



Analysis of Supplier Selection Based on Circular Economy in Fashion Retail Company Using the Fuzzy AHP Method

Ninis Banuwati*, Sawarni Hasibuan

Magister Teknik Industri, Universitas Mercu Buana, Jl. Meruya Selatan No. 1 Kembangan, Jakarta Barat 11650 Indonesia

ARTICLE INFORMATION

Article history:

Received: 6 June 2024

Revised: 10 December 2024

Accepted: 29 April 2025

Category: Research paper

Keywords:

Supplier selection

Fashion retail

Circular economy

Fuzzy

AHP

DOI: 10.22441/ijiem.v6i2.27547

ABSTRACT

Currently, the linear economic model applied in Indonesia still relies on a "take-make-dispose" pattern that is unsustainable. The circular economic approach emphasizes efforts to extend the life cycle of raw materials and product resources, minimize waste, and support the regeneration of natural systems. This research analyze the important role of suppliers in supporting circular economy success in the fashion retail compay. The objective of this study is to select and validate priority criteria and sub-criteria as a performance ranking framework for fashion retail industry suppliers using the Fuzzy Analytic Hierarchy Process (AHP) method. The results of the Fuzzy AHP analysis indicate that quality, delivery, cost, cooperation ability, and environmental performance criteria are the priority for ranking supplier performance in the fashion retail industry, with the highest weight assigned to the quality criteria. This is followed by subcriteria such as rejection rate and product price, which carry the highest subcriteria weights. This is because there is still a significant percentage of defective goods produced due to raw materials that are easily damaged or not in line with circular economic concepts. These recommendations can aid in more effective decision-making in selecting fashion retail suppliers, considering circular economic aspects and sustainable performance.

*Corresponding Author

Wahyudin

E-mail: hwwahyudin@gmail.com

This is an open access article under the CC-BY-NC license.



1. INTRODUCTION

The concept of a circular economy emerged from the idea of reducing input consumption for industrial production and has gained support since the late 1970s. Although it is difficult to define simply, two important aspects of a circular economy are the circular flow of materials and the multi-phase use of raw materials and energy. The circular economy aims to reduce material consumption, energy

use, and environmental damage without hindering economic growth. The circular economy model adopts the principles of "3R," which are reduce, reuse, and recycle, focusing on the reduction, reuse, and recycling of materials and components.

Currently, the economic model in Indonesia is linear, meaning it is unsustainable as it follows the "take-make-dispose" method. Alternatively,

the circular economy is gaining global attention because it focuses on minimizing waste and pollution, extending the lifecycle of raw materials, and regenerating natural systems. The food, textile, construction, wholesale, retail (plastic), and electronics sectors are identified as having great potential for the implementation of a circular economy in Indonesia.

According to LCDI (2020), the textile/garment industry is one of the five sectors with significant potential for implementing a circular economy in Indonesia. Although the textile/garment industry in Indonesia is rapidly developing, it generates a large amount of textile waste and poses environmental problems. Textile waste is also a major pollutant in oceans and several regions in Indonesia. Despite the fast fashion industry contributing significantly to waste and environmental damage, the trend of thrifting or buying second-hand clothes is becoming increasingly popular in Indonesia. The rising import of second-hand clothes negatively impacts the domestic textile industry and its workforce. The government has issued a ban on importing second-hand clothes to protect the local industry.

This study tries to analyze the necessity of adopting a circular economy in the fashion retail company during the selection process of competent suppliers. According to Abdillah & Hasibuan (2021), supplier selection is a crucial aspect in achieving optimal company performance. From a supply chain perspective, risk can be defined as the result of unreliable and uncertain resources, which can cause disruptions in the supply chain process. The warehouse process in supply chain operations entails risks that can negatively impact the performance of the supply chain (Indrawati et al., 2018). On the other hand, uncertainty can be understood as the corresponding risk between supply and demand (Tang & Musa, 2011). (Albab et al., 2023) The supply chain of a company involves various stages of activity, including the inspection stage, production stage, marketing stage, material handling stage, and finished product stage. The supplier selection criteria proposed in a study by Ferdinant (2021), considering circular economy

factors, include fundamentals, environment, policies, management, equipment and materials, and prevention. Supplier selection is a strategic activity because suppliers provide critical goods or those used for the long term. The main goal of the supplier selection process is to reduce risk and maximize buyer value (Muhammad et al., 2020).

Supplier selection in the context of fashion retail is complex due to uncertainties and inaccuracies in data and information, which can hinder supplier evaluation. This issue can be addressed using a fuzzy approach. By employing the Fuzzy Analytical Hierarchy Process (Fuzzy AHP), it is expected to reduce uncertainty in decision-making for supplier selection. In more complex systems, human experience and judgment are often described in linguistic terms and unclear patterns. Therefore, a better representation can be developed into quantitative data using fuzzy theory. On the other hand, the AHP method is often used in crisp applications. Traditional AHP still cannot fully represent human judgment. To avoid this risk, fuzzy AHP was developed to solve hierarchical fuzzy problems (Witjaksono, 2009). Fuzzy AHP has advantages in handling multi-criteria decisions with tolerance for inconsistency. This research will involve validation by stakeholders of the criteria and sub-criteria for supplier selection, incorporating circular economy considerations. The goal of the research is to analyze the criteria and sub-criteria using Fuzzy AHP to support the circular economy in fashion retail supplier selection.

According to Sarkis (2004), the Fuzzy AHP method can be used to rank decision alternatives using various criteria. This process involves pairwise comparisons to determine the preferences between alternatives using a 1-9 scale. The decision-making steps include defining the problem, creating a hierarchical structure, constructing a pairwise comparison matrix, pairwise assessment between elements, estimating relative weights, and final measurement of decision alternatives. Fuzzy AHP uses fuzzy numbers, particularly triangular fuzzy numbers, to describe linguistic variables and facilitate pairwise comparison analysis. The process analysis includes fuzzy

synthetic extent, the degree of possibility, the extent of probability of fuzzy numbers, and normalization of weight vectors to produce a unique solution.

2. LITERATURE REVIEW

2.1 Circular Economy

The Circular Economy Model basically applies the "3 R" principle which means Reuse, Reduce, Recycle, namely reducing, reusing and recycling materials and components to eliminate all unnecessary inputs and leaks from a system. To achieve this goal, the Circular Economy applies a different approach, namely by designing products with multi-purpose use, extending the product life cycle to maximize utilization, reusing solid waste, and several other systematic approaches to Supply Chain Management of activities that include the Circular Economy.

2.2 Circular Economy in the Textile/Garment Industry

According to (Think Conscious, 2021), apart from encouraging producers to focus more on processing textile waste, we as consumers can also take part in reducing textile waste. One of them is by implementing 5R (Reduce, Reuse, Recycle, Recover, Repair). We can also start switching to sustainable fashion, for example by reducing purchases, choosing fashion products that are quality and long-lasting, or whose designs are suitable for various eras or trends. Currently, there are many environmentally friendly fashion brands in Indonesia. Usually, environmentally friendly fashion brands produce products with good waste processing. Ensure the efficient and careful use of natural resources (water, land, biodiversity, energy, etc.). The energy source chosen is renewable at each stage of production. In addition, sustainable fashion manufacturers also maximize repair, remanufacturing, reuse and recycling of products and components.

2.3. Development of Supplier Selection Criteria

When selecting a supplier, the important thing is to consider the quality of the product, service and timeliness of delivery, although there are several other factors that must be considered. The main factors considered by a company when choosing a supplier according to

(Stevenson, 2002) are: 1). Price, 2). Quality, 3). Service, 4). Location, 5). Supplier inventory policy, and 6). Flexibility. In another study by (Ferdinant, 2021), the factors that need to be considered in selecting suppliers with the application of a circular economy are: 1). Fundamentals 2). Environment 3). Policy 4). Management 5). Equipment and Materials 6). Prevention. Several previous studies generally place price for customers or capital and finance for suppliers as the main factors that are most often taken into consideration in the supplier selection process.

2.4 Fuzzy AHP Method

Fuzzy AHP is a technique that combines AHP with fuzzy logic to handle uncertainty in decision-making when selecting an object (Anshori, 2012). In other words, The approach is implemented by fuzzifying the AHP scale to produce a new scale known as fuzzy AHP (Hassan et al., 2020). According to (Suryadi and Ramdhani, 1998), the procedures or steps for decision making using the Fuzzy AHP method are as follows: (1) Define the problem and determine the desired solution, (2) Create a hierarchical structure starting with the main goal, (3) Create a pairwise comparison matrix that describes the relative contribution or influence of each element to the goals or criteria at the level above it, (4) Make a series of pairwise comparisons between elements according to a ratio scale, (5) Using the eigenvalue method to estimate the relative weight of each element, (6) Add up these relative weights and combine them for the final measurement of given decision alternatives, (7) Checking the consistency of the hierarchy, (8) Proceed to the fuzzy stage by following the method of (Chang, 1996):

- Step 1: Fuzzy synthetic extent
- Step 2: Degrees of probability
- Step 3: The probability level for convex fuzzy numbers is better than k convex fuzzy numbers.
- Step 4. Normalization

3. RESEARCH METHOD

This research employs a mixed qualitative and semi-quantitative methodology. The qualitative approach is used to elaborate on the criteria/sub-criteria for supplier selection and propose improvements, while the semi-quantitative

approach is applied in data processing using the Fuzzy AHP method. The research design is descriptive-exploratory, focusing on identifying supplier selection criteria and sub-criteria that align with circular economy principles. Primary data is obtained through brainstorming and questionnaires involving 8 expert respondents from various fashion retail companies. Secondary data includes sales data, rejected goods, retail fashion industry developments,

and other relevant data. Data collection methods encompass brainstorming, questionnaires, interviews, literature review, and documentation. The literature review is used to acquire theories and concepts, while documentation includes historical supplier data, supplier performance results, and the standard operational procedures for supplier selection in the relevant companies. The following is the respondent data in Table 1.

Table 1. Research respondent data

No	Position	Company	Experience	Age	Education
1	Dep Head Purchasing FOB	PT. A	28	53	S1
2	Dep Head Purchasing NonFOB	PT. A	20	40	S1
3	Group Dep Head Purchasing	PT. A	23	43	S1
4	Dep Head Purchasing	PT. B	11	35	S1
5	Dep Head Procurement	PT. C	13	36	S1
6	Spv Purchasing	PT. D	10	32	S1
7	As Mng Purchasing	PT. E	12	34	S1
8	Spv Procurement	PT. F	8	30	S1

A summary of the initial criteria and sub-criteria in the brainstorming process involving

8 respondents can be seen in Table 2.

Table 2. Results of brainstorming selection criteria & subcriteria for selection of fashion retail suppliers

No	Criteria & Subcriteria	Reference
1	Quality	(Pourjavad, 2020)
1.1	Persentase Reject	(Ramadhanti, 2022)
1.2	Product Qualification Rate	(Ramadhanti, 2022)
1.3	Quality Management System	(Ramadhanti, 2022)
2	Delivery	(Stevenson, 2002)
2.1	On Time Delivery Rate	(Ramadhanti, 2022)
2.2	Order Fulfillment Rate	(Ramadhanti, 2022)
2.3	Lead Time	(Ramadhanti, 2022)
2.4	Green Transportation	(Pourjavad, 2020)
3	Cost	(Pourjavad, 2020)
3.1	Product Price	(Ramadhanti, 2022)
3.2	Transportation Cost	(Ramadhanti, 2022)
3.3	Environmentally Friendly Products (Raw Materials)	(Ferdinant, 2021)
4	Cooperation Ability	(Ramadhanti, 2022)
4.1	Payment Flexibility	(Ramadhanti, 2022)
4.2	Service Rate	(Ramadhanti, 2022)
4.3	Concern Using Hazardous Materials	(Ferdinant, 2021)
4.4	Concern for Occupational Health and Safety	(Ferdinant, 2021)
5	Environmental Performance	(Pourjavad, 2020)
5.1	Environmental Management System (ISO 14001)	(Ferdinant, 2021)
5.2	Environmental Management Capabilities (Waste)	(Pourjavad, 2020)
5.3	Green Packaging	(Pourjavad, 2020)

The complete research stages can be seen in

Figure 1.

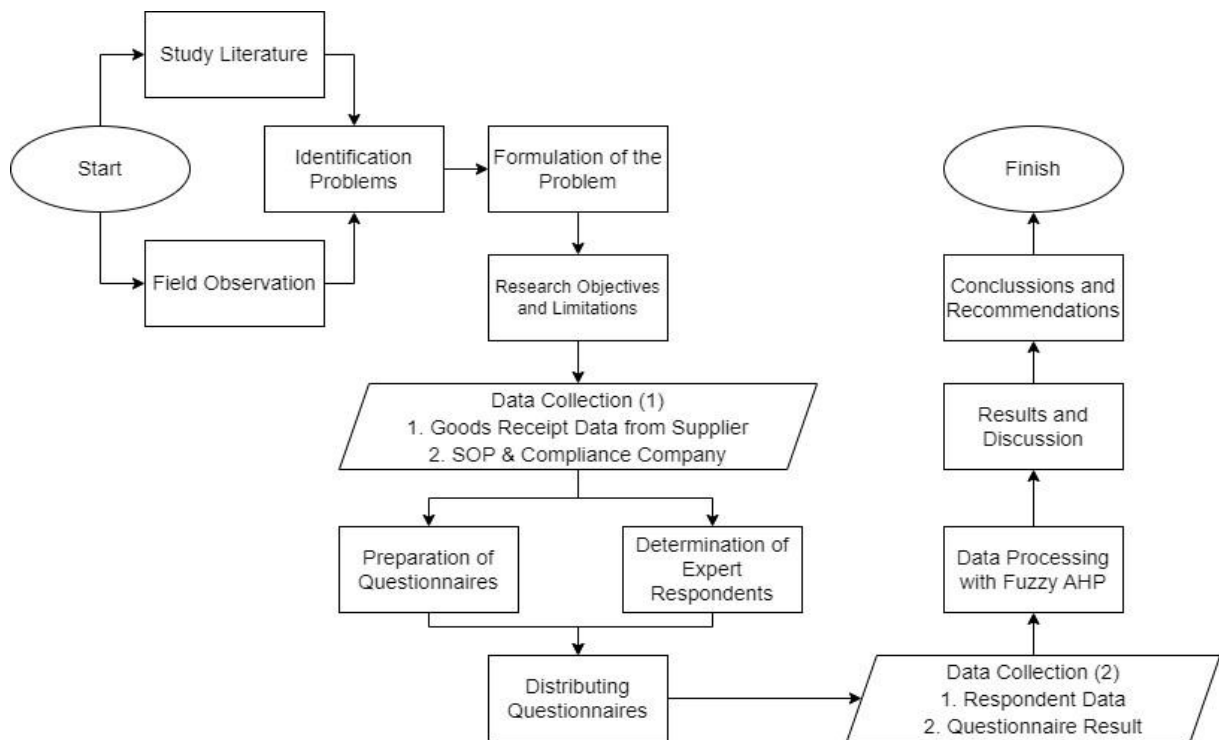


Figure 1. Research steps

Data analysis using the fuzzy AHP method is carried out using the following stages:

- Develop a hierarchical structure.
- Calculate the value of the pairwise comparison matrix for each criterion/subcriteria. The matrix is determined based on the respondent's answers which are converted into Triangular Fuzzy Number (TFN) in *l*, *m*, *u* (lower, medium, upper).
- Calculate the average value of the members of the pairwise comparison matrix using the geometric average according to the average value of the expert assessment

$$g_i = [\sum_{j=1}^n (a_{ij})]^{1/n}, i = 1, 2, \dots, n$$
- Determine matrices A, W, AR, B, and C. Matrix A is the average matrix of pairwise comparisons which is converted into crisp numbers

$$A = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \dots & \dots & \dots & \dots \\ a_{n1} & a_{n2} & \dots & a_{nn} \end{bmatrix}$$

A normalized matrix is generated by adding the columns of the matrix and then dividing each element of the multiple matrices. Then calculate the average matrix to produce a

normalized average matrix. Calculates a matrix by multiplying the matrix columns by the matrix rows. Each row of the matrix is summed and used as a matrix element.

- Calculate the maximum eigenvalue

$$\lambda_{max} = (\text{number of elements in the matrix})/N$$
- Determine CI and CR.

$$CI = (\lambda_{max} - n)/(n-1)$$

$$CR = CI/RI$$
(RI = random index values issued by Oarkridge Laboratory in the form of a table)
- After generating the CR value ($\leq 10\%$), proceed to the step of determining the weight of the criteria taken from the Chang method

4. RESULT AND DISCUSSION

4.1 Selection of Criteria and Subcriteria

This research analyzes the relevance and weight of supplier selection criteria and sub-criteria in the context of implementing a circular economy in the fashion retail industry. In the initial stage, criteria and sub-criteria were elaborated from various references and combined with the distribution of questionnaires for validation by

expert respondents. Expert respondents were asked to agree whether the initial criteria and sub-criteria were relevant and supported a circular economy in the supplier selection process for the fashion retail industry. The results of filling out the questionnaire from

the 8 respondents involved resulted in the elimination of the green transportation sub-criteria. Thus, the hierarchical structure of supplier selection that supports the implementation of a circular economy in the fashion retail industry is as shown in Figure 2.

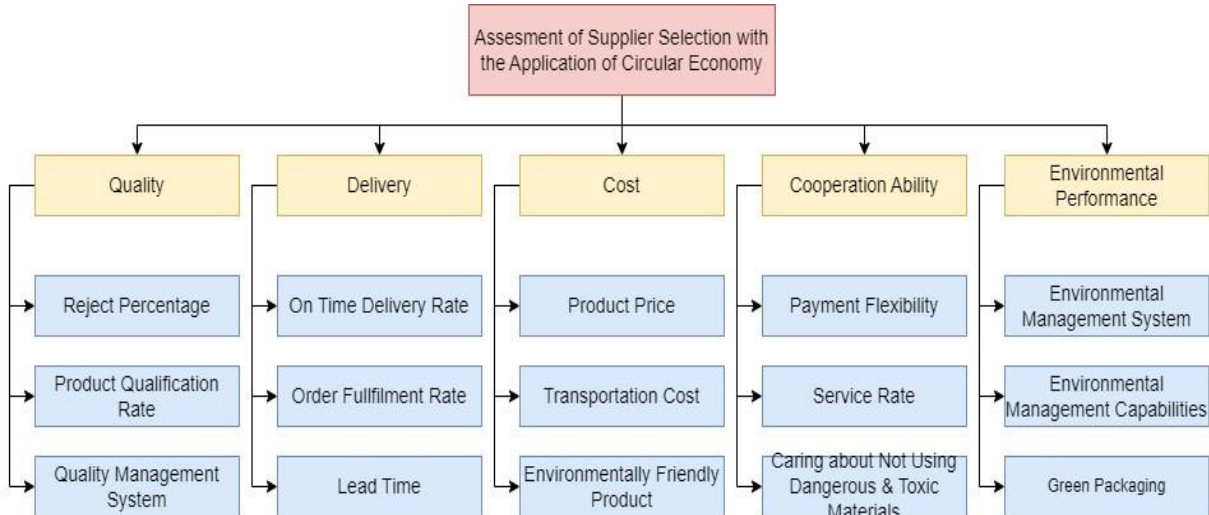


Figure 2. Results of validation of the hierarchy of criteria and sub-criteria for circular economy-based supplier selection

4.2. Weighting using the Fuzzy AHP Method

This stage involves collecting data using a closed questionnaire, where respondents are asked to provide scores on the criteria and sub-criteria for supplier selection with the implementation of a circular economy through the AHP pairwise comparison questionnaire. Respondents are asked to compare the relative importance of criteria and subcriteria in pairs to determine the most appropriate weighting

based on importance, likelihood, or preference. Data processing was carried out in two stages: first, combining respondents' assessments using the geometric average and second calculating the weights and inconsistency ratios for each criterion and sub-criterion based on pairwise comparisons in the comparison matrix. The results of filling out the pairwise comparison matrix questionnaire regarding the fashion retail supplier selection criteria are presented in Table 3.

Table 3. Pairwise comparison matrix questionnaire fashion retail supplier selection criteria

Criteria	1								2								3								4								5							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
1	1	1	1	1	1	1	1	1	3	3	5	3	3	3	5	3	3	3	5	3	5	3	3	3	7	5	5	7	5	7	5	5	3	5	3	5	3	3	5	3
2	0.3	0.3	0.2	0.3	0.3	0.3	0.2	0.3	1	1	1	1	1	1	1	1	1	3	1	1	3	3	1	1	5	3	5	0.3	0.2	5	3	3	5	5	3	5	3	5	5	3
3	0.2	0.2	0.1	0.2	0.2	0.2	0.1	0.2	0.3	0.2	0.3	0.2	0.2	0.3	0.2	0.2	1	1	1	1	1	1	1	0.3	0.2	0.3	0.3	3	0.3	3	0.2	5	3	0.3	3	0.3	3	3	5	
4	0.1	0.2	0.2	0.1	0.2	0.1	0.2	0.2	0.2	0.3	0.2	3	5	0.2	0.3	0.3	3	5	3	3	0.3	3	0.3	5	1	1	1	1	1	1	1	5	3	0.3	3	5	0.3	3	3	
5	0.3	0.2	0.3	0.2	0.3	0.3	0.2	0.3	0.2	0.2	0.3	0.2	0.3	0.2	0.2	0.3	0.2	0.3	3	0.3	3	0.3	0.3	0.2	0.2	0.3	3	0.3	0.2	3	0.3	0.3	1	1	1	1	1	1	1	
Total	1.9	1.9	1.8	1.8	2.0	1.9	1.7	2.0	4.7	4.7	6.8	7.4	9.5	4.7	6.7	4.8	8.2	12.3	13.0	8.3	12.3	10.3	5.6	10.2	13.5	9.5	14.3	8.9	9.4	16.3	12.3	9.5	19.0	17.0	7.6	17.0	12.3	12.3	17.0	15.0
Average	1.875								6.1625								10.025								11.7125								14.650							

The next step is to calculate the weight value of the criteria, where the comparison value in each column is divided by the number of each cell. After obtaining the division results for each column, the priority weight values (eigenvector) can be calculated. The criteria weight value is the average value of each

criterion by adding up the values for each row cell and then dividing them again by the number of criteria elements, namely 5. The results of the weighting of the fashion retail supplier selection criteria are presented in Table 4.

Table 4. Weight of criteria for selection of fashion retail suppliers

Criteria	Average Value/Amount of Criteria	Weight
C1	2,263/5	0,453
C2	1,034/5	0,207
C3	0,501/5	0,094
C4	0,789/5	0,100
C5	0,405/5	0,081
Total		1,000

After getting the criteria weight value, the maximum lambda value ($\lambda_{\max}$) or eigenvalue can be calculated, namely by adding up the results of multiplying the criteria weight value by the number of criteria columns, multiplying the criteria weight value by the value of the number of criteria columns.

$$\lambda_{\max} = (0.453 \times 1.875) + (0.207 \times 6.163) + (0.094 \times 10.025) + (0.100 \times 11.713) + (0.081 \times 14.65) = 5.425$$

The $\lambda_{\max}$ value is used to obtain a consistent index value for $n=5$. To calculate the CI value, the following equation is used:

$$CI = (\lambda_{\max} - n) / (n - 1) = (5.425 - 5) / (5 - 1) = 0.106$$

The RI (random index) value for $n=5$ is 1.12, so the CR (Consistency Ratio) criteria value for the research can be calculated as follows:

$$CR = CI/RI = 0.106/1.12 = 0.095$$

After getting a CR value of 0.095, it can be concluded that the results of the expert respondent's assessment are categorized as consistent because the CR value is <0.1 . Next, the AHP pairwise comparison matrix values for the criteria labels can be converted into a triangular fuzzy set or Triangular Fuzzy Number (TFN). The fuzzy scale has three values, namely lower (l =lowest value), medium (m =middle value) and Upper (u =highest value). Then the average value of the eight respondents was taken, to obtain a pairwise comparison matrix for criteria related to objectives as shown in Table 5. Then calculated the pairwise comparison matrix for supplier selection criteria, the results can be seen in Table 6.

Table 5. Comparison matrix for fashion retail supplier selection criteria

Criteria	C1			C2			C3			C4			C5		
	<i>l</i>	<i>m</i>	<i>u</i>	<i>l</i>	<i>m</i>	<i>u</i>	<i>l</i>	<i>m</i>	<i>u</i>	<i>l</i>	<i>m</i>	<i>u</i>	<i>l</i>	<i>m</i>	<i>u</i>
C1	1	1	1	0.875	1.375	1.875	0.875	1.375	1.875	2.375	2.875	3.75	1.0625	1.5625	2.0625
C2	0.3	0.625	0.875	1	1	1	0.8125	1.000	1.188	1.013	1.450	1.875	1.438	1.938	2.438
C3	0.25	0.35	0.45	0.3	0.5125	0.6875	1	1	1	0.35	0.7	1	0.825	1.3	1.75
C4	0.225	0.325	0.425	0.5375	0.85	1.125	0.825	1.3	1.75	1	1	1	0.825	1.3	1.75
C5	0.3	0.588	0.813	0.3	0.5125	0.6875	0.35	0.7	1	0.35	0.7	1	1	1	1

Table 6. Pairwise Comparison matrix for fashion retail supplier selection criteria

Criteria	<i>l</i>	<i>m</i>	<i>u</i>
C1	0,415	0,578	0,713
C2	0,603	0,850	1,075
C3	0,773	1,075	1,363
C4	1,018	1,345	1,725
C5	1,030	1,420	1,800
Total Set Fuzzy	3,838	5,268	6,675
Invers	0,261	0,190	0,150

After the respondent's assessment data has been converted into Triangular Fuzzy numbers, the next step is to use synthetic extent analysis by determining fuzzy synthetic values to obtain a weight vector for each hierarchical element.

The final stage is normalization so that the weights obtained are not fuzzy numbers. This weight will be the basis for ranking supplier selection criteria. Calculation of the S_i value, the calculation results can be seen in Table 7.

Table 7. Calculation results of fuzzy synthetic extent values for fashion retail supplier selection criteria

Criteria	<i>l</i>	<i>m</i>	<i>u</i>
C1	0,062	0,110	0,186
C2	0,090	0,161	0,280
C3	0,116	0,204	0,355
C4	0,152	0,255	0,450
C5	0,154	0,270	0,469

After obtaining the calculation results for the Fuzzy Synthetic Extent value, then determine the level of possibility between the 2 Fuzzy Synthetic Extent values ($M1 > M1$). Next, a

comparison of the synthetic extent value and the minimum value is carried out. In Table 8 you can see the comparison results of the synthetic extent value and the minimum value.

Table 8. Comparison results of synthetic extent value criteria and minimum values

Criteria	$C1 \geq$	$C2 \geq$	$C3 \geq$	$C4 \geq$	$C5 \geq$
C1		0,653	0,427	0,190	0,167
C2	1		0,792	0,577	0,536
C3	1	1		0,800	0,753
C4	1	1	1		0,952
C5	1	1	1	1	
Min	1	0,653	0,427	0,190	0,167

The next stage is to calculate the weight vector and normalize the weight vector so that the

weight values of the criteria can be known, as shown in Table 9 and Table 10.

Table 9. Criterion weight vector

	$d'(A1)$	$d'(A2)$	$d'(A3)$	$d'(A4)$	$d'(A5)$
W'	1	0.519	0.701	0.058	0.047

Table 10. Criterion weight vector normalization

	$d'(A1)$	$d'(A2)$	$d'(A3)$	$d'(A4)$	$d'(A5)$
W'	0.430	0.223	0.302	0.025	0.020

Based on the results of data processing, the weights for supplier selection criteria in the fashion retail industry with the application of a circular economy can be seen in Figure 3. The same process is also carried out to produce

weight values for each sub-criteria from the five supplier selection criteria in the fashion retail industry using the Fuzzy AHP method with implementation of a circular economy, complete results can be seen in Figure 4.



Figure 3. Weight of fashion retail supplier selection criteria using the fuzzy AHP method

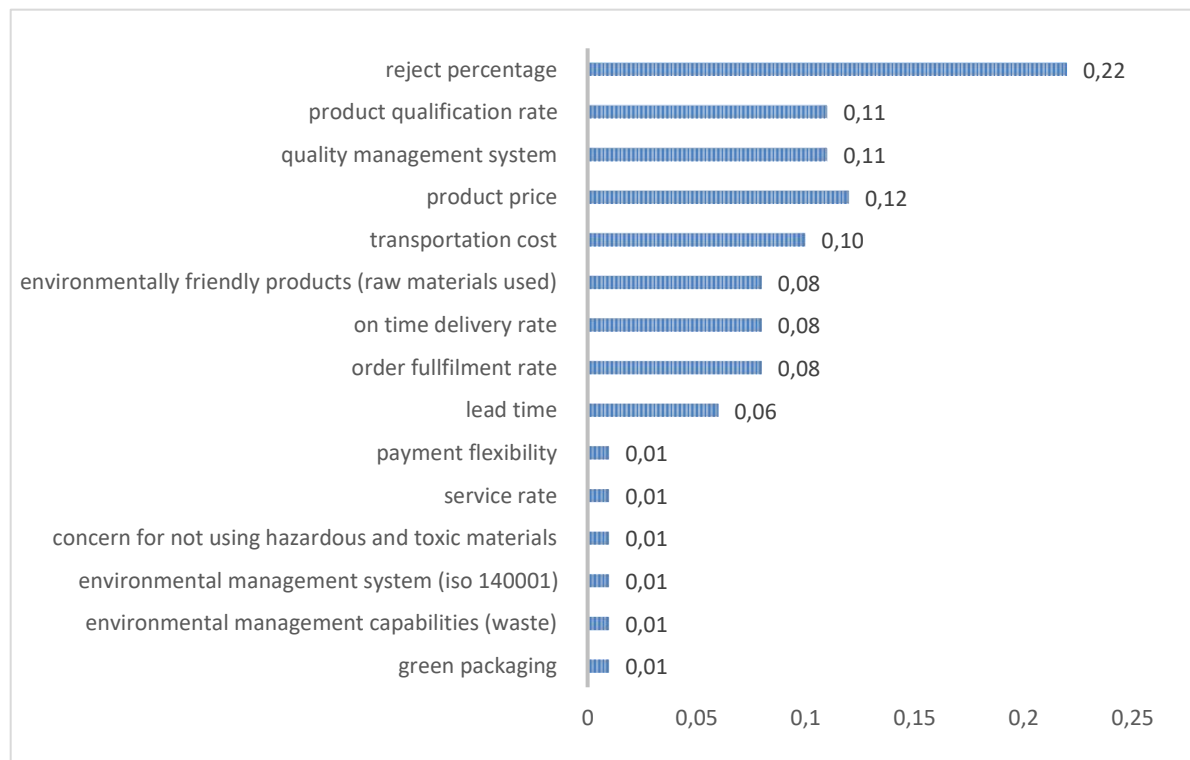


Figure 4. Weight of subcriteria for selecting fashion retail suppliers using the fuzzy AHP method

4.3 Discussion

To The validation results of the criteria and sub-criteria for fashion retail supplier selection that support the implementation of a circular economy revealed that the five initial criteria—Quality, Delivery, Cost, Cooperation Ability, and Environmental Performance—were agreed upon by all expert respondents. However, one sub-criterion, Green

Transportation, was not agreed upon by the respondents. This is because Green Transportation has not been widely practiced in Indonesia, and there are still many preparations that need to be made before its implementation.

The weighting process for the fashion retail supplier selection criteria using the Fuzzy AHP

method resulted in Quality being the top priority, while Environmental Performance ranked fifth in the context of supplier selection with circular economy implementation. This differs from the findings of Ramadhanti and

Differences also appear in the research conducted by Pourjavad in 2020 on the painting industry in Iran, where Environmental Performance, specifically the Environmental Management System (ISO 14001), ranked first in green supplier development program selection. In the study conducted by Vatansever in 2021 on the tourism industry in Turkey, Cooperation Ability ranked first, and Environmental Performance ranked seventh in the evaluation of barriers to the circular economy. Ferdinand's 2021 study with the Fuzzy AHP method for green supplier

selection in the education industry in Indonesia also found Cost to be the top criterion, with Environmental Performance ranking second.

Considering the current state of circular economy implementation in the fashion retail industry, many large companies have yet to adopt the circular economy, despite this industry being among the top five with high potential for circular economy implementation. This approach can be used to prevent thrifting goods from abroad from entering Indonesia. Therefore, support from each company and government assistance is needed to ensure the circular economy concept can be well-implemented in Indonesia.

Below is a comparison between previous studies and the current study in Table 11.

Table 11. Comparison of Previous Research with Research Conducted

	Criteria with 1 st Rank	Rating	Criteria <i>Env Perf</i>	Industry	Country
Research that has been carried out (Fuzzy AHP)	<i>Quality</i>	5		Fashion Retail	Indonesia
Research that has been carried out (TOPSIS)	<i>Cost</i>	2		Fashion Retail	Indonesia
Ramadhanti, 2022 (Fuzzy AHP)	<i>Delivery</i>	3		Wood	Indonesia
Pourjavad, 2020 (Fuzzy TOPSIS)	<i>Env Perf</i>	1		Lukisan	Iran
Vatansever, 2021 (Fuzzy AHP)	<i>Coop Ability</i>	7		Tourist	Turki
Ferdinant, 2021 (Fuzzy AHP)	<i>Cost</i>	2		Education	Indonesia

In the case of Indonesia, companies prioritize operational performance over environmental performance. This is because the quality in some industries is still very low, evidenced by the high number of rejected items produced. In contrast, supplier selection with circular economy implementation varies by country due to differences in national policies, industry-specific priorities, and the methods used. This is also related to the agility of a company or industry, especially in this era of disruption. Innovation and transformation are key to survival as technology and consumer behavior rapidly evolve. This study focuses on the broader scope of the fashion retail industry, while previous studies have predominantly focused on specific companies.

In Indonesia, the circular economy has been adopted by some companies in the fashion retail industry, but these brands have limited popularity. Therefore, government outreach is needed to promote circular economy practices, enabling major fashion retailers in Indonesia to better implement these practices. This study aims to assist stakeholders in the fashion retail industry in adopting the circular economy, as the respondents are experts from well-known fashion retail companies. Further research is needed with respondents from medium-sized industries and using various methods to align with company policies and regulations.

The limitation of this study is that it involves respondents working in large-scale companies. Therefore, it is necessary to include medium

and small-scale companies to understand the potential differences in supplier selection with circular economy implementation. The criteria and sub-criteria in this study might differ for other industries, necessitating comprehensive implementation to identify relevant criteria and sub-criteria. This study uses only two methods, indicating that many other methods could be employed in future research.

5 CONCLUSION

The priority level of importance of relevant criteria supporting the implementation of a circular economy in the fashion retail supplier selection process based on stakeholder opinions using the Fuzzy AHP method are Quality, Delivery, Cost, Cooperation Ability, Environmental Performance respectively with weights of 0.41, 0.27, 0.17, .08, and .07. Meanwhile, from the sub-criteria, the percentage of rejects is the sub-criterion that is considered to have the largest weight, namely (0.22), followed by product price (0.12) and quality management system (0.11) and product qualification rate (0.11), based on research results. Quality and Cost criteria occupy the highest weight because in Indonesia, especially in the textile industry, operational performance is being paid attention to implementing good environmental performance, so if we look at the environmental management system sub-criteria, environmental management capability and green packaging get a weight of 0.01 or the lowest. because there are still many companies that are still improving their internals first before implementing the circular economy concept. For this reason, research is still needed on medium and small scale companies to see to what extent circular economy practices are carried out, of course by using various other MCDM methods, for example the ANP method, which can be used to make comparisons between one research and another.

REFERENCES

- Abdillah, Y., Hasibuan, S. (2021). Supplier Selection Decision Making in the Pharmaceutical Industry Based on Kraljic Portfolio and Maut Method: a Case Study in Indonesia. *Proceedings of the 11th Annual International Conference on Industrial Engineering and Operations Management Singapore*, March 7-11, 2021.
<https://www.ieomsociety.org/singapore2021/papers/746>
- Albab, G, I, S, U., Supriyadi, Nalhadi A., Shofa, M, J., Maharani, A. (2023). Risk Identification Activities Warehouse using Fuzzy AHP and Fuzzy FMEA Method. *IJIEM (Indonesian Journal of Industrial Engineering & Management)*, 4(3), 278-287.
<http://dx.doi.org/10.22441/ijiem.v4i3>
- Anshori, Y. (2012). Pendekatan Triangular Fuzzy Number dalam Metode Analytic Hierarchy Process. *Foristek*, 2(1), 126–135.
<https://foristek.fatek.untad.ac.id/index.php/foristek/article/view/93>
- Chang, D, Y. (1996). Applications of The Extent Analysis Method on Fuzzy AHP. *European Jurnal of Operational Research*, 95, 649-655.
[https://doi.org/10.1016/0377-2217\(95\)00300-2](https://doi.org/10.1016/0377-2217(95)00300-2)
- Ferdinant, P, F., et al. (2021). Usulan Pemilihan Green Supplier dengan Metode Fuzzy AHP dan Fuzzy TOPSIS. *Journal Industrial Servicess*, 7(1), 112-119.
<http://dx.doi.org/10.36055/12823>
- Hassan, A., Purnomo, M. R. A., & Anugerah, A. R. (2020). Fuzzy Analytical Hierarchy Process in Failure Mode and Effect Analysis (FMEA) to Identify Process Failure in the Warehouse of a Cement Industry. *Journal of Engineering, Design and Technology*, 18(2), 378–388.
<https://doi.org/10.1108/JEDT-05-2019-0131>
- Indrawati, S., Karunia Ningtyas, K. N., Khoirani, A. B., & Shinta, R. C. (2018). Risk analysis of warehouse operation in a power plant through a Modified FMEA. *MATEC Web of Conferences*, 154, 01089.
<https://doi.org/10.1051/mateconf/201815401089>
- Muhammad, J., et al. (2020). Pemilihan Supplier Biji Plastik dengan Metode Analytical Hierarchy Process (AHP) dan Technique for Order Preference by Similarity to Ideal Solution (TOPSIS).

- Jurnal INTECH Teknik Industri Universitas Serang Raya*, 6(2), 99-106.
<http://dx.doi.org/10.30656/intech.v6i2.2418>
- Pourjavad, E., Shahin, A. (2020). Green Supplier Development Programmes Selection: A Hybrid Fuzzy Multi-Criteria Decision-Making Approach. *International Journal of Sustainable Engineering*, 13(6), 463–472.
<https://doi.org/10.1080/19397038.2020.1773569>
- Ramadhanti, V, I., Pulansari, F. (2022). Integration of Fuzzy AHP and Fuzzy TOPSIS for Green Supplier Selection of Mindi Wood Raw Materials. *Jurnal Sistem dan Manajemen Industri*, 6(1), 1-13.
<https://doi.org/10.30656/jsmi.v6i1.4332>
- Sarkis, J., et al. (2004). E-Logistics and the Natural Environment. *Supply Chain Management an International Journal*, 9, 303-312.
<https://doi.org/10.1108/13598540410550055>
- Stevenson, W, J. (2002). Operations management. Boston McGraw-Hill: New York.
https://www.google.co.id/books/edition/Operations_Management/fb9aAAAAYA-AJ?hl=id&gbpv=0&bsq=inauthor:%2William%20J.%20Stevenson
- Tang, O., & Musa, S. N. (2011). Identifying risk issues and research advancements in supply chain risk management. *International Journal of Production Economics*, 133(1), 25–34.
<https://doi.org/10.1016/j.ijpe.2010.06.013>
- Vatansever, K., et al. (2021). Evaluation of Transition Barriers to Circular Economy: A Case from the Tourism Industry. *International Journal of Mathematical, Engineering and Management Sciences*, 6(3), 824-846.
<https://doi.org/10.33889/IJMEMS.2021.6.3.049>
- Witjaksono, A.W. 2009. Perancangan Sistem Pengukuran Kinerja Di Apotik XYZ Dengan Menggunakan Metode Integrated Performance Asurement Systems (IPMS) Dan Pembobotan Triangular Fuzzy AHP. Fakultas Teknik Universitas Sebelas Maret Surakarta: Surakarta.
<https://digilib.uns.ac.id/dokumen/detail/10243/Perancangan-sistem-pengukuran-kinerja-di-apotek-xyz-dengan-menggunakan-metode-integrated-performance-measurement-systems-ipms-dan-pembobotan-triangular-fuzzy-ahp>