Application of Multi-criteria decision-making model in supplier determination in the textile industry – Application for Garment 10 Corporation.

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Abstracts - In our study, we focused on using the AHP and TOPSIS models to determine the supply chain in the textile industry in Vietnam. Establishing a successful supply chain management system is a crucial objective for businesses because it plays a significant role in optimizing business operations, cost-saving, and enhancing competitiveness through changes in raw material sources or streamlining the process of goods and service circulation. Through comprehensive research, we identified the key factors that influence the supply chain in the textile industry, which also served as the nine criteria for our model. Regarding methodology, we developed the research model, outlined the steps for its implementation, and specified the tools to be used at each stage. Furthermore, we applied the selected criteria and the model to the case of Garment 10 Corporation, involving three experts and five potential options, which ultimately helped us identify a suitable supplier for the company. The results exhibit a balanced combination of theoretical and practical approaches, making them highly applicable and valuable in the textile industry.

Keywords- The textile industry, supply chain, Multiple-Criteria Decision-Making Model, AHP, TOPSIS, multi-criteria, weighted sum.

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1. INTRODUCTION

Currently, in the textile industry, businesses face fierce competition and increasing pressure. Organizations need to find ways to optimize the production process and supply chain management to survive and thrive. In this process, selecting reliable and quality material suppliers is crucial.

However, the supplier selection process is not always easy and reliable. Without an effective supply chain management process, businesses may encounter various types of waste in their production activities. These wastes include waste of overproduction, waste of talent, waste of waiting, waste of inventory, etc.

To address these issues, supplier selection is a significant concern for any manufacturing or

service organization today, as it significantly impacts the goods or services provided by the organization. Supplier selection is an important activity to achieve high product quality, supply chain efficiency, and organizational effectiveness. The process by which companies identify, analyze and contract with suppliers is called "supplier selection" (Taherdoost & Brard, 2019) [18]. The main goal of supplier selection is to minimize the risks of purchasing, maximize the total value for the buyer, and establish long-term and close relationships between the buyer and the supplier (Rezaei & Behnamian, 2021) [15]. The supplier selection process consumes a significant amount of a company's financial resources and is crucial to the success of an organization. The author demonstrated that appropriate supplier selection significantly reduces procurement costs and enhances a business's competitiveness.

Therefore, the evaluation and determination of the supply chain for a textile company is essential to increase production efficiency, ensure product quality, and enhance market competitiveness. Supply chain management methods and tools can also improve production productivity, reduce production cycle time, and optimize the product supply process. This study aims to help businesses make the most appropriate supplier selection decisions.

2. LITERATURE REVIEW

2.1. Theoretical basis

2.1.1. Review of Supply Chain

Some concepts related to the supply chain:

According to Christopher Martin (2018) [12], The supply chain is defined as a network of organizations, activities, resources, and information involved in the production and delivery of products and services to end customers. This concept encompasses the system and the relationship between resources and information in the process of manufacturing and supplying products.

A supply chain is the management process of activities involved in creating and delivering products, and services to end customers, including activities from material suppliers to production, storage, and transportation. This concept includes not only manufacturing and delivery but also transportation and customers.

So, what is a supply chain? A supply chain includes all businesses that participate, directly or indirectly, in meeting customer demands, representing the movement of materials throughout the process from initial suppliers to end customers. The supply chain encompasses all businesses and departments directly or indirectly related to meeting customer needs. It includes not only manufacturers and suppliers but also transportation companies, warehouses, retailers, and customers. The supply chain involves multiple businesses, and each business can participate in various supply chains. Different products and services will form and exist in different supply chains.

In the textile industry, suppliers consist of businesses that provide products, manpower, services, capital, and other resources to the textile

companies to manufacture their products such as clothing and footwear.

Selecting suppliers involves finding businesses that can optimize value and cost while effectively managing risks during the operational processes.

2.1.2. Criteria

The factors influencing suppliers include the following:

Price

Based on the study conducted by Lee and Park (2018) [11], it is revealed that they directly influence the profitability and competitiveness of businesses. Increases in raw material and labor costs can raise production costs and impact sales and profits as they constitute a significant portion of the total production expenses, thereby affecting prices. Prices, in turn, can lead to a decline in product quality and disrupt the stability of the supply chain.

Product Quality

The studies by Park and Kim (2020) [14] suggest that product quality is highly important for textile businesses. This is because product quality is one of the most crucial factors in maintaining and expanding market share. High-quality textile products contribute to increased production efficiency and the establishment of a reliable brand.

Delivery time

The studies by Hossain et al. (2021) [6], Dharmadhikari and Kulkarni (2017) [5], and Naik and Patil (2018) [13] indicate that delivery time is considered a crucial factor in meeting customer demands and is an important metric to measure the effectiveness of the supply chain. The ability to respond quickly and reliably to customer orders can lead to customer satisfaction and foster customer loyalty. Additionally, delivery time also affects the inventory and financial management capabilities of businesses, influencing the enhancement of efficiency and competitiveness within the textile industry's supply chain.

Service quality

The studies by Huang et al. (2020) [7], Zhao et al. (2020) [20], and Chen et al. (2019) [3] suggest that service quality plays a crucial role in evaluating suppliers for textile businesses because it directly influences the customer experience. It is the most important factor in maintaining customer relationships and establishing the foundation for long-term relationships and future orders. High service quality enhances market accessibility and attracts and retains customers.

Performance

According to Tran et al (2021) [19], performance is a crucial factor in evaluating suppliers for the textile industry. It directly impacts a business's ability to provide products on time, in sufficient quantities, with good quality, and at reasonable prices for customers. An efficient and reliable supplier not only helps save time and money for textile businesses but also enhances market competitiveness. Furthermore, according to the research by Lee and Park (2021) [10], performance also influences the financial situation of textile businesses. When suppliers meet delivery deadlines and quantity requirements, businesses can fulfill customer demands and increase sales. This contributes to improved profitability and

competitiveness. Conversely, poor performance exposes businesses to risks such as product shortages, contract violations, and unwanted costs.

Sustainability

The studies by the International Textile Manufacturers Federation (ITMF) (2018) reveal that the textile industry is the largest consumer of resources and energy globally, leading to negative environmental impacts. Therefore, textile businesses need to ensure sustainability in their supply chains to create stability and enhance their competitiveness. The sustainable factors in supplier evaluation include resource management, risk management, business ethics, and social responsibility. Suppliers with high sustainability tendencies are more likely to provide higher-quality products and services, as well as strengthen long-term relationships with their customers. In this context, sustainability is becoming an important and necessary factor in assessing and selecting suppliers for textile businesses, ensuring the sustainable development of this industry while protecting the environment and society.

Flexibility

Flexibility allows suppliers to quickly and adaptively respond to the diverse and changing production requirements of customers. In the textile industry, customers often demand products that meet various standards and requirements, ranging from style to quality and size. The flexibility of suppliers has a positive impact on cost efficiency and overall supply chain effectiveness (Kim & Park, 2018) [9], helping to increase the resilience of businesses to fluctuations in the business environment (Chiarini & Marzi, 2021) [4], and is related to the success of businesses in maintaining and developing markets. Additionally, flexibility in service and product delivery also helps create a competitive advantage for textile businesses. Flexibility in product and service design helps create competitive differentiation and value for customers, thereby enhancing customer attraction and retention. The study by Sharifi et al. (2019) [16] also indicates that supplier flexibility is an important factor in optimizing the production process and minimizing waste in the supply chain of textile businesses.

Reputation

Reputation is an important factor in evaluating suppliers for textile businesses because it directly relates to the image and reputation of the business in the market. If a supplier has a good reputation, it means they can provide quality products and services, at reasonable prices, ensure timely delivery, and be flexible in production and supply. Furthermore, according to the research by Aragon-Correa et al. (2017) [2], the reputation of suppliers also influences the ability to attract investors and banks. Suppliers with a good reputation are more likely to attract more investors and banks, thereby helping businesses obtain capital for development and business expansion. Kim et al. (2019) [8] state that businesses often make investment decisions based on factors such as product quality, price, flexibility, and reliability of suppliers, and reputation is one of the most important factors among them. Alan et al. (2017) [1] have highlighted

the role of supplier reputation in determining the relationship between businesses and suppliers.

Technology

Due to the increasing competition in the textile and apparel industry, suppliers with high technological capabilities will help textile businesses utilize advanced technologies to enhance product quality, reduce production costs, and increase efficiency. Additionally, technology also influences the ability to provide products and services to suppliers. According to the research by Singh and Smith (2018) [17], suppliers with high technological capabilities can provide higher-quality products and services, thereby enhancing the competitiveness of businesses in the textile industry. Moreover, technological capability also influences the ability to respond to market demands and changes quickly, enabling suppliers to adapt and respond quickly to market changes and customer needs.

Below is a summary of the factors influencing suppliers in the textile industry:

TABLE 1
SUMMARY OF FACTORS INFLUENCING SUPPLIERS IN THE TEXTILE INDUSTRY

No.	Criteria	Explanation
1	Price	Influences profitability and competitiveness
2	Product quality	Enhances production efficiency and brand value
3	Delivery time	Measures efficiency and inventory management
4	Service quality	Impacts customer experience and brand reputation
5	Performance	Supplier's effectiveness in providing benefits and building trust
6	Sustainability	Applied to environmental impact, resources, and risk management
7	Flexibility	Coordination among suppliers to meet customer requirements
8	Reputation	Strengthens business-supplier relationships and expands networks
9	Technology	Suppliers with advanced technology can offer better solutions and develop new products to meet customer needs more effectively

(Source: Author)

2.2. AHP Model with Fuzzy Set and TOPSIS Model

- ***Fuzzy Set:***

The concept of the fuzzy set was introduced by American professor Lotfi Zadeh at the University of California, although it was not initially well-received by scholars who regarded it as an extension of probability theory and statistics. It wasn't until the 1970s that the theory of fuzzy sets found application in controlling steam engines at Mary Queen University, UK. By 1983, it was first commercially applied in a water treatment plant by Fuji Electric in Japan, which made other scholars recognize the value of fuzzy sets and their distinction from statistical theory. Several

organizations support research and application of fuzzy theory worldwide, including IFSA, SOFT, BMFSA, LIFE, and FLSI. The application of fuzzy set theory in engineering has been present in Vietnam for a long time, but it has recently gained traction in economics.

According to Scholarpedia's definition, a fuzzy set is a mathematical model of imprecise qualitative or quantitative data, often generated by natural language. The model is based on generalizing classical concepts of sets and their characteristic functions.

In summary, fuzzy sets represent vague, semantic, and uncertain information through mathematical concepts.

- ***AHP Model***

The Analytic Hierarchy Process (AHP) is one of the multi-objective decision-making methods. AHP is a quantitative method used to rank decision alternatives and select one alternative that satisfies predetermined criteria. Additionally, AHP is a qualitative method expressed through a hierarchical arrangement. Based on pairwise comparisons, AHP can be described with three main principles: analysis, evaluation, and synthesis. The application of AHP to solve economic, political, social, and engineering design issues. The author mentioned AHP's applications in selecting architectural designs, pricing strategies, marketing strategies, technology choices, etc. Its goal is to quantify the relationships between the priorities of a set of given alternatives on a ratio scale based on evaluative opinions and emphasize the importance of intuitive judgments of the decision-makers and consistency in comparing alternatives through the pairwise comparison process.

- ***TOPSIS Model***

The TOPSIS method quantifies the relationships between the priorities of a set of given alternatives on a ratio scale. It is used to solve complex decision-making issues that involve multiple criteria and multiple choices. The TOPSIS method is a popular tool to solve multi-criteria decision-making (MCDM) issues. The main content of TOPSIS is to evaluate alternatives by simultaneously measuring the distances from the alternatives to the Positive Ideal Solution (PIS) and the Negative Ideal Solution (NIS). The chosen alternative should have the shortest distance to the PIS and the longest distance to the NIS.

2.3. Methodology

2.3.1. Data collection methods

Secondary data collection method

To evaluate and determine suppliers for the textile industry, the authors used various research methods such as synthesis, analysis, and comparison of data obtained from relevant studies both domestically and internationally regarding factors influencing supplier determination. Based on these secondary sources, the author synthesized and established a set of criteria to be used in the model.

Primary data collection method

The characteristic of the multi-criteria model is the expert interview in step 3. To conduct the expert interview, we prepared a questionnaire (Table 1). In the multi-criteria model, the number of experts

interviewed typically ranges from three to four experts. In this study, we interviewed three experts.

2.3.2. Data analysis method

The combined AHP - TOPSIS model uses fuzzy set theory and consists of two main components named Fuzzy AHP (the combination of fuzzy logic and the AHP method) and the TOPSIS approach.

This method provides the following implementation steps:

Step 1: Identify potential options.

In this step, we identify suppliers that are closely aligned with the textile industry based on the mentioned influencing factors. In other words, we eliminate suppliers that are not suitable for the textile industry. From this process, we obtain potential options: A1, A2, A3, and so on.

Step 2: Establish a decision-making committee.

One characteristic of this model is that decisions are made collectively involving multiple individuals. Therefore, a decision-making committee needs to be established. Typically, this committee consists of three to four experts.

Step 3: Determine the evaluation criteria.

As shown in Table 1.

Step 4: Determine the weights of the criteria.

The study utilizes Chang's (1996) fuzzy AHP model, which is widely known and user-friendly.

Step 5: Determine the proportional values of the options.

We use the model proposed by Luu Quoc Dat et al (2017) as follows:

Set $x_{ijt} = \left(e_{ijt},\ f_{ijt},\ g_{ijt}\right)$ where i =1, K, n; j =1, K, n, and t = 1, k, l is the appropriate ratio of Ai suppliers by decision maker Di, and the mean $x_{ij} = \left(e_{ij},\ f_{ij},\ g_{ij}\right)$ is given by the following formula:

$$x_{\mathrm{ij}} = \frac{1}{l} \otimes \left(x_{\mathrm{ij1}} \oplus x_{\mathrm{ij2}} + \ldots + x_{\mathrm{ijl}}\right) \quad \text{where}$$

$$e_{\mathrm{ij}} = \frac{1}{l}\sum_{t=1}^{l} e_{\mathrm{ij}t},\ f_{\mathrm{ij}} = \frac{1}{l}\sum_{t=1}^{l} f_{\mathrm{ij}t},\ g_{\mathrm{ij}} = \frac{1}{l}\sum_{t=1}^{l} g_{\mathrm{ij}t}$$

To standardize options, the following is used:

Assume $r_{ij} = \left(a_{ij},\ b_{ij},\ c_{ij}\right)$ is the average value of supplier i for standard j. The normalized value is divided into 2 cases.

Case 1: For cost standards B (Textile enterprises must spend value):

$$x_{\mathrm{ij}} = \left(\frac{a_{\mathrm{ij}}}{c_j^*}, \frac{b_{\mathrm{ij}}}{c_j^*}, \frac{c_{\mathrm{ij}}}{c_j^*}\right),\ j \in B.$$

Case 2: For the beneficiary criteria C (Textile enterprises enjoy value):

$$x_{\mathrm{ij}} = \left(\frac{\overline{a_{\mathrm{j}}}}{c_{\mathrm{ij}}}, \frac{\overline{a_{\mathrm{j}}}}{b_{\mathrm{ij}}}, \frac{\overline{a_{\mathrm{j}}}}{a_{\mathrm{ij}}}\right),\ j \in C$$

In there:

$$\overline{a_j} = \min a_{\mathrm{ij}},\ c_j^* = \max c_{\mathrm{ij}},\ i = 1, K, n;\ i = 1, K, m.$$

Step 6: Calculate the final values.

To calculate the final value, we take the average value of the choices multiplied by the normalization coefficient based on the following formula:

$$G_{\mathrm{ij}} = \frac{1}{k}\sum_{j=1}^{k} g_{\mathrm{ij}} = \frac{1}{k}\sum_{j=1}^{k} x_{\mathrm{ij}} \otimes \mathrm{w}_j, i = 1, 2,\ \ldots, n$$

Then, calculate the positive ideal solution A+ (FPIS) with A^+ = (1.0; 1.0; 1.0) and the negative ideal solution A- (FNIS) with A^- = (0.0; 0.0; 0.0), calculate the distance from each choice to the ideal solutions, and calculate the closeness coefficient.

Calculate the distance from each choice A1, A2, A3, A4, A5 to the fuzzy positive ideal point and fuzzy negative ideal point using the Euclidean distance in n-dimensional space. Apply the formulas as follows:

Distance to the fuzzy positive ideal point:

$$d^+ = \sqrt{\sum_{i=1}^{n}\left(A_i - A^+\right)^2}$$

Distance to the fuzzy negative ideal point:

$$d^- = \sqrt{\sum_{i=1}^{n}\left(A_i - A^-\right)^2}$$

The closeness coefficient is used to determine the ranking order of the choices and is calculated as follows: $CC_i = \frac{d^-}{d^+ + d^-}$

d^-, CC_i is better when larger, and d^+ is better when smaller.

Step 7: Rank the options.

Select the supplier with the most optimal value calculated in Step 6

3. APPLICATION OF MCDM IN SUPPLIER SECTION FOR GARMENT 10 CORPORATION

3.1. Proposed Model

Based on research and references to domestic and International Topics, The Author Has Synthesized The Most Common observed variables and those addressed by multiple models. From there, the author proposes a research model with factors that the author considers important: (C1) Price, (C2) Product Quality, (C3) Delivery Time, (C4) Service Quality, (C5) Performance, (C6) Sustainability, (C7) Flexibility, (C8) Reputation, (C9) Technology.

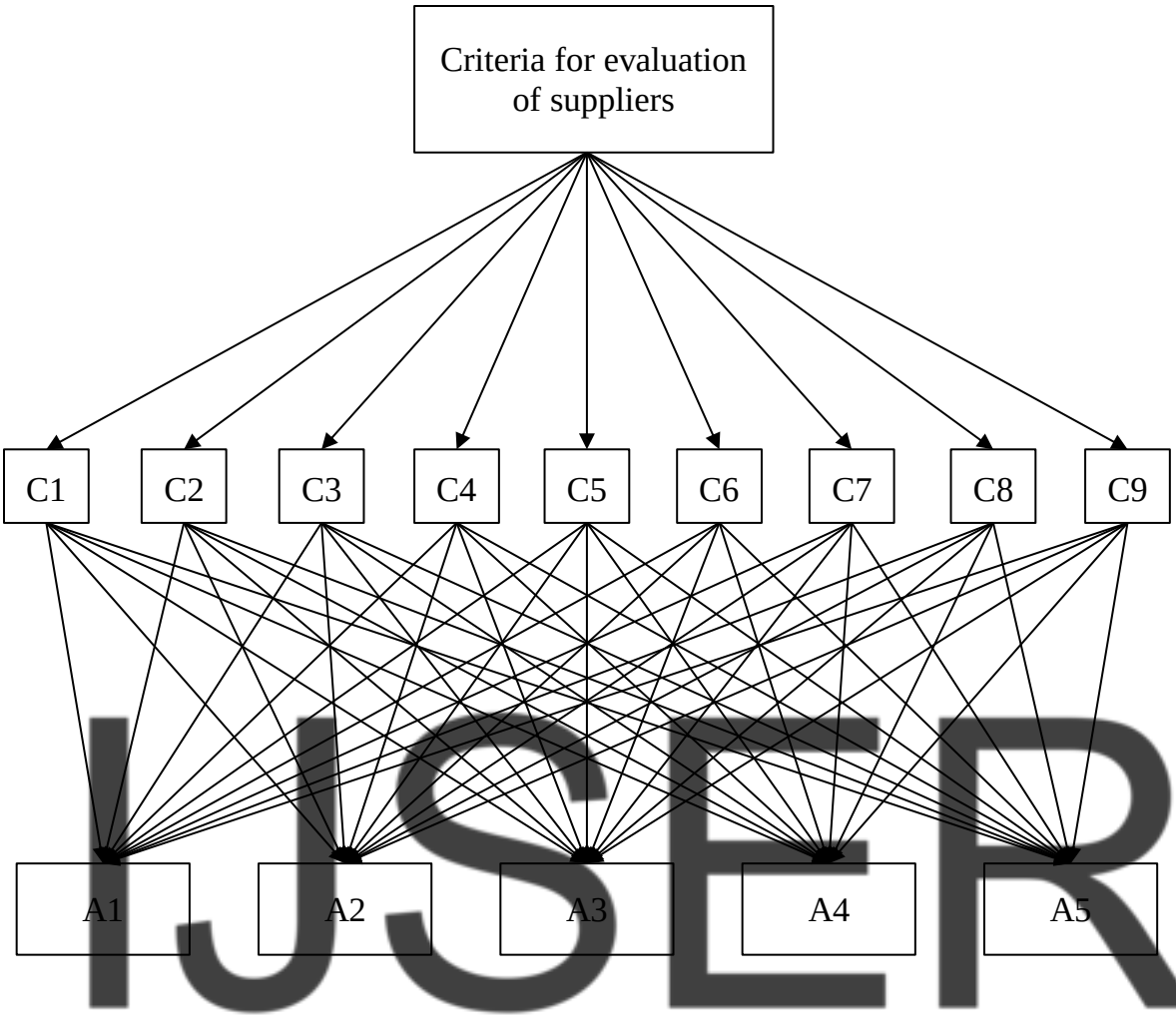
Criteria for evaluation of suppliers
C1
C2
C3
C4
C5
C6
C7
C8
C9
A1
A2
A3
A4
A5

Fig. 1. Proposed Research Model

(Source: Author)

3.2. Identify potential options

There are 5 potential choices presented:

A1: Thanh Cong Group

A2: Vinatex

A3: Phu Thanh Group

A4: Daewoo Vina

A5: Texhong Textile Group

3.3. Establish a decision-making committee

The decision council consists of 3 experts: D1, D2, and D3. All of them are experienced and have a deep understanding of the supply chain.

3.4. Determine the evaluation criteria

In this study, data was collected through interviews with experts who have a deep understanding of the supply chain. Three individuals among them were chosen to select and determine the weights of the criteria. By using the criteria from the literature review in Table 1, combined with the practical situation of supplier selection for textile enterprises in Vietnam, the research team selected a set of 9 criteria: (C1) Price, (C2) Product Quality, (C3) Delivery Time, (C4) Service Quality, (C5) Performance, (C6) Sustainability, (C7) Flexibility, (C8) Reputation, (C9) Technology.

3.5. Determine the weights of the criteria

After identifying the evaluation criteria and potential suppliers, the members of the decision council are requested to provide pairwise comparisons of the criteria using the AHP model combined with the TOPSIS model to determine the weights of the criteria.

In this step, the decision council will evaluate the choices based on the given set of criteria. The opinions of the decision council are expressed through specific linguistic variables as shown in Table 1.

TABLE 2
LINGUISTIC VARIABLES USED FOR CRITERIA EVALUATION

Convention			
Linguistic Variable		**Inverse Linguistic Variable**	
Equally Important	(1;1;1)	Equally Important	(1;1;1)
Slightly more important than equally	(2;3;4)	Slightly less important than equally	(1/4;1/3;1/2)
More important	(3;4;5)	Less important	(1/5;1/4;1/3)
Significantly more important	(4;5;6)	Significantly less important	(1/6;1/5;1/4)
Extremely more important	(5;6;7)	Extremely less important	(1/7;1/6;1/5)

(Source: Author)

Based on Table 2, after collecting opinions from the decision-making council, we have the comparison table for pairwise comparisons of criteria:

(Source: Author)

As a result, the author calculated the weights of the evaluation criteria for suppliers, and the results are presented in Table 3.

Criteria	The fuzzy weights		
C1	0.123	0.194	0.303
C2	0.109	0.167	0.256
C3	0.092	0.145	0.227
C4	0.048	0.076	0.120
C5	0.107	0.166	0.254
C6	0.052	0.082	0.130
C7	0.032	0.049	0.077
C8	0.021	0.028	0.042

3.6. Determining the average ratio of choices for each criterion

In this step, the decision-making committee will evaluate each supplier (A1, A2, A3, A4, A5) based on the selected criteria. The ratio values and the average values for the five suppliers based on each criterion will be assessed by the decision-making committee using predefined linguistic variables presented in Table 4.

TABLE 4
CONVENTIONS FOR EVALUATING CHOICES

	Convention		
Excellent	0.7	0.8	0.9

To facilitate the calculation process, this study assumes that all fuzzy numbers are within the range [0, 1], so the normalization step for choices is unnecessary.

TABLE 3
THE AVERAGE WEIGHT OF CRITERIA

C9	0.062	0.093	0.142

(Source: Author)

From the result table, the factors influencing supplier determination are ranked in decreasing order of importance as follows: (C1) Price, (C2) Product quality, (C5) Performance, (C3) Delivery time, (C9) Technology, (C6) Sustainability, (C4) Service quality, (C7) Flexibility, (C8) Reputation.

Good	0.6	0.7	0.8
Average	0.4	0.5	0.6
Poor	0.3	0.4	0.5
Very poor	0.1	0.2	0.3

(Source: Author)

Applying the formula: Xij = (Xij1 + Xij2 + ... + Xijh)/h to calculate the average ratio values of the choices. Xij represents the value of the choices determined by decision-making member Dt for each criterion. The results of the average ratio values are presented in Table 5.

TABLE 5

AVERAGE RATIOS OF THE 5 CHOICES BASED ON 9 CRITERIA

Criteria	Option	Average ratios		
C1	A1	0.63	0.73	0.83
	A2	0.70	0.80	0.90
	A3	0.63	0.73	0.83
	A4	0.67	0.77	0.87
	A5	0.63	0.73	0.83
C2	A1	0.63	0.73	0.83
	A2	0.67	0.77	0.87
	A3	0.67	0.77	0.87
	A4	0.53	0.63	0.73
	A5	0.47	0.57	0.67
C3	A1	0.60	0.70	0.80
	A2	0.67	0.77	0.87
	A3	0.63	0.73	0.83
	A4	0.33	0.43	0.53
	A5	0.33	0.43	0.53
C4	A1	0.63	0.73	0.83
	A2	0.63	0.73	0.83
	A3	0.60	0.70	0.80
	A4	0.33	0.43	0.53
	A5	0.53	0.63	0.73
C5	A1	0.53	0.63	0.73
	A2	0.67	0.77	0.87
	A3	0.67	0.77	0.87
	A4	0.43	0.53	0.63
	A5	0.60	0.70	0.80
C6	A1	0.60	0.70	0.80
	A2	0.67	0.77	0.87
	A3	0.67	0.77	0.87
	A4	0.33	0.43	0.53
	A5	0.47	0.57	0.67
C7	A1	0.37	0.47	0.57
	A2	0.50	0.60	0.70
	A3	0.70	0.80	0.90
	A4	0.60	0.70	0.80
	A5	0.63	0.73	0.83
C8	A1	0.67	0.77	0.87
	A2	0.50	0.60	0.70
	A3	0.53	0.63	0.73
	A4	0.37	0.47	0.57
	A5	0.53	0.63	0.73
C9	A1	0.63	0.73	0.83
	A2	0.63	0.73	0.83
	A3	0.47	0.57	0.67
	A4	0.33	0.43	0.53
	A5	0.53	0.63	073

(Source: Author)

3.7. Calculate the final values

The final values of the choices are calculated by multiplying the average ratio values with the average weights.

TABLE 6
FINAL VALUE TABLE

Criteria	Option	Final value		
C1	A1	0.078	0.143	0.252
	A2	0.086	0.156	0.272
	A3	0.078	0.143	0.252
	A4	0.082	0.149	0.262
	A5	0.078	0.143	0.252
C2	A1	0.069	0.123	0.213
	A2	0.073	0.128	0.222
	A3	0.073	0.128	0.222
	A4	0.058	0.106	0.188
	A5	0.051	0.095	0.171
C3	A1	0.055	0.102	0.181
	A2	0.062	0.112	0.196
	A3	0.059	0.107	0.189
	A4	0.031	0.063	0.121
	A5	0.031	0.063	0.121
C4	A1	0.030	0.055	0.100
	A2	0.030	0.055	0.100
	A3	0.029	0.053	0.096
	A4	0.016	0.033	0.064
	A5	0.026	0.048	0.088
C5	A1	0.057	0.105	0.187
	A2	0.072	0.127	0.220
	A3	0.072	0.127	0.220
	A4	0.046	0.088	0.161
	A5	0.064	0.116	0.203
C6	A1	0.031	0.057	0.104
	A2	0.034	0.063	0.112
	A3	0.034	0.063	0.112
	A4	0.017	0.036	0.069
	A5	0.024	0.047	0.087
C7	A1	0.012	0.023	0.044
	A2	0.016	0.029	0.054
	A3	0.022	0.039	0.069
	A4	0.019	0.034	0.062
	A5	0.020	0.036	0.064
C8	A1	0.014	0.021	0.036
	A2	0.010	0.017	0.029
	A3	0.011	0.018	0.031
	A4	0.008	0.013	0.024
	A5	0.011	0.018	0.031
C9	A1	0.039	0.068	0.118
	A2	0.039	0.068	0.118
	A3	0.029	0.053	0.095
	A4	0.021	0.040	0.076
	A5	0.033	0.059	0.104

(Source: Author)

3.8. Determine the FPIS and FNIS, and obtain the closeness coefficients

From Table 8, we can calculate the total final value of each choice Ai, resulting in the following outcomes:

A1 = (0.07; 0.21; 0.06)

A2 = (0.08; 0.22 ; 0.65)

A3 = (0.08; 0.22; 0.63)

A4 = (0.06; 0.17; 0.50)

A5 = (0.06; 0.19; 0.55)

3.9. Rank the options

Based on the values of the distance to the fuzzy positive and negative ideal points for each choice, we can calculate the closeness coefficient for each choice as follows:

A1 has $CC_1 = 0.333$; A2 has $CC_2 = 0.355$; A3 has $CC_3 = 0.345$; A4 has $CC_4 = 0.280$; A5 has $CC_5 = 0.280$.

The larger the CCi value, the closer the distance to the positive ideal point and the farther the distance to the negative ideal point, indicating that the choice is more optimal. It can be observed that $CC_2 > CC_3 > CC_1 > CC_5 > CC_4$. Therefore, we can rank the suppliers as follows: A2 > A3 > A1 > A5 > A4. Hence, the supplier Vinatex is the most optimal choice.

4. CONCLUSION AND RECOMMENDATIONS

The research contributes in the following aspects:

Theoretical contribution: It systematizes the theory of supply chains and the activities of supply chains in Vietnamese businesses. The study utilizes the combined Fuzzy AHP - TOPSIS model to evaluate the influence between criteria and select suitable suppliers. Additionally, the study uses fuzzy sets to quantify qualitative evaluation criteria and accurately analyzes complex and ambiguous concepts.

Practical contribution: The research clarifies the factors affecting the suppliers for the textile industry and applies to Garment 10 Corporation. This improves accuracy and reliability in supplier selection, minimizes unnecessary risks and costs, optimizes the supplier search and selection process, and enhances the company's competitiveness.

Based on the research results, the author proposes the following recommendations:

With the goal of expanding export activities and becoming one of the leading textile companies in Vietnam, the Company needs to: (1) Build an efficient supply chain, (2) develop human resources, and (3) mitigate certain risks such as exchange rate risk, raw material risk, labor and productivity risk, competition risk, and distribution risk.

The final calculation results are as follows:

TABLE 7
CLOSENESS COEFFICIENT TABLE

	Di +	Di -	CCi
A1	1.285	0.640	0.333
A2	1.255	0.690	0.355
A3	1.268	0.667	0.345
A4	1.357	0.527	0.280
A5	1.320	0.586	0.308

(Source: Author)

To enhance the efficiency of the supply chain, the following recommendations for supply chain development are proposed: (1) Strengthen investment in infrastructure, (2) promote public-private partnerships, (3) embrace technology and digitalization, (4) ensure safety and sustainability, (5) create a favorable business environment, and (6) enhance international cooperation.

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