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Analysis of The Selection of Ship Spare Parts Suppliers at PT. PTK Indonesia with an Analytic Hierarchy Process Approach

Wagimin[1*], Wahyu Ismail Kurnia[1*]

[1,2] **Department of Industrial Engineering, Faculty of Industrial Technology, Universitas Balikpapan**
Email Address: wagimin66.leo@gmail.com, wahyu.ismail.kurnia@bpn-uniba.ac.id

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Abstract

This study aims to analyze the selection of ship spare parts suppliers at PT. PTK Indonesia uses the Analytic Hierarchy Process method. The research method used to select ship parts suppliers is the Analytic Hierarchy Process (AHP) method. The data collection technique was carried out by distributing questionnaires to 4 respondents. The questionnaire design consists of a comparative assessment of the importance of the criteria and each criterion. For data processing, the software used is Expert Choice. The results showed that the quality criterion was the most important selection criterion with a percentage of 55.8% (0.558) compared to other criteria. And PT. Askrindo is the most appropriate supplier to meet the demand of PT. PTK Indonesia has the highest importance presentation compared to other suppliers, which is 55.3% (0.553). The limitations of this study lie in the number of respondents, who only amounted to 4 companies (people), the number of criteria used to select suppliers, and the field of supplier selection. Meanwhile, the implications of the results of this study are in the form of determining criteria and potential suppliers that can be used by the Company to meet the needs of ship spare parts for PTK Indonesia. The origin of this research lies in case studies and the use of the AHP method as a decision-making tool in choosing criteria and potential supplier companies appropriately in meeting the needs of ship spare parts at PT. PTK Indonesia.

Keywords: ***Analytic Hierarchy Process, Expert Choice, Supplier Selection***

1. Introduction

Suppliers are important actors in a supply chain. The smooth and successful operational activities of manufacturing companies depend heavily on the role of supplier companies as providers of raw materials and supporting materials for the needs of manufacturing companies. The important role played by suppliers is able to influence the main performance of manufacturing companies. To maintain the stability and continuity of the flow of raw materials and supporting materials, manufacturing companies must establish long-term cooperation and collaboration with suppliers appropriately. (Pujawan, 2010). In addition, the selection of suppliers as the main supplier is important for manufacturing companies before deciding to establish long-term cooperation. Considering that mistakes in choosing the main supplier can be fatal to the smooth production process and quality assurance of the Company's products (Revanda, 2023).

In principle, supplier selection is a form of decision-making aimed at eliminating several suppliers obtained to get potential end suppliers. Decision-making is based on several determining criteria in quantitative and qualitative forms (Rodrigues et al., 2014). However, under certain conditions, the Company requires the search for new suppliers who are more potential for long-term collaboration. Because it is influenced by various factors and stakeholder perceptions, sometimes supplier selection becomes complex and long (Taherdoost & Brard, 2019). Amindoust et al. (2012) advise that the Company, in selecting suppliers, should use references to past data. In addition, researchers and practitioners have suggested using the Multi-Criteria Decision Making (MCDM) method to solve problems in supplier selection. MCDM is designed to make it easier for stakeholders to make their choices based on several criteria and priority-based

alternatives (Soylu, 2010). One of the recommended MCMM methods is the Analytic Hierarchy Process (AHP).

AHP is an MCDM-based problem-solving method with the basic principle of choosing the best alternative from several alternatives and evaluating determining criteria (Fu, 2019). AHP is equipped with a framework for comprehensive problem-solving decision-making by measuring subjective assessment results (Liao et al., 2015). Some literature discusses the use of the AHP method for supplier selection, such as Rajesh & Malliga, (2013), Fu, (2019), Rodrigues et al., (2014), Rajesh & Malliga, (2013) dan Revanda, (2023). Given that AHP can describe complex problems in selecting potential suppliers based on a comprehensive framework, choosing the best alternative, and being able to evaluate determining criteria, this study uses the AHP method to determine potential suppliers of ship parts for PT. PTK Indonesia.

PT. PTK is one of the subsidiaries of state-owned enterprises owned by the Indonesian government engaged in the procurement of fuel distribution to all ports in Indonesia. As one of the important companies, in order to support the operational activities of PT. Pertamina, PT. PTK considers it important to select potential suppliers for the procurement of ship spare parts. However, in the supplier selection process, PT. PTK has problems in terms of determining criteria and potential suppliers among existing suppliers. For this reason, this study aims to analyze the selection of ship spare parts suppliers at PT. PTK Indonesia uses the AHP method. The results of this research it is expected to be a reference for the Company in designing and determining the best supplier based on priority criteria for supplier selection.

2. Literature Review

2.1. Analytic Hierarchy Process (AHP)

The Analytic Hierarchy Process (AHP) is a specialized method of multi-criteria decision-making (MCDM) introduced by Saaty in 1980 (Saaty, 1980). AHP is widely used as an analytical tool in decision-making and has been applied in various fields, such as evaluation, appraisal, forecasting, employee selection, product concept assessment, and so on. The AHP method helps to break complex and unstructured situations into smaller components. These variables are then arranged in a hierarchy and assigned numerical values based on subjective considerations about their importance. After that, a synthesis of various considerations is carried out to determine which variable has the highest priority and acts as an influence on the outcome of the situation. (Faisol et al., 2014). In solving problems with the AHP Method, several basic principles must be understood, namely. (Rahmanita et al., 2018):

a. Decomposition is the process of thoroughly breaking down a problem into its elements in the form of a hierarchy in decision-making. Each element is interconnected and connected in that hierarchy. Solving is done by dividing the elements of the problem until further solutions are no longer possible.
b. Comparative Judgment is the process of assessing the relative importance of two elements at a given level above a level above it. This assessment is at the core of the AHP method because it will affect the priority order of its elements. The results of this assessment can be presented in the form of a pairwise comparison matrix, which contains the degree of preference of several alternatives for each criterion. The preference scale used in the pairwise comparison matrix is a scale of 1 to 9, where scale 1 indicates the lowest level of importance (equal importance) and scale 9 indicates the highest level of importance (extreme importance) (Saaty, 2004).
c. Synthesis of priority is performed using the eigenvector method to derive relative weights for decision-making elements.
d. Logical Consistency is one of the important characteristics of the AHP method. To achieve logical consistency, all eigenvectors obtained from each level of the hierarchy are combined into a weighted composite vector. These composite vectors are then used to generate a sequence of decision-making. Thus, Logical Consistency ensures that all the weight given to elements in the hierarchy as a whole is consistent and conforms to predefined preferences.

3. Research Methodology

This research uses the Analytical Hierarchy Process (AHP) method to determine the selection of ship spare parts suppliers appropriately. AHP is a method or tool of decision-making based on criteria with a nine-point rating scale (Saaty, 2004). AHP was chosen as the analysis method in this study because it considers criteria and subcriteria for the selection of the most suitable alternative. Through AHP, the process of selecting alternatives for complex decision-making can be simplified into small and limited decisions. Data collection techniques are carried out by distributing questionnaires to respondents. The

respondents in this study are each the director of PT. Askindo, PT. Kapal Jaya, PT. Samudra Emas and PT. Sea Flower. Then, the questionnaire distributed consists of a comparative assessment between criteria and the assessment of each criterion. The criteria used to select a ship parts supplier are shown in Table 1. The criteria assessment uses a paired comparison scale as shown in Table 2 (Saaty, 1980).

Table 1. Supplier Selection Criteria

No.	Criterion	Source
1	Quality	(Ardiantono et al., 2019; Helianty et al., 2021)
2	Delivery	(Muhammad et al., 2020; Pitaloka, Adelia Amanda; Barry, Husnil; Sofa, 2022; Rivaldi et al., 2023)
3	Service	(Azzahra & Saroso, 2018; Wahid et al., 2022)
4	Price	(Noviandri et al., 2015; Safira & Susanty, 2021)

Table 2. Paired Comparison Rating Scale

Importance Level	Definition
1	Both elements are equally important.
3	One element is slightly more important than the other.
5	One element is more important than the other.
7	One element is more absolutely important than another.
9	One element is absolutely more important than another.
2, 4, 6, 8	Values between two adjacent values

Data processing and analysis in this study follow the basic principles of AHP, including (1) compiling a hierarchy; (2) arranging the order of priority; and (3) determining logical consistency. The software used for the application of AHP in this study is Expert Choice version 11. Results of data processing. Adjusted to consistency provisions to find out whether the processed data is declared feasible or not. The standard used is that if the Consistency Ratio (CR) = 0, then the hierarchy is declared consistent; if CR < 1, then the hierarchy is expressed as fairly consistent; and if CR > 1, then the hierarchy is declared inconsistent and must re-collect data.

4. Results and Discussion

The initial stage in this section is decomposition. Decomposition is solving or dividing a complete problem into its elements in a hierarchical form of the decision-making process, where each element is interconnected. The hierarchy that is arranged contains the objectives, criteria, and alternatives of ship parts suppliers as shown in Figure 1. The picture displays 4 criteria (Quality, Delivery, Service, and Price) and 4 alternative suppliers of ship spare parts.

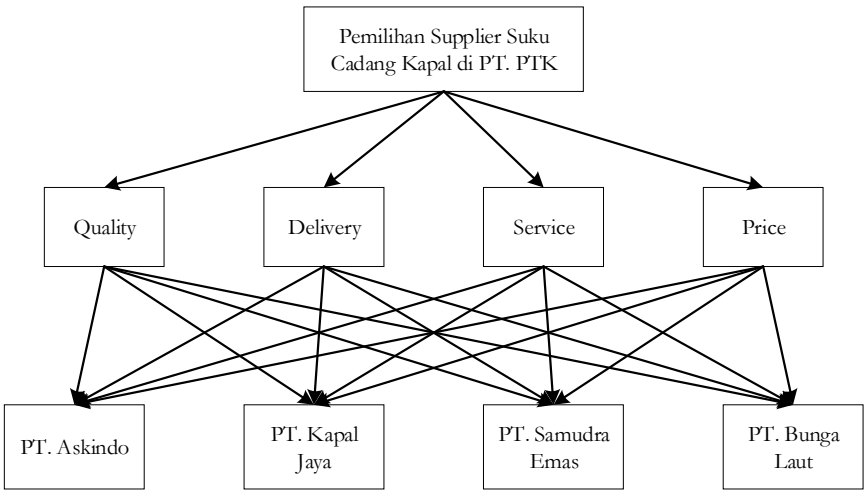

Figure 1. Hierarchy of ship parts supplier selection process

After creating a hierarchy of supplier selection processes, the next step is to determine the most important criteria through a pairwise comparison matrix between criteria. This matrix allows decision-makers to compare each pair of criteria and determine to what extent one criterion is more important than

the other. Calculation of importance value using Expert Choice software. The calculation results are displayed in the pairwise comparison matrix table between criteria as follows.

Table 3. Pairwise Comparison Matrix Between Criteria

	Quality	Delivery	Service	Price
Quality	-	3,7224	3,80675	4,28139
Delivery	-	-	2,05977	2,44949
Service	-	-	-	1,18921
Price	-	-	-	-

Based on the calculation results displayed in the pairwise comparison matrix between the criteria above, it shows that of the 4 criteria, the quality criterion has a higher level of importance than the other 3 criteria. The comparison value between Quality and Delivery is 3.7224, between Quality and Service is 3.80675, and between Quality and Price is 4.28139. This shows that quality is considered more important than delivery, service, and price. After calculating the importance of each criterion, the next step is to determine the order of priority for the criteria in supplier selection. The priority order of criteria is presented in Table 4 and Figure 2 as follows.

Table 4. Priority Order of Supplier Selection Criteria

Goal: Selection of Ship Spare Parts Supplier at PT. PTK Indonesia	
Quality	0,558
Delivery	0,215
Service	0,122
Price	0,105

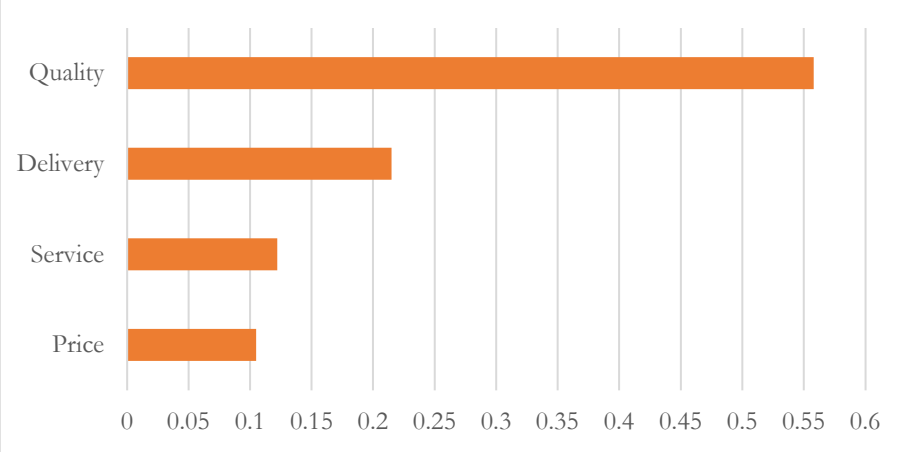

Figure 2. Order of Priority Supplier Selection Criteria

Table 4 above shows the priority order of criteria used for the supplier selection process. Quality has a weighting of 0.558, which indicates that the quality of ship parts is considered the most important factor in supplier selection. Delivery has a weight of 0.215, which shows that the supplier's ability to deliver on time is considered an important factor. Service has a weight of 0.122, which indicates that the service provided by suppliers in meeting customer needs and requests is considered an important factor. Price has a weighting of 0.105, which indicates that the price of ship parts is considered a relatively less important factor in supplier selection. From these results, it can be seen that the quality of ship parts is the most important factor in supplier selection, followed by delivery, service, and price. In addition, the processing results obtained a CR Consistency Ratio of 0.03. This means that the results of weighting the value of the criteria are declared feasible or consistent.

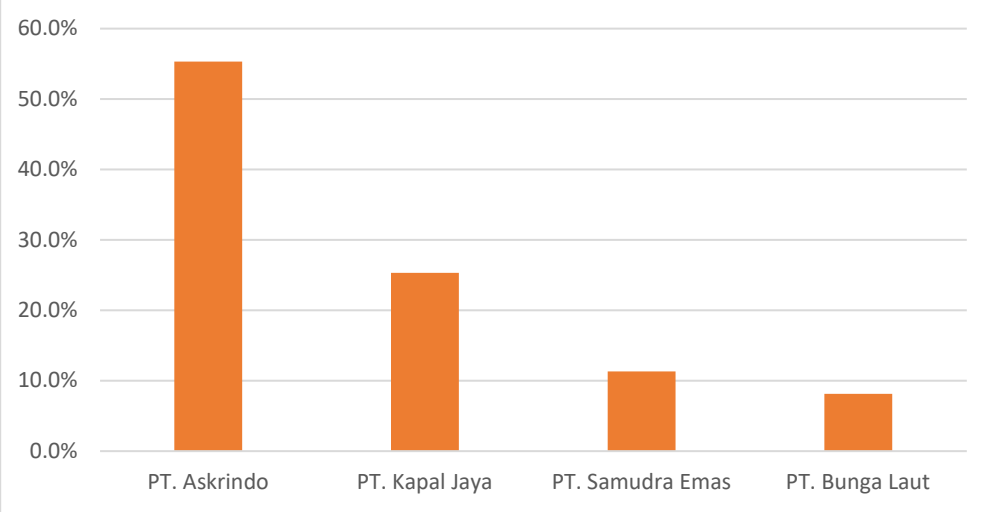

Figure 3. Fourth Alternative Supplier Score

The graph shown in Figure 3 above shows the calculation results of the four suppliers based on 4 criteria. From these results, the PT can be known as PT. Askrindo with a nipa weight presentation of 55.3% (0.553), PT. Kapal Jaya by 25.3% (0.253), PT. Samudra Emas 11.3% (0.113) and PT Bunga Laut 8.1%. From this result, it can also be said that PT. Askrindo is considered the most appropriate supplier company to supply ship spare parts for PT. PTK Indonesia. Followed by the second, third, and fourth positions, namely PT. Kapal Jaya, PT. Kapal Jaya, PT. Samudra Emas and PT. Seaflower.

5. Conclusion

Based on the results of the research obtained, it can be concluded that the criteria and value presentation of choosing a ship spare parts supplier for PT. PTK Indonesia is Quality 55.8%, Delivery 21.5%, Service 12.2% and Price 10.5%. Quality criteria are the most important criteria for choosing a ship spare parts supplier company, according to delivery, service, and price criteria. In addition, from the four suppliers, PT. Askrindo is the most appropriate supplier company to meet the needs of shipping spare parts for PT. PTK Indonesia has a percentage of importance value of 55.3% (0.553).

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