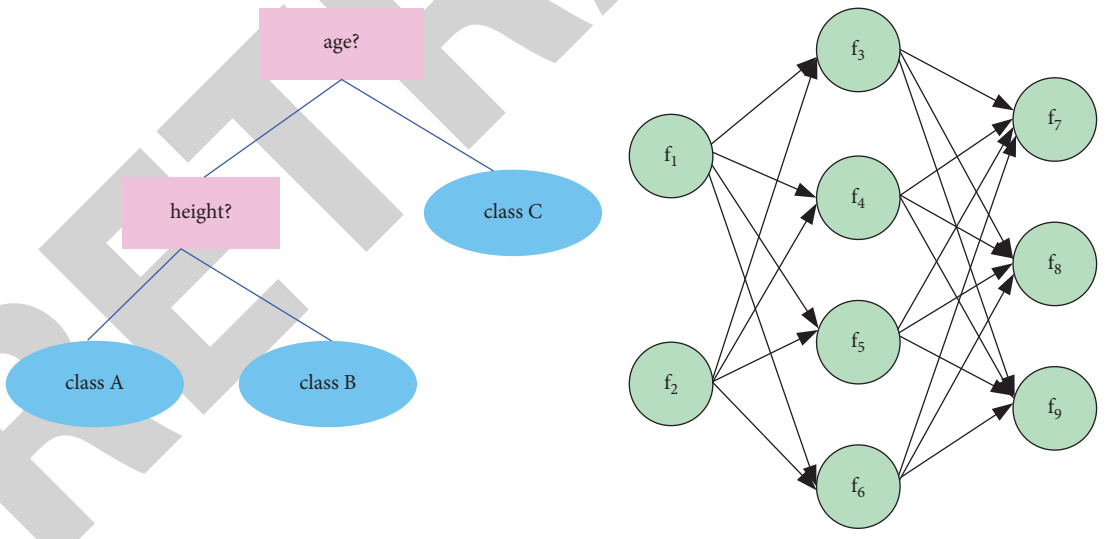


Figure 1: The whole process of knowledge discovery in data.



(a) (b)

age (X1, "youth") ANDheight (Y1, "tall") → Class ("A")
age (X2, "youth") ANDheight (Y2, "medium") → Class ("B")
age (X3, "middle_aged") → Class ("C")
age (X4, "senior") → Class ("D")

(c)

Figure 2: Different forms of classification models. (a) is the decision tree, (b) is the neural network, and (c) is the IF-THENG rule.

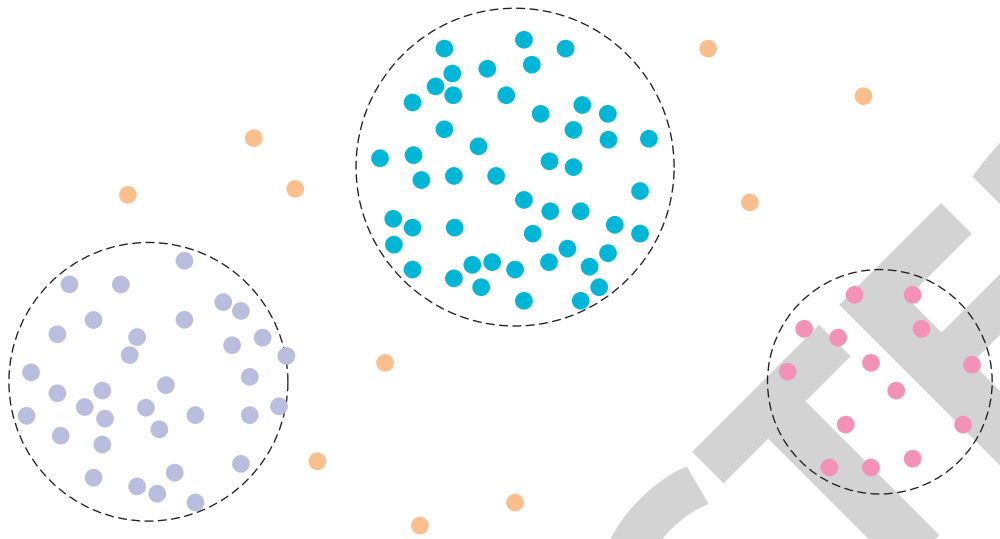


Figure 3: Cluster visualization including three data clusters.

3.2.3. Features of Data Mining. After decades of development, the data mining industry can be said to be changing with each passing day and forever. The types of data processed are becoming more and more abundant, the technologies used are changing rapidly, and their application scenarios are constantly expanding [24, 25]. These characteristicscan be summarizedas follows.

(1) Multidisciplinary integration. As an application-based field, data mining has absorbed a large number of techniques in many fields. Figure 4 shows examples of disciplines that have had a significant impact on the development of data mining.

(2) It is oriented to specific needs and applications.

(3) Large volume and rich types of data. Typically, these raw data are large and unprocessed, although the data types may vary, as shown in Figure 5.

(4) Modes are interesting. That is, the patterns or rules should be easy to understand, valid for new or test data, and have a certain level of credibility, potential usefulness, and innovation.

3.3. Data Mining Algorithms

3.3.1. Incremental Kernel Fuzzy Clustering Algorithm. wFCM (weighted Fuzzy C-Means) is one of the most commonly used fuzzy clustering algorithms. It is based on the FCM algorithm and assigns different weights according to the importance of the data points, so as to carry out the process of clustering [26]. For a given dataset $S = \{s_1, s_2, \ldots s_n\}$, let $\lambda_a\,(a = 1, 2, \ldots, n)$ be the weight of data point s_a. The wFCM method initially randomly selects x different initial cluster centers, and calculates the participation of each data point in the cluster center according to formula (1), then updates the cluster center according to formula (2), obtains a new cluster center, and then restarts the process. Engagement is calculated at each data point and the above process is repeated until the convergence criterion is achieved.

$$u_{ba} = \sum_{c=1}^{x} \left(\frac{d_{ba}^2}{d_{ca}^2} \right)^{-1/m-1}, \tag{1}$$

$$v_b = \frac{\sum_{c=1}^{n} \lambda_a u_{ba}^y s_a}{\sum_{c=1}^{n} \lambda_a u_{ba}^y}. \tag{2}$$

Among them, $a = 1, 2, \ldots$, n, $b = 1, 2, \ldots$, x, m represents the blur coefficient. v_b represents the cluster center, u_{ba} represents the degree to which the data point s_a belongs to the cluster center v_b, and d_{ba} represents the distance from the data point s_a to the cluster center v_b, and its calculation formula can be given by formula.

$$d_{ba}^2 = \left\| s_a - v_b \right\|^2. \tag{3}$$

Generally speaking, for clustering algorithms, there are three convergence criteria:

(1) All u_{ba} no longer change;

(2) All cluster centers v_b no longer change;

(3) Satisfying $|B^{e+1}(U, V) - B^e(U, V)| < \varepsilon$, where ε is the convergence accuracy, e is the number of iteration steps, J(U, V) is the criterion function, and the calculation method is as shown in formula (4).

$$J(U, V) = \sum_{b=1}^{x} \sum_{a=1}^{n} \lambda_a u_{ba}^m d_{ba}^2. \tag{4}$$

When clustering a linearly inseparable dataset, the accuracy of the clustering result of wFCM is poor. At this time, the data points can be mapped to a high-dimensional space by the kernel function method, so that the data becomes linearly separable. The wKFCM (weighted Kemel Fuzzy C-Means) algorithm is a clustering method that maps data to

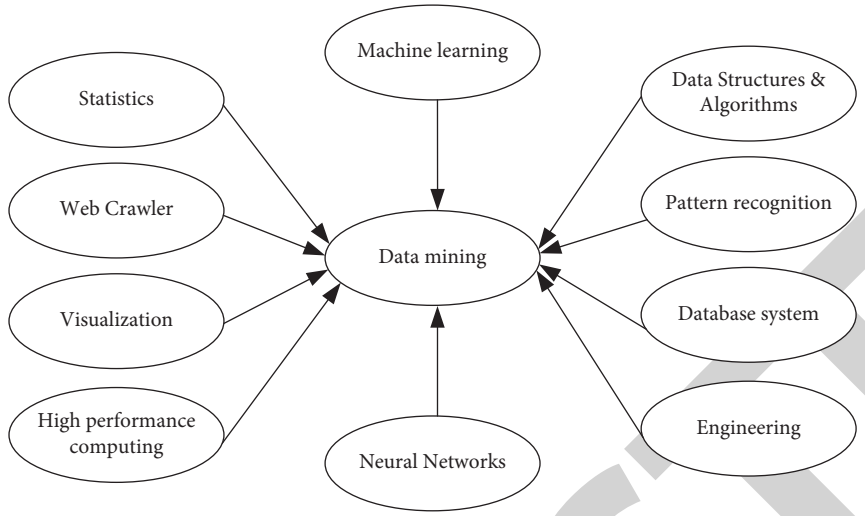


Figure 4: Data mining draws techniques from multiple domains.

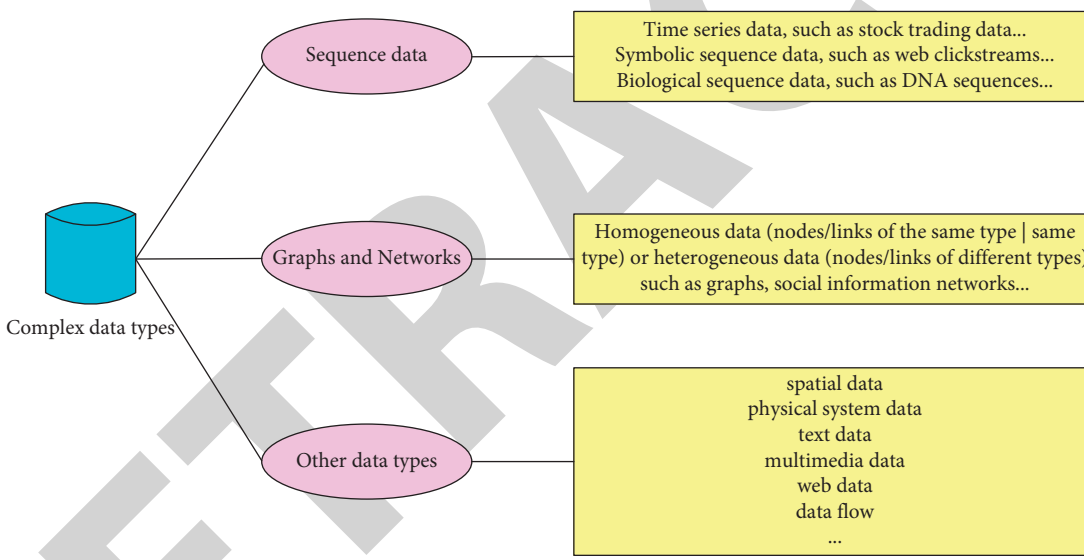


Figure 5: Complex types of data mining.

a high-dimensional space through a kernel function based on the wFCM algorithm. The definition of the kernel function is as formula.

$$x(s_a, s_b) = \theta(s_a)^T \theta(s_b). \tag{5}$$

Among them, θ is the mapping function. For the convenience of description, $x(s_a, s_b)$ is abbreviated as x_{ab}. Generally speaking, the commonly used kernel functions are Gaussian kernel function and polynomial kernel function.

The wKFCM and wFCM processes are basically the same, the difference is the distance calculation formula. In wKFCM, the definition of distance is shown in formula.

$$d_{ba}^2 = \left\|\theta(s_a) - \theta(v_b)\right\|^2 = x_{aa} + x_{bb} - 2x_{ba}. \tag{6}$$

Among them, $x_{aa} = \theta(s_a)^T\theta(s_a), x_{bb} = \theta(v_b)^T\theta(v_b), x_{ba} = \theta(s_a)^T\theta(v_b)$.

Substituting formula (6) into formula (1), the calculation formula of the membership degree in the wKFCM algorithm can be obtained, see formula.

$$u_{ba} = \sum_{c=1}^{x} \left(\frac{\left\|\theta(s_a) - \theta(v_b)\right\|^2}{\left\|\theta(s_a) - \theta(v_c)\right\|^2} \right)^{-1/m-1}. \tag{7}$$

The update formula of the cluster center is shown in formula.

$$\theta(v_b) = \frac{\sum_{a=1}^{n} \lambda_a u_{ba}^m \theta(s_a)}{\sum_{a=1}^{n} \lambda_a u_{ba}^m}. \tag{8}$$

It should be noted that since the mapping function θ has no specific expression, the specific value of the cluster center vector cannot be obtained in the wKFCM algorithm.

Incremental kernel fuzzy clustering refers to an algorithm that uses the wKFCM algorithm to cluster the data

block S_t and the clustering result V_{t-1} of the step t - 1 in the t ($t = 1, 2, \ldots, N$) step of clustering. The incremental clustering model is simple, and a core step is the utilization of the clustering results of existing data blocks, and some improved algorithms are also carried out for this problem. In the general incremental clustering algorithm, in the tth step of clustering, the clustering center in the t-1 step is directly used for subsequent clustering [27, 28].

Let $R_t = \{r_1^t, r_2^t, \ldots r_x^t\}$ represent the set of mapped points from the result of clustering at time t-1, and let $r_b^t = \sum_{a=1}^{n_t} \alpha_{ba}^t \theta(s_a^t)$. Since R_t is obtained by mapping V_{t-1}, it can be obtained by solving the optimization problem shown as

$$\min \left\| \theta\left(v_b^{t-1}\right) - r_b^t \right\|. \tag{9}$$

In the incremental kernel fuzzy clustering algorithm, the cluster centers obtained by the tth step clustering are expressed as formula (10) and formula (11).

$$\theta\left(v_b^t\right) = \sum_{c=1}^{n_t} q_{ac}^t \theta\left(s_c^t\right). \tag{10}$$

Among them:

$$q_{ac}^t = \frac{\lambda_c^t \left(u_{ac}^t\right)^m + \sum_{z=1}^{n} \alpha_{zc}^t \lambda_z^{(t,\alpha)} \left(u_{az}^{\alpha}\right)^m}{\sum_{z=1}^{n_t} \lambda_z^t \left(u_{az}^t\right) + \sum_{z=1}^{x} \lambda_z^{(t,\alpha)} \left(u_{az}^{\alpha}\right)^m}. \tag{11}$$

For data point $s_a^t \in S_t$, its weight value is generally set to 1, that is $\lambda_a^t = 1$. And the calculation of the weight value $\lambda_b^{(t,\alpha)}$ of the transfer point r_b^t can be obtained by formula.

$$\lambda_b^{(t,\alpha)} = \sum_{a=1}^{n_t} u_{ba}^t \lambda_a^c + \sum_{z=1}^{x} u_{bz}^{\alpha} \lambda_z^{(t-1,\alpha)}. \tag{12}$$

And the membership degree u_a^t of data point s_a^t is calculated as formula:

$$u_a^t = \sum_{c=1}^{x} \left(\frac{\left\| \theta\left(s_a^c\right) - \theta\left(v_b^t\right) \right\|^2}{\left\| \theta\left(s_a^t\right) - \theta\left(v_c^t\right) \right\|^2} \right)^{-1/m-1}. \tag{13}$$

The calculation method of the membership degree $u_b^{(t,\alpha)}$ of the transfer point r_b^t is as formula:

$$u_a^{(t,\alpha)} = \sum_{c=1}^{x} \left(\frac{\left\| \theta\left(r_b^c\right) - \theta\left(v_b^t\right) \right\|^2}{\left\| \theta\left(r_b^t\right) - \theta\left(v_c^t\right) \right\|^2} \right)^{-1/m-1}. \tag{14}$$

The incremental kernel fuzzy clustering algorithm is a process of continuously re-clustering new data blocks and existing clustering results, and each step of the clustering is the same.

3.3.2. Information Gain Calculation. In the early stages of machine learning, there was only a blank decision tree and no idea how to divide existence based on features. The currently learned decision tree model is used to classify the entire feature space [29]. The training set divided into X class is defined as L, symbolized as the example of class i, $|L|$ represents the total number of cases L in the training set, and the probability $G(A_i)$ of an unknown instance belonging to class i is defined as:

$$G\left(A_i\right) = \frac{\left|A_i\right|}{|L|}. \tag{15}$$

At this point, the partition A uncertainty measure is

$$H(L, A) = -\sum_{i=1}^{r} G\left(A_i\right) lbG\left(A_i\right). \tag{16}$$

It can be seen from the whole decision tree learning process that the uncertainty of the classification dataset in the decision tree is getting smaller and smaller. If the test attribute b is used for testing, when $b = b_j$, the samples belonging to the i-th class can be regarded as A_{ij}, then there are

$$G\left(A_i; b = b_j\right) = \frac{\left|A_{ij}\right|}{|L|}. \tag{17}$$

That is, $G(A_i; b = b_j)$ represents the size of the probability that it belongs to the i-th class when $b = bj$. The conditional entropy of the training set for attribute L is the uncertainty degree of the decision tree for the division.

$$H\left(L_j\right) = \sum_{i} G\left(A_i | b_j\right) lbG\left(A_i | b = b_j\right). \tag{18}$$

The information entropy of all $b = b_j$ branches L extending after selecting the test attribute b for the classification information is

$$H(L, b) = \sum_{i} G\left(b = b_j\right) H\left(L_j\right). \tag{19}$$

The information gain $I(L; b)$ provided by attribute b for classification is

$$I(L; b) = H(L) - H(L|b). \tag{20}$$

4. Logistics Service Supply Chain Experiment and Analysis

Company Z is a logistics company dedicated to developing a modern logistics company that is safe, efficient, accurate, and timely. After a long period of hard work, the company has gradually transformed from an ordinary third-party logistics company to a comprehensive enterprise integrating large-scale logistics services. However, with the rapid development of the outsourcing business of transportation companies and the increasing number of suppliers, the previous supplier management methods are no longer suitable for the current large-scale supplier form, which leads to many problems in the actual operation process [30].

4.1. Establishment of Evaluation Index System. For the preliminary selection of the evaluation indicators of Z company's transportation suppliers, this paper adopts the theoretical analysis method and selects a series of evaluation indicators in combination with the actual situation of Z

company's requirements for transportation suppliers. This paper firstly develops a questionnaire that affects the choice of Z company's transportation suppliers, and distributes the questionnaire to 40 experts (twenty of them are university professors who study logistics service supply chains or transport suppliers. There are 12 people who are experienced transport supplier enterprise managers. There are 4 people who are developers of supplier management information system. There are 4 people who are corporate account managers who often work with Z company and 20 managers of Z company's internal supply chain department and supplier department. A total of 60 questionnaires were distributed this time, 56 questionnaires were recovered, 56 valid questionnaires, and the recovery rate was 93%. Experts are invited to select representative evaluation indicators. Figure 6 shows the general flow of supplier selection.

After statistics, 14 influencing element indicators and corresponding 5 influencing factors that affect the evaluation and selection of Z company's transportation suppliers at this stage are obtained. As a result, a three-level Z company transportation supplier evaluation index system was established. After sorting and classification, 14 evaluation indicators come from four aspects, namely, supply chain, integrators, suppliers, and enterprise customers. According to the four aspects of the evaluation content summarized in the paper, the evaluation indicators are arranged in order, and the evaluation index system of Z company's transportation suppliers is formed as shown in Table 1.

4.2. Shipping Provider Selection. Company Z has a logistics and transportation business that needs to be outsourced to a specialized transportation provider. In order to meet the customer's requirements for service quality, the business needs to be completed through the overall coordinated operation of the logistics service supply chain. First of all, Z company should investigate the supplier in the early stage of selecting the transportation supplier. After investigation and review of transportation suppliers, 5 candidate transportation suppliers were finally screened out, and 3 logistics transportation suppliers were required to be selected for this task. Candidate transportation providers are denoted by A, B, C, D, and E, respectively.

In order to complete the logistics business, company Z decided to use the newly established index system to evaluate four transportation suppliers. According to the evaluation results, three qualified transportation suppliers were selected to cooperate with company Z. The specific operation procedures are as follows:

After three stages of investigation, review and in-depth investigation of alternative transportation suppliers by company Z, the relevant real and reliable data of each alternative transportation supplier have been basically determined. The values of the quantitative indicators are directly calculated from the surveyed data through the evaluation criteria in Table 2, while the values of the qualitative indicators are obtained by 30 experts who simulate and score according to the evaluation criteria in Table 1. By summarizing the recovered questionnaires, the average value of each index item was calculated. The specific data are shown in Table 2.

4.3. Performance Evaluation of Transportation Suppliers. Company Z is evaluating the performance of the three suppliers A, B, C, D, and E that have been assigned tasks. The staff of Z company counted three transportation suppliers to complete the survey and summary of the feedback data in this task, and the values of the quantitative indicators were directly calculated from the statistical data. By summarizing the data, the average value of each index item is obtained, and the result is shown in Figure 7.

The hierarchical structure of the performance evaluation of Z company's transportation suppliers is shown in Figure 8.

4.4. Z Company Transportation Supplier Analysis. The performance evaluation and assessment of Z company's transportation suppliers is to supervise the selection of high-quality suppliers to maintain a high service level and maintain a good cooperative relationship with the integrator Z company, which is an effective way to maintain the relationship in the later stage. Since the previous work has screened out high-quality suppliers that meet the requirements of company Z, in the performance evaluation stage, the obtained performance evaluation results can be directly used to implement hierarchical management of transportation suppliers. The standard of its classification is mainly based on the performance in the entire operation process of the supply chain, which is obtained through the ranking of Z company on the final performance evaluation stage of transportation suppliers, C is a strategic supplier, B is a competitive supplier, and D is a general alternative supplier.

Company Z's transportation supplier performance evaluation system mainly includes three parts: performance evaluation, incentive mechanism, and hierarchical management. These three parts are interlinked, and the performance appraisal results directly affect the classification level of transportation providers. The classification level corresponds to different reward and punishment measures, and the formulation of reward and punishment measures comes from the performance appraisal content of transportation suppliers. A dynamic performance evaluation system is formed between the three, which is one of the important contents of transportation supplier management. The scientific management of these three parts is conducive to creating an advantageous competitive environment for Z company, thereby improving its core competitiveness, and is conducive to the improvement of the service quality of transportation suppliers in the entire logistics service supply chain environment [31].

5. Discussion

First of all, through the study of relevant knowledge points of literature works, this paper initially masters the relevant basic knowledge, and analyzes how to research the logistics

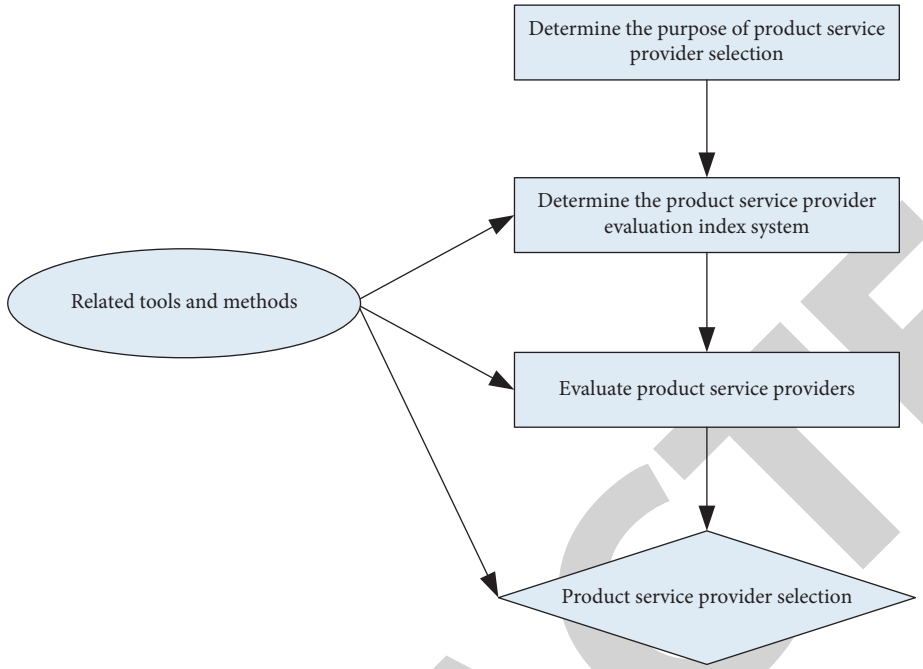


Figure 6: General process for supplier selection.

Table 1: The evaluation index system of logistics service supply chain suppliers.

First-level indicator	Secondary indicators	Three-level indicator	Element source
Z company transportation supplier evaluation index	X coordination ability	X1 core Enterprise Industry competitiveness	supply chain
		X2 logistics technology level	
	C logistics service cost	C1 logistics transportation cost	
		C2 energy consumption rate	
	I level of informatization	I1 information investment	supplier
		I2 systems share integration capabilities	
	R cooperation risk	R1 corporate reputation	integrators
		R2 collaborative	
		R3 financials	
	Q logistics service quality	Q1 logistics operation accuracy rate	client
		Q2 cargo damage rate	
		Q3 logistics operation speed	
		Q4 logistics service scope	
		Q5 customer satisfaction	

Table 2: Values of evaluation indicators for candidate transportation suppliers of Z company.

Index	Transport provider				
	A	B	C	D	E
Proportion of information technology investment (%)	5	9	10	7	8
Systems share integration capabilities	51	70	78	80	73
Core enterprise industry competitiveness	63	72	80	83	78
Logistics technology level	72	89	92	86	75
Corporate reputation	79	82	77	87	79
Collaborative development capability	80	78	81	7 9	88
Financial status	88	83	86	84	91
Logistics and transportation cost (yuan/ton ∗ km)	0.6	0.38	0.41	0.48	0.53
Energy consumption rate (%)	49	50	46	44	48
Customer satisfaction (%)	74	80	86	85	80
Scope of logistics services (piece)	148	185	178	158	139
Logistics operation accuracy rate (%)	79	80	88	90	77
Logistics operation speed (h/km)	51	58	60	56	49
Cargo damage rate (%)	7.5	5.5	6.4	6.3	8.2

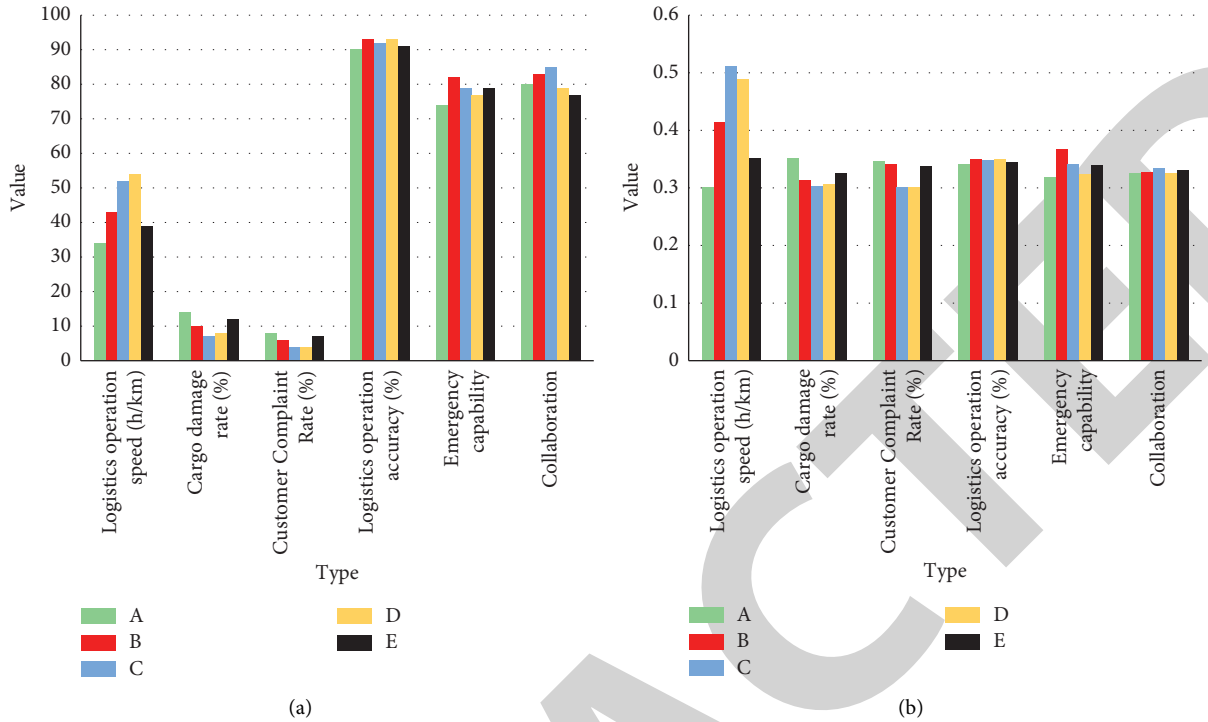


Figure 7: Transportation supplier performance evaluation: (a) Z company supplier performance index assessment; (b) index normalization results.

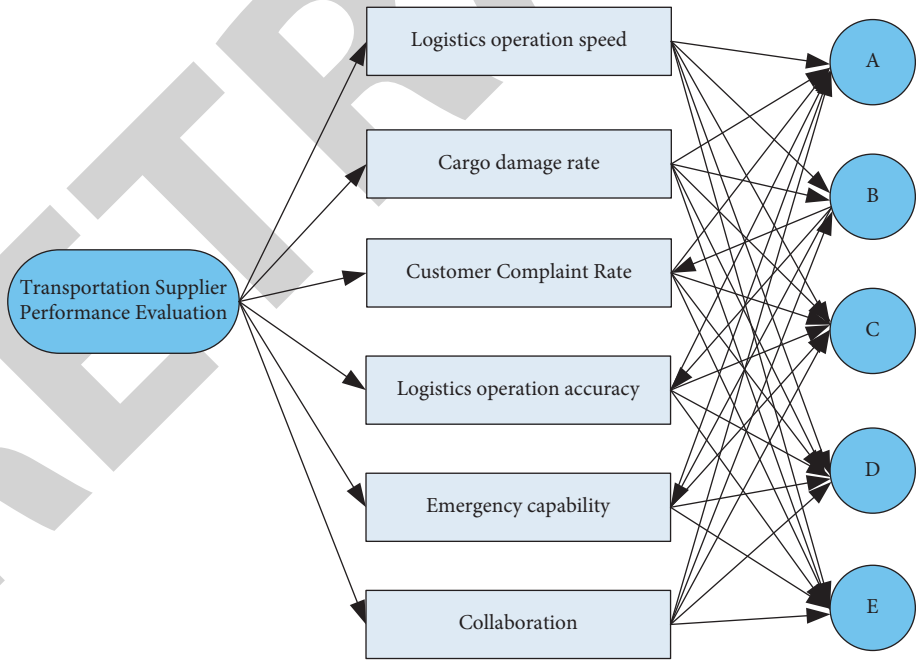


Figure 8: Performance Evaluation Hierarchy Diagram for Transportation Suppliers.

service supply chain model based on artificial intelligence and big data analysis. Then, the concept of big data analysis and related technical algorithms are expounded, focusing on data mining, exploring the algorithm application, and analyzing the logistics service supply chain mode through experiments.

This paper studies from the perspective of integrators in the logistics supply chain, taking the management of logistics enterprises as the research object, the transportation supplier of company Z. Aiming at the establishment, operation, and the development of the logistics service supply chain, the company has improved and effectively managed

the transportation suppliers of Z company, and has conducted in-depth analysis. Finally, a more reasonable and complete management system has been established and successfully applied [32].

Through experimental analysis, this paper shows that the customer satisfaction rate of supplier C reaches 86%, the accuracy rate of supplier D's logistics operations is as high as 90%, and the logistics transportation cost of supplier B is only 0.38 yuan/ton ∗ km. According to company Z's ranking of transportation suppliers in the final performance evaluation stage, C is a strategic supplier, B is a competitive supplier, and D is a general alternative supplier [33].

6. Conclusions

In different periods, the development model of the logistics industry is different. There are differences in cultural backgrounds, differences in regions, and different types of logistics development. At this stage, there are relatively few studies on supplier management under the logistics service supply chain. The theoretical data and other contents that can be referenced in the actual operation process of each member of the logistics service supply chain are even more limited, especially for the selection of evaluation indicators and performance appraisal indicators. But with its gradual development, various related researches are bound to be more in-depth. For example, a more complete dynamic evaluation index system suitable for the actual situation has been established, and the dynamic evaluation control of the whole process has been adopted for performance evaluation, which has promoted the further improvement of the supplier management level in the logistics supply chain environment. This article only elaborates on the selection process of product service providers. Moreover, the elaboration of the new logistics service supply chain and the selection process of product service providers are still insufficient, and a large number of related issues have not been touched. Moreover, with the rapid development of information technology and the continuous growth of personalized and diversified logistics service requirements, there will be many problems to be studied in the field of logistics service supply chain.

Data Availability

No data were used to support this study.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Acknowledgments

The Central University Basic Scientific Research Business Expense subsidizes the project "A Comparative Study of Epidemic Emergency Management in China based on big data technology" (3142020006).

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