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Decision Making for the Selection of Plywood Suppliers at PT Papan Decoratif Using the Analytical Hierarcy Process (AHP) Method

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ABSTRACT

The proper selection of suppliers is a crucial factor in the manufacturing industry as it significantly influences production efficiency and the quality of final products. PT Techno Wood Indonesia, a company engaged in the production of decorative panels, highly depends on high-quality plywood as its main raw material. This study applies the Analytical Hierarchy Process (AHP) method to determine the best plywood supplier based on relevant criteria. Data were collected through observation, interviews, documentation, and questionnaires distributed to the Purchasing/Procurement staff, supported by secondary data from company documents and literature. The results indicate four main criteria with the following weights: Performance (0.537), Quality (0.271), Cost (0.131), and Responsiveness (0.061). From the global priority synthesis, PT Sumitomo Forestry ranked first with a weight of 0.476, followed by PT SMB Gobel Indonesia (0.362) and PT Itochu Indonesia IDR (0.162). These findings highlight that PT Techno Wood Indonesia prioritizes performance and quality over cost and responsiveness, with PT Sumitomo Forestry identified as the primary plywood supplier.

Keywords: *Analytical Hierarchy Process, plywood supplier, decision making PT Techno Wood Indonesia*.

Introduction

In the manufacturing industry, the selection of the right supplier is a crucial factor that greatly affects the production efficiency and quality of the final product [1]. PT Techno Wood Indonesia as a company engaged in the production of decorative panels relies heavily on the supply of high-quality plywood to ensure that the products produced are in accordance with the company's standards. However, the challenge of selecting suppliers is not only limited to product quality, but also includes aspects of price, timeliness of delivery, production capacity, and after-sales service [2]. Mistakes in choosing suppliers have the potential to disrupt the supply chain, which ultimately impacts customer satisfaction and company profitability[3].

One of the methods that is widely used in supporting multi-criteria decision-making is *Analytical Hierarchy Process* (AHP). This method is able to break down complex problems into simpler hierarchies, then make paired comparisons between criteria to determine priorities[4], [5]. Thus, AHP assists decision-makers in choosing the best alternative based on various relevant considerations.

Previous research has shown the effectiveness of AHP in increasing the objectivity and accuracy of the supplier selection process. [6], [7], [8]found that AHP was able to determine the priority of criteria objectively, where price was the main criterion with a score of 0.3696, followed by quality and *Lead Time*.[9] The results of another study by Fauzan Ahmad et al. (2025) also confirm that AHP is effective in ranking suppliers based on aspects of quality, price, timeliness of delivery, and product quantity.[10] The application of this method has been proven to help companies optimize their supply chains and increase customer satisfaction.

In the context of PT Techno Wood Indonesia, the main problem faced is the lack of a standard system to determine the main plywood supplier. So far, companies tend to choose suppliers based on available lists, specification suitability, and price agreements. Although cooperative relationships with many suppliers have been well established, the reality in the field shows that there are still delivery errors, such as formalin emission levels that are too high so that they do not comply with the company's specifications (±13%). This condition emphasizes the importance of applying a more objective and structured method in supplier selection.

Based on this background, this study aims to: (1) determine the best plywood supplier using the AHP method based on four main criteria (*performance*, *quality*, *cost*, *responsiveness*), (2) analyze the factors that cause the supplier with the highest score to excel compared to other alternatives, and (3) formulate managerial implications for PT Techno Wood Indonesia in taking Strategic decisions related to the selection of plywood suppliers. This research is expected to provide practical benefits for companies in formulating more effective

and efficient supplier selection strategies, as well as being theoretically useful as a reference for the application of AHP in decision-making in the manufacturing industry.

Research Methods

The object of this research focuses on the raw materials of plywood used by PT Techno Wood Indonesia to produce decorpoly. These raw materials are very important because they are ordered repeatedly, so an effective supplier selection method is needed so that companies do not make mistakes in determining the main supplier. This research was carried out for approximately one month, from January 7 to February 20, 2025.

The data used consists of primary, secondary, general, and special data. Primary data was obtained directly through observations, interviews, documentation, and questionnaires given to the company's staff, including a list of suppliers and plywood prices. Secondary data is obtained from company documents and literature studies such as books, journals, and articles [11], [12], [13], [14], [15], [16]. General data includes information on the company's history, organizational structure, production process, and product type. Meanwhile, special data related to supplier selection criteria, the weight of the importance of each criterion, and the assessment of suppliers are collected through forms and consideration of purchasing/procurement staff.

The data collection technique was carried out in four ways, namely direct observation in the field, interviews with experts related to raw material purchasing activities, documentation in the form of photos or supporting documents to strengthen validity, and questionnaires addressed to expert staff to determine criteria, subcriteria, and alternatives for plywood suppliers [17], [18], [19].

The data processing in this study uses the Analytical Hierarchy Process (AHP) method. The stages include the preparation of a hierarchical structure of criteria and subcriteria, paired comparisons between criteria and alternatives, calculation of priority weights, consistency tests with Consistency Ratio (CR), and analysis of results to determine the best supplier ranking. Data analysis techniques with AHP help to change qualitative criteria to quantitative so that decisions can be made more rationally. The final result is in the form of identifying the supplier with the highest weight that is considered the most suitable for PT Techno Wood Indonesia [20], [21], [22].

The research flow is described through a flowchart consisting of several stages, ranging from practical work planning, literature study, field study, problem identification, determination of the AHP method, formulation of problems and limitations, data collection, data processing, to analysis and discussion. Furthermore, the research was closed with drawing conclusions and giving suggestions. The entire series of activities will be completed on February 20, 2025.

Results and Discussion

The research was conducted at PT Techno Wood Indonesia with a focus on selecting plywood suppliers using the *Analytical Hierarchy Process* (AHP). Data were obtained from observations, interviews, documentation, and questionnaires involving staff *purchasing/procurement* and supported by secondary data from company documents and literature. The hierarchical structure consists of four levels: objectives → criteria → subcriteria → supplier alternatives. The results of the consistency test in each comparison matrix show *Consistency Ratio (CR) < 0.1*, so that the assessment is declared valid.

Based on the results of calculations and analyses at PT Techno Wood Indonesia, the *Analytical Hierarchy Process* (AHP) is used to determine the weight of each criterion so that the highest value alternative is obtained. The calculation of AHP begins with the preparation of a paired comparison matrix. The matrix values are then normalized using the formula:

$$a'_{ij} = \frac{a_{ij}}{\sum_{i=1}^{n} a_{ij}} \quad (1)$$

Next, the priority weight for each criterion is calculated with the formula:

$$w_i = \frac{\sum_{j=1}^{n} a'_{ij}}{n} \quad (2)$$

The validity of results is measured through *the Consistency Ratio (CR):*

$$CI = \frac{\lambda_{max} - n}{n-1}, CR = \frac{CI}{RI} \quad (3)$$

and all results show , so the assessment is declared consistent.$CR < 0{,}1$

From this calculation, four main criteria were obtained with the following weights: Performance (0.537), Quality (0.271), Cost (0.131), and Responsiveness (0.061). From each criterion, there were 16 sub-criteria assessed, including aspects of price, discount, payment period, price compatibility with quality,

consistency of plywood specifications, defect-free, service quality, quality of quality, conformity of order quantity, delivery accuracy, contract agreement, environmental standards, clarity of communication, complaint handling, warranty guarantee, and ability to deal with variations in demand.

Table 1 Weighting of Supplier Selection Criteria

Criteria	Weight
Performance (P)	0,537
Quality (Q)	0,271
Cost (C)	0,131
Responsiveness (R)	0,061

Based on the results of the subcriteria analysis, the highest priority in each criterion is the price of plywood (C1) with a weight of 0.510; supply of defectless goods (Q2) with a weight of 0.468; conformity of the number of goods according to the order (P1) with a weight of 0.375; and the provision of a guarantee (R3) with a weight of 0.439.

Next, a global priority calculation is carried out, namely by multiplying the weight of criteria, subcriteria, and supplier alternatives.

Table 2. Alternative Supplier Ranking Results

Supplier Alternatives	Total Weight	Ratings
PT Sumitomo Forestry	0,476	1
PT SMB Gobel Indonesia	0,362	2
PT Itochu Indonesia IDR	0,162	3

In the application of the *Analytical Hierarchy Process* (AHP) to determine the best plywood supplier for PT Techno Wood Indonesia, data was obtained through a questionnaire distributed to Purchasing staff and related staff, and supplemented with additional data from company documents. The data is organized into a four-level hierarchical structure, namely objectives, criteria, subcriteria, and supplier alternatives. The first stage is the comparison of the level of importance between the criteria using a paired comparison matrix. The results of the calculation of priority weights show that the *Performance* (0.537) took first place, followed by *Quality* (0,271), *Cost* (0.131), and *Responsiveness* (0.061). Because the value of *Consistency Ratio* (CR) < 0.1, the results of the comparison are declared consistent so that the analysis can be continued.

The next stage is the comparison of the level of importance between the subcriteria under each criterion. The calculation results show the main sub-criteria in each criterion, namely the price of plywood (C1) with a weight of 0.510 in the criterion *Cost*, supply of defectless goods (Q2) with a weight of 0.468 on the criteria *Quality*, the suitability of the amount of plywood according to the order (P1) with a weight of 0.375 on the criteria *Performance*, and the provision of a guarantee guarantee (R3) with a weight of 0.439 on the criteria *Responsiveness*. All comparisons between subcriteria also met the consistency requirement with a CR value of < 0.1.

Furthermore, a comparison of the level of interest between suppliers is carried out based on all subcriteria. The results showed that PT Sumitomo Forestry excelled on most of the important subcriteria, such as C1 (0.621), Q2 (0.621), Q4 (0.666), P1 (0.683), and R3 (0.531). PT SMB Gobel Indonesia stands out more on subcriteria such as price alignment with quality (C4 = 0.555) and on-time delivery (P2 = 0.571), while PT Itochu Indonesia IDR only has a relatively better score in some aspects such as compliance with environmental standards (P4 = 0.316). All of the results of these comparisons between suppliers are also consistent with a CR < 0.1.

The final stage is the calculation of global priorities by multiplying the weight of the criteria, the weight of the subcriteria, and the alternative weight of each subcriterion. The results show that PT Sumitomo Forestry occupies the first position with a total weight of 0.476, PT SMB Gobel Indonesia occupies the second position with a total weight of 0.362, and PT Itochu Indonesia IDR is in third place with a weight of 0.162. Thus, the main supplier of plywood that is most suitable to choose is PT Sumitomo Forestry. However, to anticipate the risk of supply delays or distribution disruptions, PT SMB Gobel Indonesia and PT Itochu Indonesia IDR can still be used as supporting reserve suppliers.

Analysis of global priorities shows that PT Sumitomo Forestry has the highest score (0.476). This is due to: (1) *Performance* has the highest number of deliveries (P1) with a value of 0.683, which is the most important sub-criterion in the performance criteria, (2) *Quality*) stands out on the aspects of supplying defect-free goods (Q2) and quality consistency (Q4), which are the main considerations of the company to ensure the quality of the final product, (3) *Cost*, although not the highest in terms of price, the value of the proportion between price and quality (C1 and C4) remains competitive, (4) *Responsiveness* provides the highest value

warranty guarantee (R3) among all suppliers. The combination of strong performance in these key criteria is what led PT Sumitomo Forestry to be chosen as the main supplier.

These findings confirm that PT Techno Wood Indonesia prioritizes performance factors (*Performance*) and quality (*Quality*) versus cost (*Cost*) and responsiveness (*Responsiveness*). This is in line with the research of Anisa and Rahmatullah (2020) which states that companies tend to prioritize quality and reliability aspects of the supply chain to maintain customer satisfaction[30]. Thus, the selection of PT Sumitomo Forestry as the main supplier of plywood is the right decision because it has the highest priority value. However, to reduce the risk of delays and maintain supply sustainability, PT SMB Gobel Indonesia and PT Itochu Indonesia IDR are still considered as alternative suppliers. This strategy is in accordance with the concept *Multiple Sourcing* which is recommended in modern supply chain management (Saaty, 1988).

The results of this study are in line with several previous studies, [31], [32], [33], [34]which showed that the quality and accuracy of delivery are the dominant factors in supplier selection. Fauzan Ahmad et al. (2025) who strengthened that AHP is able to sort suppliers based on quality performance, price, and delivery time. The main difference is that PT Techno Wood prioritizes quality and performance over cost, due to its industry characteristics that demand high product quality [35], [36], [37]

Based on the findings of the research, the managerial implications that can be applied are by strengthening the partnership with PT Sumitomo Forestry through long-term contracts, implementing a multiple sourcing strategy by retaining PT SMB Gobel Indonesia and PT Itochu Indonesia IDR as backup suppliers, developing AHP-based supplier evaluation SOPs so that the assessment is more objective and structured and tightening quality inspections, especially on defect-free (Q2) and quality consistency aspects.

Conclusion

Based on the results of calculations and analysis at PT Techno Wood Indonesia, the Analytical Hierarchy Process (AHP) method is used to determine the weight of each criterion so that an alternative with the highest value is obtained. The four main criteria set are Performance (0.537), Quality (0.271), Cost (0.131), and Responsiveness (0.061). From these criteria, there were 16 subcriteria assessed, including aspects of price, discount, payment period, price alignment with quality, consistency of plywood specifications, defectless goods, service quality, ability to maintain quality, suitability of the number of goods, accuracy of delivery, contract agreement, environmental standards, clarity of communication, handling of complaints, warranty guarantees, and the ability to deal with variations in demand. The results of the analysis show that PT Sumitomo Forestry ranks first with a total weight of 0.476, followed by PT SMB Gobel Indonesia in second place with a weight of 0.362, and PT Itochu Indonesia IDR in third place with a weight of 0.162. Thus, the main supplier of plywood that is most feasible for PT Techno Wood Indonesia is PT Sumitomo Forestry because it has the highest value. PT Sumitomo Forestry's advantages are mainly due to the consistency of performance and quality that exceeds other suppliers. Managerial implications include the need for companies to strengthen strategic cooperation with major suppliers and establish more measurable supplier evaluation standards using AHP.

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