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Supply Chain Trust Evaluation Model Based on Improved Chain Iteration Method

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Abstract

The modern market is highly competitive. It has progressed from traditional competition between enterprises to competition between supply chains. To ensure that enterprise can form the best strategy consistently, it is necessary to evaluate the trust of other enterprises in the supply chain. First, this paper analyzes the background and significance of supply chain trust research, analyzes and expounds on the qualitative and quantitative methods of supply chain trust evaluation, and summarizes the research in this field. Analytic hierarchy process (AHP) is the most frequently used method in the literature to evaluate and rank criteria through data analysis. However, the input data for AHP analysis is based on human judgment, and hence there is every possibility that the data may be vague to some extent. Therefore, in view of the above problems, this study improves the global trust method based on chain iteration. The improved global trust evaluation method based on chain iteration is more flexible and practical, hence, it can more accurately evaluate supply chain trust. Finally, combined with an actual case of Zhaoxian Chengji Food Co. Ltd., the paper qualitatively analyzes the current situation of supply chain trust management and effectively strengthens the supervision of enterprises to cooperative enterprises. Thus, the company can identify problems on time and strategic adjustments can be implemented accordingly. The effectiveness of the evaluation method proposed in this paper is demonstrated through a quantitative evaluation of its trust in downstream enterprise A. Results suggest that the subjective preferences of and historical transactions together affect the final evaluation of trust.

Keywords

Chain Iteration, Supply Chain, Trust Evaluation

1. Introduction

In recent years, with the further development of science and technology and the improvement of productivity, the gradual formation of information globalization and economic globalization, the continuous improvement of consumers' consumption ability, the continuous changes in politics, the economy, and culture, and the further increase in the uncertainty of market supply and demand.

Traditional manufacturing resource planning (MRP), just-in-time production (JIT), and other management modes have failed to adapt to the requirements of current market environments. To take advantage of fierce market competition, reduce inventory, and quickly respond to market change, enterprises must optimize their own manufacturing industries and management modes, combine upstream and downstream enterprises and complement each other's advantages to improve their marketplace

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competitiveness. Supply chain management is the management mode of upstream and downstream enterprises. In recent years, market competition has significantly increased. To ensure the smooth operation of the entire enterprise, the decision-maker's choice of decision-making scheme in the supply chain should be considered, alongside how best to strengthen management ability and combine trust relationships.

Therefore, it is of great significance to study the trust relationship of supply chains for enterprise operation and supply chain operation. More enterprises are attaching importance to supply chain management. The enterprise business model has also changed from vertical integration to horizontal integration to strengthen cooperation and maximize competitive advantages.

Supply chain management differs from competition between traditional enterprises. It is the competition between the supply chain and others. Therefore, strengthening supply chain management is key to improving the competitiveness of enterprises. In supply chain management, it is necessary to evaluate the trust degree of supply chain partners. Only through the professional evaluation of the supply chain partner enterprises can we decide whether to continue cooperation and how to manage if we continue to cooperate. Quantitative evaluation of the supply chain trust relationship can establish and improve the supply chain partner evaluation system from the perspective of external enterprises, play the role of supervision, management and control, and provide a better basis for the selection of partner enterprises. From the perspective of internal enterprise, it can better regulate cooperation between the enterprise and supply chain partners.

As for the supply chain of its own enterprises, it can play the role of supervision and control for all enterprises in the supply chain, which is conducive to the multidirectional selection of all enterprises in the supply chain, the survival of the fittest, and competition between enterprises. However, it has been established that many traditional evaluation methods are difficult to apply, produce inaccurate evaluation results and cannot objectively evaluate supply chain trust. Therefore, it is necessary to study a more scientific and accurate quantitative evaluation method for this purpose. In addition, quantitative evaluation does not fully reflect the opinions of decision-makers. Therefore, qualitative evaluation must be combined with quantitative analysis. According to the decision-maker's risk preference, the quantitative data is given, and the optimal decision is made according to the enterprise's own planning.

The remainder of this paper is organized as follows. Section 2 presents a literature review. Section 3 introduces the improved chain iteration-based global trust assessment method. Section 4 qualitatively analyzes the current situation of supply chain trust management, quantitatively assesses its trust in downstream enterprise A, and verifies the rationality of the proposed model. Finally, Section 5 concludes the paper.

2. Literature Review

Research in supply chain trust can be conducted using two types of research methodology. The first is qualitative research, which is mainly conducted from the perspectives of sociology, institutional science, and economics, and the research results are abundant. The other methodology is quantitative research on the basis of qualitative analysis, that is, quantitative research. Owing to a lack of relevant theoretical research and lack of practical experience, research results are sparse and difficult to apply in practice. The following two directions are for the current research situation.

2.1 Quantitative Research Status

Currently there are several hot spots in quantitative research: statistics, agent technology, fuzzy theory, and game theory. Statistical empirical research is mainly conducted to analyze the factors that affect trust and quantify them using corresponding methods. Yan et al. [1] studied the relationship of supply chain trust, explored this in the supply chain network, and gradually achieved a balanced process. They used the concept of trust to quantify the trust relationship among members of the supply chain and designed a transfer mechanism and superposition mechanism of trust under different trust atmospheres.

Ayadi et al. [2] proposed a decision support system based on the information sharing dimension of supply chain trust evaluation. The system calculates the trust level by using a fuzzy decision support system to integrate the information sharing dimension through the level of information engineering and the quality of trust calculation level. Luo et al. [3] used the KMRW reputation model to design the corresponding restraint mechanism and incentive mechanism for limited repeated games. They believed that the reputation model provides recessive incentives for the trust and cooperation of both parties and established long-term strategic cooperation, which favors opportunistic compliance. The intervention of third-party credit regulators can restrain the opportunistic behavior of both parties in the transaction, reduce the information asymmetry between them, and minimize the risks in online buyout transactions.

Miao et al. [4] examined the process of establishing trust between members of the virtual supply chain and analyzed the related theories of one-time games, infinite repeated games, and evolutionary games. They pointed out that improving the functions of the third-party information service center plays an important role in building trust among members. By constructing a service value model, scholars such as Xu and Qin [5] analyzed the impact of service relationships between suppliers and manufacturers on information sharing and trust decision-making. They posited that if the service value of suppliers is high enough, then manufacturers will choose to truly share information. At this point, the supplier can fully trust the manufacturer's information. If the service value is low, then the manufacturer will use the fraud to magnify the demand information. The supplier should doubt the authenticity of the information shared by the manufacturer.

Chang et al. [6] defined general trust indicators in real supply chain settings and designed a multidimensional trust and reputation model. They introduced a K-mean clustering algorithm to remove unfair rating scores. Then, based on this trust and reputation model, they proposed a multicriteria decision-making approach based on variable weights and satisfaction principles. Hou et al. [7] built a dynamic supply chain network where firms can select suppliers according to the trust, selling price, or just randomly. Simulation results showed that the trust-based rule can significantly increase the aggregated working capital and decrease the likelihood of bankruptcy. Moreover, a firm's sizes under trust-based and price-based rules follow power-law distributions. However, those under trust-based and randomly chosen rules are similar to those of a random network.

Fu et al. [8] proposed a quantitative method to study the trust relationship between a retailer and an agent in the supply chain. They studied how repeated interaction and updated trust influence decisions of the retailer and the agent and their impacts on supply chain performance. They also investigated how the social characteristics of the agent affect the decisions and supply chain performance. Josang and Ismail [9] proposed a reputation system based on the beta probability function in 2002. However, he neglected the fact that trust is difficult to establish, so the evaluation is blind in positive and negative evaluations. Griffiths [10] evaluated trust from four attributes of interaction, including the ability to complete tasks,

timeliness, and transaction results. However, some qualitative problems are not convincing in practical application.

Kaihara [11] formally described trust transfer, reasoning, and fusion using Bayesian probability and statistics, and showed the evolution process of supply chain trust based on game theory. However, he did not discuss it in light of the preferences of policymakers. Harrison et al. [12] proved that the preference of purchasing managers can affect supplier selection, which is an important factor in the selection of supplier behavior, and found that budget also affects the preference of purchasers. Nyaga et al. [13] believed that operational performance should be defined from the perspective of order production. In his research, he used four indicators to measure operational performance: shortening order cycle, improving order processing accuracy, improving punctual delivery rate, and increasing predictive accuracy. Operational performance is one aspect of trust evaluation, and it should also be considered. Information factors were considered, and the evaluation of operational performance also involved cost control and other aspects of capital turnover. Many other scholars asserted that the supply chain has a negative effect on enterprise performance [14,15].

Zhu and Pan [16] focused their research on supply chain member enterprises and explored the possible relationship between supply chain organizational trust, commitment, personal trust, and supply chain cooperation benefits by building theoretical models and empirical verification. There is a positive correlation between trust and cooperation returns. Mutual trust can indeed be a positive factor in the return of cooperation, but in practice, it is necessary to consider the possible existence of mutual trust. Panayides and Lun [17] found that the positive role of trust can bring higher performance to supply chains through the analysis of questionnaires survey data, and structural equation. However, the premise of higher performance is cooperation, the premise of cooperation is credible, there is no mutual trust evaluation, and higher performance is just empty talk. Honhon et al. [18] described how retailers choose suppliers and order quantities based on the supplier scorecard system (including past performance, quality, service, geographical location, and financial strength) to maximize their expected profits. The author proposed an effective algorithm to obtain the optimal solution. However, this only describes the optimal strategy of retailers based on suppliers and cannot be applied to the entire supply chain.

Smith and Dhillon [19] discussed the use of blockchain technology as a mechanism for facilitating trust between various supply chain agents. Doroudi et al. [20] modeled a pharmaceutical supply chain with boundedly rational artificial decision-makers capable of reasoning about the motivations and behaviors of others. The agents possess a Theory-of-Mind capability to reason about the beliefs and past and future behaviors of other agents, which enables them to assess other agents' trustworthiness. In a study by Liu and Ran [21], environmental uncertainty (supplier uncertainty, technical uncertainty), supply chain partnership (goodwill trust, ability trust, emotional commitment, computational commitment) and capacity (technology) were examined.

The research results of Yang et al. [22] showed the mediating effects of interorganizational knowledge trading (explicit knowledge trading and tacit knowledge trading) on the relationships between supply chain partnership (shared goal, trust, and relationship commitment) and enterprise innovation performance. Li et al. [23] analyzed the tendency of coordinated decisions, and evolutionary game models concerning traditional and trust mechanisms were developed. Computational studies based on hypothetical data were then simulated to validate the effectiveness of the proposed model. The results indicated that trust had a significantly positive impact on coordination promotion under the support of potential returns and high-level trust. Giannoccaro and Iftikhar [24] adopted a recent conceptualization

of network-level trust and developed an agent-based model of the supply network, simulating its resilient performance. A simulation analysis was carried out to assess the effect of trust on the resilience of supply networks with different interdependence structures. The results confirmed that trust positively affects supply network resilience.

Kamisah et al. [25] examined the influence of halal practices integrity on halal supply chain trust and supply chain performance. Structural equation modeling with partial least squares was used to analyze the collected data. The findings showed that halal integrity is significantly related to halal supply chain trust and supply chain performance. Shete et al. [26] believed that supply chain coordination and trust stand at the third rank. This implies that creating an environment of mutual coordination and trust among the supply chain partners is necessary. Coordination and trust between supply chain members increases responsiveness. The results in [27] suggested that the importance of complementary capability development depends on organizational culture, within which an organization operates during emergencies to build trust and improve collaboration.

2.2 Qualitative Research Status

At present, most of the qualitative research involves the economics, sociology, and other aspects of the trust factors among enterprises, the establishment process, and maintenance mechanisms. Das and Teng [28] divided trust, perception, and control into three dimensions. Perception is divided into relationship and performance, trust is divided into goodwill trust and ability trust, and control is divided into behavior control, result control, and social control. They believed that different kinds of connections existed among different types of perception, trust, and control in general, however, they conducted only qualitative research without quantitative evaluation of their relationship. This cannot be sufficiently applied in practice. Shi et al. [29] described the trust relationship among enterprises using the utility function. They examined the influence of selfish, reciprocal, and mutual benefit on cooperation among enterprises.

Fawcett et al. [30] believed that trust in the supply chain is based on ability. For the company, commitment and execution in the relationship are what the company needs. The company's capabilities are related to the quality of materials, their costs, and the efficiency of delivery. Nold [31] concluded that companies that are dependent on and work for organizations often tend to be more productive than those with lower levels of trust. For example, cultural attributes facilitate knowledge sharing and facilitate efficient knowledge processes, resulting in innovation and flexibility that reflect higher growth rates. Zeng and Wu [32] constructed a theoretical model of the relationship between government support, trust, and external integration in the supply chain. He used structural equation as a tool and conducted empirical research on the relationship between government support, customer trust, supplier trust, customer integration, and supplier integration.

Some scholars, such as Singh and Teng [33], focused on five factors: information technology integration (IT), interorganizational trust (TR), relational governance (RG), transaction cost (TC), and supply chain performance (PE). Their theoretical models clarified that there are two common resources that locate the complex relationship of the supply chain among the five factors: TR and IT. As an independent variable, the impact measure involves performance and transaction costs. RG promotes joint decision-making and theoretically plays a central role in the measurement of resources and outcomes. To achieve resilience and avoid risk blindness, empowered organizational cultures based on trust and respect are considered vital [34]. Singi et al. [35] presented a delivery governance framework based on distributed

ledger technology that uses the notion of "software telemetry" to record data from disparate delivery partners and enables compliance monitoring and adherence, provenance and trace ability, transparency, and thereby trust. In the field of services, little research has focused on the issue of the company's SCM. Bentalha et al. [36] sought to identify the concept of SCM in services and its specificities, and then that of digitization of the SCM and its organizational dimension. Trust and commitment are identified as the main promoting factors [37].

These empirical findings have implications for supply-chain risk managers considering the implementation of joint risk management activities. Koberg and Longoni [38] proposed that third-party multi-industry standards facilitate coordination in a supply chain by improving the information flows through the supply chain, reducing information asymmetries, and building trust between buyers and suppliers. In the research of Wang and Fang [39], after a long period of product research and development, these mature manufacturers have accumulated rich research and development experience and have conquered many core technologies. In addition, their products have earned trust from users, occupy a certain market share, and even monopolize the market to a certain extent.

The business and economic attributes of "the supplier" are two-fold: strategic performance measures such as consistent quality, delivery speed, conflict resolution, innovativeness; and organizational factors such as feeling of trust, technological compatibility, and communication openness [40]. Gaining competitive advantage by means of supply chain management means sharing information that is perceived as evidence of trust between partners [41]. The type and range of information shared indicates the level of trust.

In the first round of the simulation experiment in [42], it emerged that relationship maturity, and in particular trust, are key when it comes to intercompany finance; they determine both the level of openness as well as the acceptance and success of supply-chain finance schemes. The integration of big data technology and supply chain ideas into the cost management of enterprises [43] not only solves the problem of information and resource sharing among various departments but also reduced the operation costs of the internal supply chain. When this was achieved, the companies in the supply chain cooperated and gained trust in each other.

3. Improved Chain-Iteration-based Global Trust Assessment Method

This method calculates local trust based on the historical transaction records of nodes, calculates the satisfaction degree of neighboring nodes iteratively, and finally obtains the global trust degree. Each node in the network has a unique global trust value. In this method, the local trust value between nodes is calculated by a binary method, such as in Formula (1).

$$s_{ij} = \mathrm{sat}(i,j) - \mathrm{unsat}(i,j) \tag{1}$$

The value of sat(i,j) denotes the number of successful transactions, and unsat(i,j) denotes the number of unsuccessful transactions. The local trust degree is normalized into the [0,1] interval by Formula (2), while c_{ij} is the local trust degree of node i to node j.

$$c_{ij} = \frac{\max(s_{ij},0)}{\sum \max(s_{ij},0)} \tag{2}$$

The matrix C = $|c_{ij}|$, which is composed of the local trust degree of all nodes in the network, forms a recommendation trust relationship between neighboring nodes. Thus, the global trust degree of any node K in the network can be obtained through Formula (3).

$$T_k = (1-\alpha)\ \Sigma(c_{ij} * c_{jk}) + \alpha_{ti} \tag{3}$$

Among them, α belongs to [0,1], which is the weight factor of the fusion operation. The value of α depends on the number of historical interaction experiences between enterprises. The higher the number, the greater the value, generally speaking, and α is not less than 0.5.

t_i denotes node i's current direct transaction satisfaction, and t_i = number of satisfactory transactions/ total number of transactions.

The trust degree of any global node can be calculated. However, the current direct calculation method cannot be used to accurately evaluate direct cooperation enterprises. Moreover, the formula used in this method is based on the situation of many transactions. Otherwise, there is a possibility of a negative value. Therefore, we use chain iteration to improve the global trust method.

On the basis of the original method, which is not suitable for evaluating the trading indicators of direct trading companies, we advance the original method. Before each cooperation, we first provide a general trust value, where the initial general trust value is set at 0.5. Then, we can combine the comprehensive trust coefficient α with the data of previous transactions and the comprehensive coefficient β. Then, we obtain Formulas (4), (5), and (6).

$$C_{ij} = 0.5 + \alpha S_{ij} - \beta K_{ij} \tag{4}$$

$$S_{ij} = \frac{sat(i, j)}{sumsat(i, j)} \tag{5}$$

$$K_{ij} = \frac{unsat(i, j)}{sumsat(i, j)} \tag{6}$$

Among them, sat(i, j) denotes the number of successful transactions, and unsat(i, j) denotes the number of unsuccessful transactions. The value of sumsat(i,j) denotes the total number of transactions. The values of α and β are between 0 and 1, and because it is often difficult to establish trust, the values of β are often larger than α. Simultaneously, the values of α and β are often influenced by the preferences of decision-makers, hence they are not quantitative.

Thus, the improved global trust evaluation method based on chain iteration is more flexible, more practical and based upon a scientific approach.

4. Analysis and Assessment of Supply Chain Trust of Zhaoxian Chengji Food Co. Ltd.

4.1 Supply Chain Trust Qualitative Analysis of Zhaoxian Chengji Food Co. Ltd.

Zhaoxian Chengji Food Co. Ltd. paid more attention to supply chain trust and carefully chose supply chain partner enterprises. This is necessary for a young company. In recent years, the company's

management strengthened and attached importance to the evaluation of supply chain trust, but in the process of investigation, some problems were still found.

(i) Supply chain management is not included in the formulated strategy.

Management has not formulated a reasonable supply chain trust management plan according to the subjective presumptions of decision-makers, nor has it formulated a quick solution when the trust level of the cooperative enterprise is low, nor has it evaluated the overall trust level of the supply chain. Rather, only the upstream and downstream enterprises were examined, and the evaluation is not sufficiently comprehensive.

(ii) The supply chain trust management system of Zhaoxian Chengji Food Co. Ltd. has not been established.

Although the company's management and evaluation system involves trust control of external enterprises, it has not formed an effective system. There is no complete trust management system to improve cooperation efficiency, maximize cooperation efficiency, reduce unnecessary inventory, and increase the flexibility of market response. Market competition is the competition between supply chains. Zhaoxian Chengji Food Co. Ltd. should not only consider the trust evaluation of cooperative enterprises but also the entire supply chain.

(iii) The evaluation method of supply chain trust is not scientific enough.

Zhaoxian Chengji Food Co, Ltd. uses simple economic methods to evaluate the supply chain, ignoring the fact that trust is difficult to establish, and does not include the subjective factors of decision-makers. Thus, the evaluation results are inevitably inaccurate and differ from expectations.

The chain-iteration-based global trust method is used to calculate the trust degree of downstream company A. It is mainly based on the record of past transaction data of Zhaoxian Chengji Food Co. Ltd. and can be based on five main aspects for reference. The reference indicators of the five aspects are shown in Table 1.

Table 1. Trust assessment indicators

Reference indicators of five aspects	Detailed description
Information	Whether the cooperation information can be kept secret and self-information cannot be disclosed.
Operational	Ability to execute contracts and control costs
Decision-making	Decision-making behavior disgusted by decision-makers
Social	Corporate reputation and policy change
Investment	Investment in fixed assets and other investments

In the application of Zhaoxian Chengji Food Co. Ltd. the i node is Zhaoxian Chengji Food Co. Ltd. and the j node is a factory.

In the process of calculating the local trust value between nodes, because we need to evaluate each index, we empower each index in the improved chain-iteration-based global trust method. The final trust degree is determined by the normalized value empowerment, so the evaluation of the trust degree is more in line with the actual situation. It has a higher reference value.

As a member of the entire supply chain from raw materials to production, processing, distribution, and retail, Zhaoxian Chengji Food Co. Ltd. can look at the present situation and also pay attention to its own interests. The current competition in the free market is no longer the competition of a single enterprise and similar enterprises, but the competition of the entire supply chain in the final analysis. The trust evaluation of this supply chain should not only look at the upstream and downstream enterprises but also analyze and understand the entire situation. The improved global trust method based on chain iteration can flexibly calculate the trust situation between local nodes and also control the trust situation of the whole in order to strengthen the supply chain.

This study evaluates the trust degree of downstream company A by using the global trust method based on chain iteration. This is mainly based on the record of past transaction data of Zhaoxian Chengji Food Co. Ltd. and can be given as the following indicators.

In order to evaluate downstream enterprise A, we need to collect data from Zhaoxian Chengji Food Co. Ltd. We collated and counted the cooperation data of Factory A in five years as recorded by Zhaoxian Chengji Food Co. Ltd. The results are shown in Table 2.

Table 2. Assessment indicator data statistics

Indicators	Number of occurrences	Total number of cooperation
Can cooperation information be kept secret?	2	17
Decision-making behavior disgusted by decision-makers	5	17
Corporate reputation	13	17
Investment in fixed assets	8	17
Do not disclose your own information	4	17
Contract performance ability	9	17
Cost control capability	16	17
Policy changes	1	17

4.2 Quantitative Assessment Trust of Factory A

In the application of Zhaoxian Chengji Food Co. Ltd. to factory A, the i node is Zhaoxian Chengji Food Co. Ltd. and the j node is Factory A. In the process of calculating the local trust value between nodes, because we need to evaluate the corresponding indicators, we empower each indicator in the original chain-iteration-based global trust method, and the final trust degree is determined by the normalized value empowerment.

First, the paper calculates several trust evaluation indexes of factory A and uses Formula (7):

$$S_{ij} = \frac{sat(i, j)}{sumsat(i, j)} \tag{7}$$

Calculate the positive value of trust S_{ij}. sumsat(i,j) represents the total number of transactions, unsat(i,j) represents the number of transaction exceptions, and sat(i,j) represents the number of normal transactions. Calculate the negative value of trust K_{ij} using Formula (8):

$$K_{ij} = \frac{unsat(i, j)}{sumsat(i, j)} \tag{8}$$

Using the comprehensive trust coefficient and comprehensive coefficient combined with the subjective factors of the decision-maker, the trust degree of each index is calculated. Then, the weighted average is used to obtain the final trust degree by Formula (9):

$$C_{ij} = 0.5 + \alpha S_{ij} - \beta K_{ij} \tag{9}$$

In this case, the decision-makers are divided into disgust type and preference type. According to the preference of the decision-makers, the comprehensive trust coefficient and the comprehensive coefficient are selected.

For the risk aversion decision-maker, set α1 = 0.4 and β1 = 0.4. According to the formula, calculate the credibility of the corresponding evaluation indicators, and obtain Table 3.

Table 3. Trust assessment indicators under risk aversion

Indicators	Weight	S_{ij}	K_{ij}	C_{ij}	After weighting C_{ij}
Can cooperation information be kept secret?	7	0.882	0.118	0.806	5.639
Decision-making behavior disgusted by decision-makers	4	0.701	0.299	0.661	2.643
Corporate reputation	6	0.235	0.765	0.288	1.728
Investment in fixed assets	4	0.529	0.471	0.523	2.093
Do not disclose your own information	5	0.764	0.236	0.711	3.556
Contract performance ability	7	0.471	0.529	0.477	3.338
Cost control capability	8	0.059	0.941	0.147	1.178
Policy changes	4	0.941	0.059	0.853	3.411

By averaging the weighted C_{ij}, we obtain the trust c_{ij} between the two nodes, that is, Zhaoxian Chengji Food Co. Ltd. and Factory A.

$$c_{ij} = \frac{5.639+2.643+1.728+2.093+3.556+3.338-1.178+3.411}{45} = 0.524$$

Therefore, in the case of risk aversion, when Zhaoxian Chengji Food Co. Ltd. cooperated with factory A again, the trust evaluation value of factory A was only 0.524.

In the case of the risk preference decision-maker, set α1= 0.65 and β1 = 0.3. According to the formula, the credibility of the corresponding evaluation indicators is calculated, and Table 4 is obtained.

By averaging the weighted C_{ij}, we obtain the trust c_{ij} between the two nodes, that is, Zhaoxian Chengji Food Co. Ltd. and Factory A.

$$c_{ij} = \frac{7.265+3.464+2.540+2.810+4.629+4.532+2.048+4.376}{45} = 0.704$$

Therefore, in the case of the preferences of decision-makers, when Zhaoxian Chengji Food Co. Ltd. cooperates with Factory A again, the trust evaluation value Factory A is 0.704.

Table 4. Trust assessment indicators with regard to risk preference

Indicators	Weight	S_{ij}	K_{ij}	C_{ij}	After weighting C_{ij}
Can cooperation information be kept secret?	7	0.882	0.118	1.038	7.265
Decision-making behavior disgusted by decision-makers	4	0.701	0.299	0.866	3.464
Corporate reputation	6	0.235	0.765	0.423	2.540
Investment in fixed assets	4	0.529	0.471	0.703	2.810
Do not disclose your own information	5	0.764	0.236	0.926	4.629
Contract performance ability	7	0.471	0.529	0.647	4.532
Cost control capability	8	0.059	0.941	0.256	2.048
Policy changes	4	0.941	0.059	1.094	4.376

Comparing the above two situations and results, the subjective preferences of decision-makers and historical transactions together affect the final evaluation of trust.

4.3 Evaluating Trust of Other Enterprises in Supply Chain

In the supply chain network, all nodes, that is, all supply chain enterprises, evaluate each other's trust degrees. The trust degrees can form matrix $C = |c_{ij}|$, and the trust relationship between upstream and downstream enterprises will become a recommendation trust relationship. Therefore, the global trust degree of any enterprise X in the supply chain can be shown by Formula (10):

$$T_x = (1-\gamma)\ \Sigma(c_{ij} * c_{jx}) + \gamma_{ti} \tag{10}$$

The values of γ are between 0 and 1, which is the weight factor of the fusion operation. The historical transaction quantity experience of upstream and downstream enterprises often has an impact on the alpha. The greater the number, the greater the value. The parameter t_i denotes node i's current direct transaction satisfaction. t_i = number of transaction satisfaction/total number of transactions.

5. Conclusion

On the basis of summarizing the research status of supply chain trust at home and abroad, this paper analyzed the supply chain trust of Zhaoxian Chengji Food Co. Ltd. according to its actual situation, and identified the challenges for its supply chain trust. This improved the global trust based on chain iteration. The method was applied to Factory A, and the results were recorded. The risk preferences of the decision makers were explained. This method, combined with the risk preferences of decision makers is more valuable for reference. This compensates for loopholes in previous evaluations and can help enterprises obtain better results. Real and effective information can help managers make accurate decisions, which is beneficial to the development of enterprises.

The improved global trust method using chain iteration is based on historical transaction records. By sorting and summarizing the historical transaction records of various indicators, this method can be used

to evaluate the credibility of trading enterprises. If the entire supply chain is evaluated, then the global trust method based on chain iteration can be used directly on the premise that the credibility of all enterprises in all supply chains is evaluated. Therefore, in the practical application of our method, enterprises need to complete the division and record of various indicators.

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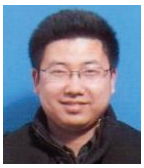

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