Supplier Performance Evaluation Based on the Vendor Performance Index using the Analytical Hierarchy Process

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ABSTRACT

Nowadays, competition in the business world is very tight. Competition in the service sector or the trade sector requires all stakeholders to rack their brains to survive. To get stable production results, the company must have suppliers who can be relied on in various situations and conditions. It is therefore necessary to evaluate the performance of suppliers that regularly supply raw materials for production. In this research, supplier performance assessment is carried out using the analytical hierarchy process method, which is based on the Vendor Performance Index criteria. A garment company in Yogyakarta was used as a case study. The results of this study are in the form of priority order of importance from the alternative suppliers used. The ranking order of supplier performance is in first place, namely the supplier named Supplier A with a final score of 0.361, followed by Supplier B in second place with a final score of 0.348 and Supplier C in third position with a final score of 0.291.

ARTICLE INFO

Received September 4, 2022
Accepted September 19, 2022
Available online September 28, 2023

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Keywords:
analytical hierarchy process; MCDM; supplier performance evaluation; vendor performance index

1. Introduction

The manufacturing industry is an industrial sector in Indonesia whose influence on the Indonesian economy is very pronounced. The manufacturing industry conceptually processes raw materials into a finished or semi-finished product with benefits and value for a product (Amin & Rahmiati, 2018). Converting raw materials into finished or semi-finished products requires contributions from various parties, one of which is workers. With the increasing number of manufacturing industries in Indonesia, the number of workers needed also increases, so indirectly, the manufacturing industry also helps drive the economy in Indonesia. According to the Ministry of Industry of the Republic of Indonesia, the manufacturing industry sector showed growth of 15.08% and exceeded economic growth in the same period of 5.02% (Fantini et al., 2021).

Currently, the business world is experiencing very tight competition in the services sector or the commercial industry, requiring all stakeholders or stakeholders in a company to have to rack their brains so that the company they manage can survive or endure under the pressure of competition, which is becoming more and more accurate. One of the steps that can be taken in dealing with current market conditions is to improve the quality of the products produced, payment quality, price, service, timeliness, aesthetics, and various forms of quality in line with the development of market demands and demands to meet customer satisfaction to get customers who are loyal to the company (Noviani et al., 2021).

In Indonesia, industry is divided into several sectors, including the textile or garment sector. The garment industry itself is an industry that produces clothing with an enormous production volume (Pratiwi, 2022). In the Yogyakarta Special Region province itself, there is one of the largest garment companies in D.I.Y Yogyakarta, which was then selected as a case study. The garment company certainly needs suppliers who can be relied on to meet raw material needs during the production process. Buttons are accessories that are necessary for almost all types of clothes. Moreover, the majority of the company only produces clothes for women. There are at least three supplier buttons at the company.

The competition that is getting more challenging daily shows business people the importance of evaluating performance or the performance of suppliers. In addition, garment companies need to get more efficient resources. To realize this, the company must continuously assess suppliers to carry out the production process effectively and efficiently and be more competitive with competing companies.

Based on the description above, this research aims to evaluate the performance of button suppliers at the studied company. Researchers use one MCDM or Multiple Criteria Decision-Making method to assess supplier performance. Multiple Criteria Decision Making (MCDM) is a tool or method used to solve problems composed of numerous criteria, often called multicriteria and multifactor (Zhu et al., 2021). One method of Multiple Criteria Decision Making is the Analytical Hierarchy Process. The Analytical Hierarchy Process is a powerful and effective method or tool for solving problems from various fields of science, such as politics, economics, and engineering (Leal, 2020). It is hoped that the results of this research can provide recommendations to the company to give suppliers priority rankings so they can become a powerful weapon in dealing with their competitors.

2. Theoretical Background

2.1 Multiple Criteria Decision Making (MCDM)

Multiple criteria decision-making (MCDM) is a method that is very closely related and is used in solving problems in the real world that are known to be complicated very often. There are differences of opinion between fellow stakeholders regarding the final decision because each expert has their assessment of a problem by considering the constituent criteria—the problem. Using MCDM will produce output as a final decision based on a mathematical model and can be accounted for (Popovic et al., 2019).

2.2 Analytical Hierarchy process (AHP)

Analytical Hierarchy Process (AHP) is a top-rated tool or method used by experts from various fields of science such as engineering, technology, manufacturing, production, social sciences, and other areas of science where AHP is a reliable and efficient method in supporting researchers in solving complex decision-making problems (Khan et al., 2020). The use of the AHP method in the research is considered appropriate because the problem is a complex decision-making problem and contains many criteria (multi-criteria).

2.3 Vendor Performance Index (VPI)

Vendor Performance Index (VPI) is a method used to determine criteria or indicators used as a reference in evaluating supplier performance. VPI plays a role in maintaining production stability in a factory or company from shortages of raw materials during the production process. Supplier evaluation should be carried out periodically and continuously so that the best supplier is always obtained, which does not only depend on the price of raw materials but also on how precisely the supplier fulfills demand so that the total cost of procuring the best material can be known (Zakaria, 2021). Based on the Vendor Performance Index, several main criteria are used to measure supplier performance: Quality, Cost, Delivery, Flexibility, and Responsiveness (QCDFR).

2.4 Supplier Performance Evaluation

Supplier performance evaluation is a strategic action taken to determine whether the supplier has met the criteria desired by the company (Himawan, 2022). By doing an evaluation, the company can give priority to the supplier that has the best performance rating. Determining supplier priority is a complex problem.it is because many criteria are involved in the decision-making process. So, researchers use multiple measures of decision-making methods to solve problems in evaluating supplier performance or performance.

3. Methodology

This research was conducted by distributing questionnaires and direct interviews with experts in the procurement of goods at the studied company. The questionnaire distributed is a pairwise comparison questionnaire based on the Vendor Performance Index (VPI). Several main criteria are used to measure supplier performance: Quality, Cost, Delivery, Flexibility, and Responsiveness (QCDFR) (Sukendar et al., 2021). Questionnaires will be

distributed to the assistant manager of the logistics section of the studied company is considered an expert and knows each button supplier's characteristics at the company.

After getting the pairwise comparison results, the researcher processed the data using a method that allows researchers to solve problems that have multicriteria and multifactor-type criteria (Zhu et al., 2021). One of the MCDM methods used is the analytical hierarchy process (AHP), a solid and effective method or tool for solving problems from various fields of science, such as politics, economics, and engineering (Leal, 2020).

As a result of this research, the researcher can determine the priority ranking of each criterion and sub-criteria, which can be reviewed through the eigen vector score, while determining the best alternative is determined based on the alternative weight evaluation value so that the researcher can provide suggestions and suggestions for improvements to the company. The following is the research flow shown in Figure 1.

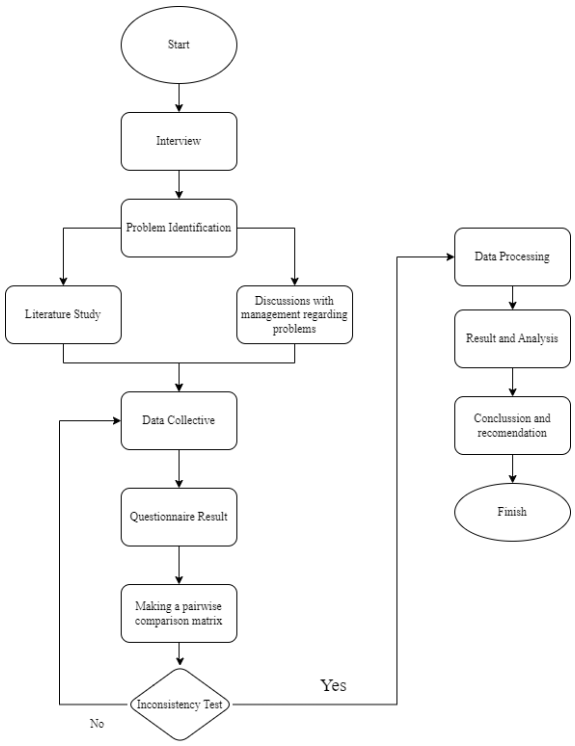

Figure 1. Research flow

The following are the analytical hierarchy process (AHP) method steps. The calculations in this research were completely carried out with the help of Microsoft Excel.

1. Decomposition
   This stage is carried out to transform complex problems into a hierarchical form so that they are easier to understand.
2. Perform pairwise comparisons
   This stage is carried out directly by conducting interviews with experts, which are then translated into a pairwise comparison matrix. The following is data from experts who helped fill out the paired comparison questionnaire.
   - Job title : assistant logistics manager
   - Age : 28 years old
   - Gender : female
3. Conduct a consistency test
   The consistency test was carried out to determine whether the completion of the paired comparison questionnaire was consistent. The following is a consistency test stage.
   - Calculating matrix weights (eigen vectors)

- Calculating matrix multiplication by multiplying the pairwise comparison matrix with the matrix weight matrix (eigen vectors)
- Calculating the eigenvalues by dividing the matrix multiplication matrix by the eigen vector matrix
- Calculating the λmax value by dividing the eigenvalue matrix by the number of elements
- Calculate the consistency index value using Equation 1 below.

$$\frac{\lambda\text{maks-n}}{\text{n-1}} \quad (1)$$

- Calculate the consistency ratio (CI) using the following formula.

$$\frac{\text{CI}}{\text{RI}} \quad (2)$$

Information:
CI = consistency ratio
RI = random index

4. Determination of alternative weights (alternative weight evaluation)
This stage determines the best alternative by looking at the alternative weight evaluation value. Calculation of alternative weight evaluation can be done using the following equation 3.

$$\sum (\text{eigen vector criteria} \times \text{eigen vector sub-criteria}) \quad (3)$$

4. Results

4.1 Criteria and Sub-criteria

The following are the criteria and sub-criteria used as assessment indicators based on the Vector Performance Index model, namely Quality, Cost, Delivery, Flexibility, and Responsiveness (QCDFR) obtained through literature review and interviews conducted by researchers during the research carried out as shown in Table 1 below.

Table 1. Criteria and sub-criteria

Criteria	Sub-Criteria	Code
Quality	Conformity of Raw Material Specifications	Q1
	Raw Material Quality	Q2
	Ability to provide consistent quality	Q3
Cost	Raw Material Price	C1
	Payment method	C2
	Bill Payment period	C3
Delivery	Timeliness of Delivery	D1
	Packaging	D2
	Accuracy of the Quantity of Raw Materials Sent	D3
Flexibility	Fulfillment of Return Requests	F1
	Changes in the Quantity of Raw Materials Ordered	F2
	Change of Delivery Time	F3
Responsiveness	Response to changes in delivery schedule	R1
	Response to complaints	R2
	Communication	R3

4.2 Decomposition

This stage aims to transform complex problems into a hierarchical form so that they are easier to understand and solve. The following is a hierarchy of decomposition results shown in Figure 2.

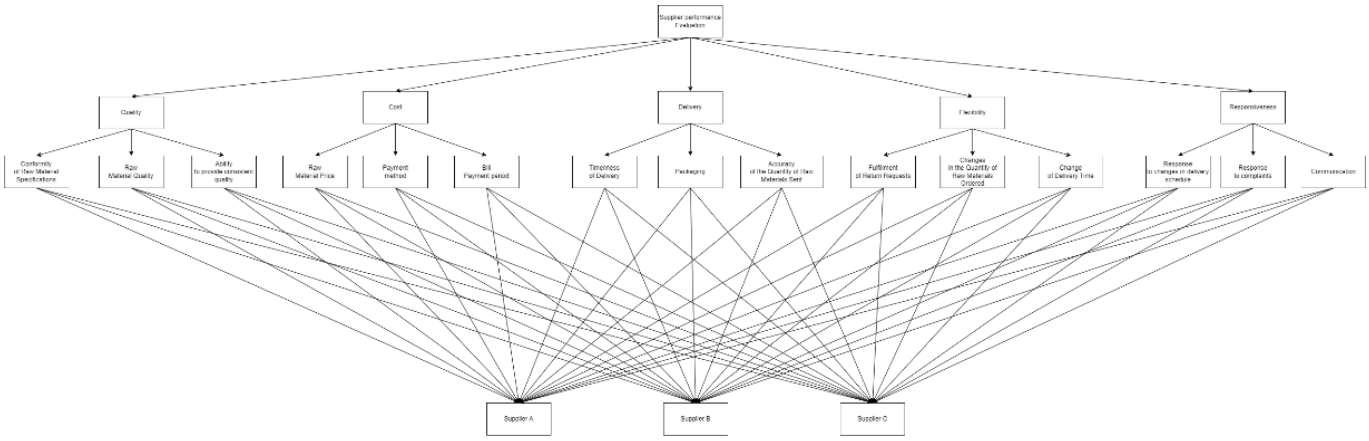

Figure 2. Decomposition

4.3 Priority Synthesizes

The next stage in this research is to perform calculations using the Analytical Hierarchy Process method using the results of a pairwise comparison questionnaire filled out by experts. This stage will calculate the weight of the eigen vector values of all existing criteria and sub-criteria and then calculate the consistency ratio (CR) value where the results of filling out the pairwise comparison questionnaire can be considered valid if the inconsistency ratio is ≤ 0.1. The scale of importance of the criteria and sub-criteria used can be identified by carrying out a priority synthesis. The following are the results of the calculations performed and the ranking order of the importance scale of the criteria and sub-criteria, summarized in Table 2. Furthermore, the results of alternative weighting of the sub-criteria are shown in Table 3.

Table 2. Results of weighting criteria and sub-criteria

Level 1	Vektor Eigen	CR	Rank	Level 2	Vektor Eigen	Rank	Consistency Ratio
Quality	0.4959	0.0927	1	Q1	0,43528	2	0.01087
				Q2	0,48656	1	
				Q3	0,07817	3	
Cost	0.27864	0.0927	2	C1	0,73939	1	0.08821
				C2	0,08182	3	
				C3	0,17879	2	
Delivery	0.11516	0.0927	3	D1	0,48656	1	0.01087
				D2	0,07817	3	
				D3	0,43528	2	
Flexibility	0.06496	0.0927	4	F1	0,63335	1	0.03337
				F2	0,2605	2	
				F3	0,10616	3	
Responsiveness	0.04534	0.0927	5	R1	0,18675	2	0.02517
				R2	0,65549	1	
				R3	0,15776	3	

Table 3. Results of weighting alternatives to sub-criteria

Sub-criteria	*Supplier A*	*Supplier B*	*Supplier C*
Q1	0.333	0.333	0.333
Q2	0.2	0.6	0.2
Q3	0.2	0.6	0.2
C1	0.589	0.159	0.252
C2	0.429	0.143	0.429
C3	0.429	0.143	0.429
D1	0.429	0.143	0.429
D2	0.333	0.333	0.333
D3	0.333	0.333	0.333
F1	0.333	0.333	0.333
F2	0.333	0.333	0.333
F3	0.333	0.333	0.333
R1	0.333	0.333	0.333
R2	0.333	0.333	0.333
R3	0.333	0.333	0.333

4.4 Alternative Weight Evaluation

The alternative weight evaluation value is obtained through calculations using equation 3, namely by multiplying the eigen vector of the criteria, sub-criteria, and alternatives and then adding them all up. The following is the final calculation to determine supplier ranking based on the QCDFR model or Vendor performance index criteria through alternative weight evaluation calculations, The scale and the weighting results for each alternative are shown in Table 4.

Table 1. Alternative weight evaluation

Alternatives	Alt Weight Evaluation	Rank
Supplier A	0.360896432	1
Supplier B	0.347644546	2
Supplier C	0.291459021	3

Based on the alternative weight evaluation priority synthesis calculation shown in Figure 3, the three button suppliers are PT, XYZ, Supplier A is the best alternative or supplier based on the Vendor Performance Index (VPI) criteria, with a final score of 0,360896432, They are followed by Supplier B with a final score of 0,347644546 and Supplier C with a final score of 0,291459021.

4.5 *Improvement Suggestions*

Based on the results of calculations that have been carried out using the Analytical Hierarchy Process method, a proposal for improving supplier performance can be designed, To enhance the performance of suppliers, partner companies can use various techniques, namely by making a contract agreement that contains sanctions for suppliers who do not meet the recommended criteria based on the AHP method calculations carried out, If performance does not improve, the company can choose another similar supplier (Legaretsa & Purnamawaty, 2021), Besides that, suppliers can also pay more attention to the accuracy of the quantity and delivery time that will be carried out and suppliers are expected to always be open to receiving suggestions and criticism from consumers (Hartati, 2019).

5. Conclusion

Based on the results of pairwise comparisons carried out by experts in this research, through the Vendor Performance Index criteria, it can be seen that the main criteria (level 1) according to the highest to lowest ranking are the Quality, Cost, Delivery, Flexibility, and Responsiveness criteria, Meanwhile, for the sub-criteria in the Quality

criteria, the main sub-criteria is the quality of raw materials; for the Cost criteria, the main sub-criteria is the price of raw materials; for the delivery criteria, the main sub-criteria is Timeliness of Delivery; for the Flexibility criteria the main sub-criterion is the fulfilment of return requests and for responsiveness the main sub-criterion is the supplier's response to complaints submitted by the company, To determine alternative priorities, the supplier performance ranking order is in first place, namely the supplier named Supplier A with a final score of 0,361, followed by Supplier B in second position with a final score of 0,348 and Supplier C in third position with a final score 0,291. The research carried out proves that the application of the AHP method has proven to be effective in knowing supplier performance subjectively. For future research, it is hoped that methods will be used to assess supplier performance objectively.

Declaration of Conflicting Interests. The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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To Cite This Article: Syukrilah, S., Rahmah, A., & Lubis, T. C. (2023). Evaluate Supplier Performance Using the Analytical Hierarchy Process Based on the Vendor Performance Index, *Journal of Industrial Engineering and Education,* 1(2), 128-135.