



Vendor selection for the main packaging box using the analytical hierarchy process (AHP) method in a mid-sized furniture manufacturing company

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ABSTRACT: This study addresses challenges in the furniture industry related to packaging box delivery delays and inconsistencies in size and print quality. The objective was to evaluate packaging box vendors systematically to improve supply chain efficiency. The Analytical Hierarchy Process (AHP) method was employed to identify and weigh key criteria influencing vendor selection. Three primary criteria (quality, delivery, and price) were assigned equal weights of 0.33. Quality was assessed through material, size, print, and lead time sub-criteria, each weighted at 0.25. Delivery was evaluated based on timeliness (0.77) and quantity accuracy (0.23), while price involved competitive pricing (0.90) and payment terms (0.10). The AHP results ranked vendors with DM as the top choice, followed by SMB, TB, DS, and CA. The findings demonstrate the effectiveness of a structured, criteria-based vendor evaluation in enhancing operational performance and minimizing packaging errors. This approach offers valuable insights for optimizing vendor management in supply chains.

Keywords: vendor evaluation; packaging quality; delivery performance; supply chain management.

Seleção de fornecedores para a caixa de embalagem principal usando o método de processo de hierarquia analítica (AHP) em uma empresa de fabricação de móveis de médio porte

RESUMO: Este estudo aborda os desafios da indústria moveleira relacionados a atrasos na entrega de caixas de embalagem e inconsistências no tamanho e na qualidade da impressão. O objetivo foi avaliar sistematicamente os fornecedores de caixas de embalagem para melhorar a eficiência da cadeia de suprimentos. O método do Processo de Hierarquia Analítica (AHP) foi empregado para identificar e ponderar os principais critérios que influenciam a seleção de fornecedores. Três critérios principais (qualidade, entrega e preço) receberam pesos iguais de 0,33. A qualidade foi avaliada por meio dos subcritérios material, tamanho, impressão e prazo de entrega, cada um com peso de 0,25. A entrega foi avaliada com base na pontualidade (0,77) e na precisão quantitativa (0,23), enquanto o preço foi avaliado com base em preços competitivos (0,90) e em condições de pagamento (0,10). Os resultados do AHP classificaram os fornecedores com DM como a principal escolha, seguidos de PMEs, TB, DS e CA. Os resultados demonstram a eficácia de uma avaliação estruturada e baseada em critérios de fornecedores para aprimorar o desempenho operacional e minimizar erros de embalagem. Essa abordagem oferece insights valiosos para otimizar a gestão de fornecedores nas cadeias de suprimentos.

Palavras-chave: avaliação de fornecedores; qualidade da embalagem; desempenho na entrega; gestão da cadeia de suprimentos.

1. INTRODUCTION

The industrial sector is characterized by intense competition, compelling businesses to continually enhance their operational processes to sustain a competitive advantage. As competition escalates, companies are increasingly required to implement rigorous and selective vendor selection procedures (MARITO, 2023). Vendors - entities or individuals providing essential goods or services for production - play a critical role in ensuring timely and efficient input supply (HASIANI et al., 2021). Effective vendor selection is thus a strategic imperative, directly influencing profitability, competitive positioning, and supply chain resilience (ALTUBAISHE; DESAI, 2023). However, the vendor selection process is often complex and time-

consuming, involving the assessment of multiple criteria, including price, delivery time, quality, and service (HUTABARAT et al., 2021).

In the furniture manufacturing industry, the significance of effective vendor selection intensifies due to its competitive nature and the necessity of maintaining seamless supply chain operations to deliver high-quality products punctually (SHOFFIYATI; KRISTIANTO, 2025). This industry frequently faces challenges such as delays in raw material supply, delivery tardiness, and mismatches in product specifications, notably with packaging materials. For example, companies often encounter packaging delays, incorrect sizing, or printing errors, which contribute to operational inefficiencies, increased costs, and reduced

customer satisfaction. These persistent challenges highlight the urgent need for a systematic and objective vendor selection methodology (SUKENDAR et al., 2021).

To address these challenges, adopting a precise and structured vendor selection process is essential for minimizing risks and maximizing supplier relationship benefits. The Analytical Hierarchy Process (AHP) has emerged as a robust multi-criteria decision-making tool, enabling the systematic evaluation and comparison of vendor alternatives based on clearly defined criteria (AL HAZZA et al., 2023). AHP decomposes complex decisions into hierarchical layers of criteria and sub-criteria, facilitating a comprehensive and consistent analysis (SYAHRIANI et al., 2022). Its capacity to manage decision-maker inconsistency further enhances the reliability of vendor evaluations (NUGROHO et al., 2022).

Although AHP's effectiveness in vendor selection is well-documented, its specific application within the furniture industry - especially for companies confronting packaging and raw material supply challenges - remains underexplored (ILYAS, 2017). Previous studies such as Fitriana; Santosa (2020) have developed generalized vendor selection frameworks, but few have tailored AHP to address the distinct operational needs of mid-sized furniture manufacturers. This study focuses on applying AHP to ensure quality consistency, timely delivery, and cost efficiency in packaging materials, thereby filling a critical gap.

The objective of this research is to develop a structured, criterion-based vendor selection approach tailored to the furniture industry, aimed at mitigating common operational challenges, including delivery delays, specification mismatches, and low-quality materials. This work contributes by extending AHP's application within this sector and providing a practical method to enhance supply chain efficiency and reliability.

2. MATERIAL AND METHODS

This study employs a descriptive qualitative research approach, combining both qualitative and quantitative methods for data collection and analysis. The primary objective is to evaluate the vendor selection process for packaging material suppliers at a mid-sized furniture manufacturing company using the Analytical Hierarchy Process (AHP). The research began with a thorough assessment of the company's current situation through direct observation and interviews with key stakeholders. This initial step was critical to understanding the company's ongoing activities, challenges, and operational context. Observing the daily operations and engaging directly with stakeholders allowed for the identification of specific issues related to the vendor selection process, particularly those impacting packaging material suppliers (CANCO et al., 2021). Following this, a comprehensive literature review was conducted to explore relevant theories, methodologies, and best practices to address the company's challenges, ensuring the methods used were grounded in established research.

The primary data sources consisted of both primary data, obtained through interviews and direct observation, and secondary data collected from existing literature. Key respondents in the study included the Head of Purchasing, who has extensive experience in supplier evaluation and procurement processes, providing critical knowledge about supplier criteria and decision-making factors specific to the company's operational needs; the General Manager, whose

strategic decision-making role ensured that the AHP model aligned with broader operational and strategic goals; and the Purchasing Staff, involved directly in the daily procurement activities, whose insights added practical perspectives on the challenges of supplier performance. The sampling technique employed was purposive sampling, where respondents were selected based on their direct involvement in procurement and vendor evaluation. The sample size included the Head of Purchasing, the General Manager, and three Purchasing Staff members, ensuring that the data collected was relevant and from individuals with diverse roles in the vendor selection process (SHARMA et al., 2020). Figure 1 shows a Research Framework.

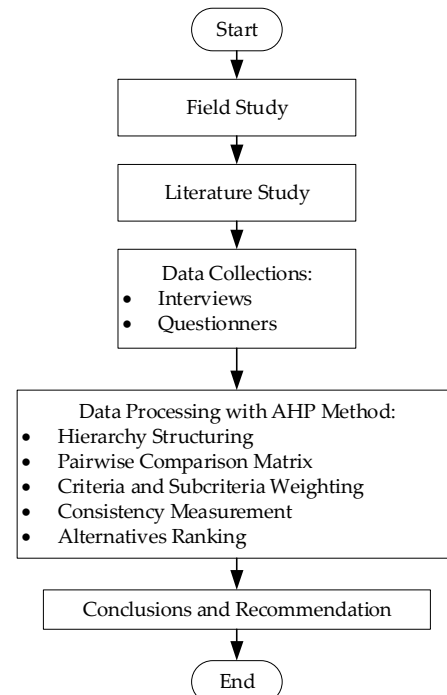


Figure 1. Research framework. Source: Fonte: (MUNIER; HONTORIA, 2021)

Figura 1. Fluxograma de pesquisa. Fonte: (MUNIER; HONTORIA, 2021)

For data analysis, the study followed a structured process using the AHP method. This method organizes the decision-making goals into a systematic hierarchy, including criteria, sub-criteria, and alternative vendors. A pairwise comparison matrix was created to evaluate the relative importance of each element within the hierarchy. The eigenvector method was used to calculate the relative priorities or weights of each criterion and sub-criterion, providing a consistent and mathematically robust way to determine the relative importance of each factor. The Consistency Ratio (CR) was then calculated to ensure the reliability and validity of the results, with a CR value of ≤ 0.1 considered acceptable, confirming the consistency of the decision-makers' comparisons. This structured approach ensured that the decision-making process was rigorous and that the final results were reliable and valid (SANTOS et al., 2021).

In summary, the research methodology integrated qualitative insights from interviews with quantitative analysis through AHP to assess the vendor selection process. By using structured interviews, questionnaires, and AHP, the study provided a comprehensive and systematic evaluation of vendor selection criteria, ensuring the results were both valid

and reliable for improving the vendor selection process in the company (ETLANDA; SUTAWIDJAYA, 2022).

3. RESULTS

3.1. Respondent Characteristics

In this study, key stakeholders involved in the vendor selection process at a mid-sized furniture manufacturing company were selected as respondents (Figure 2). The respondents included the Head of Purchasing, General Manager, and Purchasing Staff, whose insights were critical in identifying the key criteria and sub-criteria for evaluating packaging material vendors.

- **Head of Purchasing:** With extensive experience in supplier evaluation and procurement processes, this respondent provided in-depth knowledge about vendor selection criteria and operational needs specific to the company.

- **General Manager:** This senior executive played a key role in strategic decision-making, ensuring the alignment of the vendor selection process with broader operational and strategic objectives.

- **Purchasing Staff:** These individuals, directly involved in day-to-day procurement, provided practical insights into the challenges and requirements associated with supplier performance.

The selection of these respondents ensured that the data collected reflected a broad range of perspectives from individuals with diverse roles in the vendor selection process.

3.2. Determination of Criteria and Sub-criteria

The criteria and sub-criteria used in this research were derived from a comprehensive literature review and direct interviews with the Head of Purchasing. These criteria reflect the operational needs and priorities of mid-sized manufacturing companies in the furniture sector when selecting packaging material vendors. Three primary criteria were identified: Quality, Delivery, and Price. Each of these criteria was further broken down into specific sub-criteria that are directly aligned with industry best practices in packaging and supply chain management (Figure 2).

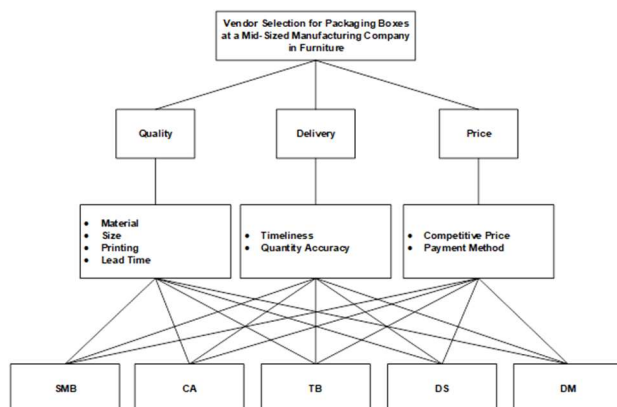


Figure 2. Hierarchical Structure. Source: (FU, 2019).

Figura 2. Estrutura hierárquica. Fonte: (FU, 2019).

This structured approach, as presented in Table 2, enables mid-sized furniture manufacturing companies to systematically assess potential vendors, ensuring the selection of the most suitable vendors that meet both quality and cost requirements while maintaining operational efficiency (TRIPATHI et al., 2022).

Table 1. Criteria and Sub-criteria

Tabela 1. Critérios e Subcritérios

No	Criteria	Code	Sub-criteria	Code
1	Quality	K1	Material	SK1.1
			Size	SK1.2
			Printing	SK1.3
			Lead Time	SK1.4
2	Delivery	K2	Timeliness	SK2.1
			Quantity Accuracy	SK2.2
3	Price	K3	Competitive Price	SK3.1
			Payment Method	SK3.2

Table 2. Criteria and Sub-criteria.

Tabela 2. Critérios e Subcritérios.

No	Vendor	City	Kode
1	SMB	Kudus	X1
2	CA	Cirebon	X2
3	TB	Jakarta	X3
4	DS	Cirebon	X4
5	DM	Cirebon	X5

3.3. AHP Calculation

In the calculation using the AHP method, there are five stages of computation, including the Pairwise Comparison Matrix for Criteria, Normalization and Weight Vector for Criteria, Weight Calculation for Sub-criteria, Consistency Check, and Calculation of Final Weight (ASTANTI et al., 2020).

i) **Pairwise Comparison Matrix for Criteria** - The pairwise comparison matrix for the criteria was developed based on the responses from the General Manager, Head of Purchasing, and Purchasing Staff. The matrix, presented in Table 3, shows the relative importance of the three criteria.

The values in the matrix reflect the equal importance assigned to each criterion, as per the respondents' feedback (YANG et al., 2022).

Table 3. Pairwise Comparison Matrix for Criteria

Tabela 3. Matriz de Comparação por Pares para os Critérios

	Quality (K1)	Delivery (K2)	Price (K3)
Quality (K1)	1	1	1
Delivery (K2)	1	1	1
Price (K3)	1	1	1
Total	3	3	3

ii) **Normalization and Weight Vector for Criteria** - After creating the pairwise comparison matrix, the normalization and weight vectors were calculated. Normalization is necessary to ensure all values are compared on a consistent scale. The normalization and weight vectors for the criteria are shown in Table 4.

Table 4. Result of normalization and weight vector for criteria.

Tabela 4. Resultado da normalização e do vetor de pesos dos critérios.

	K1	K2	K3	Total	Weight
K1	0.33	0.33	0.33	1	0.33
K2	0.33	0.33	0.33	1	0.33
K3	0.33	0.33	0.33	1	0.33
Total	1	1	1	3	1

The normalization of the pairwise comparison matrix is achieved by dividing each value in the *i*-th column and *j*-th

row by the total value of each column. This process involves adjusting the values to reflect their proportion relative to the entire column, ensuring that each value is normalized according to the sum of its respective column (DHURKARI, 2023). Based on Table 4, the normalization calculation for column K1 and row K1 is as follows equation (1).

$$a_{ij} = \frac{a_{ij}}{\sum_{j=1}^n a_{ij}} = \frac{1}{3} = 0.33 \quad (01)$$

After normalization, the next step is to calculate the weight vector for the criteria. According to Table 6, the weight vector for row K1 is 0.33. This value is derived by dividing each normalized value a_{ij} by the total number of criteria being compared (CHEN, 2020). Here is the calculation weight vector with equation (2).

$$w_i = \frac{\sum_{i=1}^n a_{ij}}{n} = \frac{1}{3} = 0.33 \quad (02)$$

iii) Weight Calculation for Sub-criteria - Next, the Weight Single Factor (WSF), Consistency Factor (CF), and λ Max (Lambda Max) were calculated for each criterion, as shown in Table 5. These calculations help verify the consistency of the pairwise comparisons.

Table 5. Result of WSF, CF and λ Max for Criteria

	K1	K2	K3	Weight Vector	WSF	CF
K1	1,00	1,00	1,00	0,33	1,00	3,00
K2	1,00	1,00	1,00	0,33	1,00	3,00
K3	1,00	1,00	1,00	0,33	1,00	3,00
λ Max						3,00

The initial calculation performed is the Weight Single Factor (WSF), which is obtained by multiplying the pairwise comparison matrix by the weight vector. The calculation for the WSF of row K1 in Table 6 is as follows equation (3).

$$WFS = \sum_{i=1}^n a_{ij} \times w_i = (1 \times 0.33) + (1 \times 0.33) + (1 \times 0.33) = 1 \quad (03)$$

After obtaining the WSF, the Consistency Factor (CF) can be calculated. Based on Table 5, the CF for row K1 has a value of 3. This is obtained by dividing the WSF by the weight vector. The calculation process is as follows equation (4).

Table 7. Result of WSF, CF and λ max for criteria.

Tabela 7. Resultado de WSF, CF e λ máximo para os critérios.

Criteria	Code	Criterion Weight	Sub-Criteria	Code	Sub-Criterion	Final Weight
Quality	K1	0,333	Material	SK1.1	0,25	0,083
			Size	SK1.2	0,25	0,083
			Printing	SK1.3	0,25	0,083
			Lead time	SK1.4	0,25	0,083
Delivery	K2	0,333	Timeliness	SK2.1	0,77	0,256
			Quantity Accuracy	SK2.2	0,23	0,078
Price	K3	0,333	Competitive Price	SK3.1	0,90	0,300
			Payment Method	SK3.2	0,10	0,033
Total Final Weight						1

Table 7 provides a breakdown of the weights for the three main criteria, Quality, Delivery, and Price and their sub-

$$CF = \frac{\sum_{i=1}^n WFS}{w_i} = \frac{1}{0.33} = 3 \quad (04)$$

iv) Consistency Check - The next step is to calculate λ Max. According to Table 5, the λ Max is 3. This value is obtained by summing the CF values and then dividing the total by the number of criteria. Below is the detailed calculation process for determining λ Max as presented in Table 5.

$$\lambda \max = \frac{\sum CF}{n} = \frac{3+3+3}{3} = 3 \quad (05)$$

The next step is to calculate the Consistency Index (CI) and Consistency Ratio (CR) to test the consistency of the data (GULER; YOMRALIOGLU, 2020). The results for CI and CR are shown in Table 6.

Table 6. Result of WSF, CF, and λ Max for Criteria

λ Max	N	RI	CI	CR	Result
3	3	0.58	0.00	0.00	Consistent

The Consistency Index (CI) is calculated first by subtracting the number of criteria (n) from λ Max and then dividing the result by the number of criteria minus 1. Below is an example of the CI calculation in Table 5.

$$CI = \frac{\lambda \max - n}{n - 1} = \frac{3 - 3}{3 - 1} = 0 \quad (06)$$

The next step is to calculate the Consistency Ratio (CR). The CR is obtained by dividing the Consistency Index (CI) by the Random Index (RI). The RI value is determined from its table, and for 3 criteria, the corresponding RI value is 0.58. Below is the calculation of the CR as shown in Table 6.

$$CR = \frac{CI}{RI} = \frac{0}{0.58} = 0 \quad (07)$$

Based on the calculations and information in Table 6, the CR value is 0, indicating that the data is consistent because $CR \leq 0.1$. Therefore, the calculations can proceed to the next stage (PATHAK et al., 2022).

v) Calculation of Final Weight - The final step in the AHP calculation involved applying the weights to the sub-criteria for Quality, Delivery, and Price, and deriving the final weight values for each sub-criterion. The final weight values, along with the results for each alternative, are presented in Table 8.

Each main criterion is given an equal weight, showing that they are considered equally important.

The Quality criterion assigns equal weight to each sub-criterion, each contributing 0,083 to the final weight value. This uniform distribution implies that all aspects of quality material, size, printing, and lead time are considered equally vital to the overall quality assessment (SIVAPRAKASAM; ANGAMUTHU, 2023).

In the Delivery criterion, Timeliness is assigned a significantly higher weight (0,256) compared to Quantity Accuracy (0,078). This distribution underscores the prioritization of on-time delivery as a critical component of operational efficiency and customer satisfaction. Timeliness is often a key performance indicator in supply chain management, reflecting its substantial impact on service quality. The lesser weight of Quantity Accuracy suggests it is secondary to timeliness, but still contributes to the overall evaluation of delivery performance (MA et al., 2021).

Within the Price criterion, Competitive Price carries a dominant weight of 0,300, emphasizing its critical role in market competitiveness and decision making. The high weight reflects the importance of pricing strategies in capturing market share and maximizing profitability. The Payment Method, with a minimal weight of 0,033, is considered less influential in the decision-making process, indicating that while payment options are considered, they do not weigh heavily compared to pricing competitiveness (COFFEY; CLAUDIO, 2021).

The final weight values in Table 7 are calculated by multiplying the weight of each criterion by the weight of its corresponding sub-criterion. This approach ensures that the sub-criteria are proportionally represented within the overall decision-making framework. By combining the weights of both criteria and sub-criteria, the final weight values accurately reflect the hierarchical importance of each factor, enabling a comprehensive evaluation of the decision variables.

The total final weight sums to 1.00, ensuring that the analysis is comprehensive and all criteria are considered proportionately. This balanced framework supports a holistic evaluation of the decision-making criteria, ensuring no single

aspect is disproportionately weighted at the expense of others (LI et al., 2021).

Once the final weight values have been determined, the next step is to calculate the alternative values by multiplying the final weight of each sub-criterion by the value of each alternative. This calculation is crucial as it provides a detailed assessment of each alternative's performance relative to specific sub-criteria, allowing for a comprehensive analysis of their strengths and weaknesses.

By applying the final weights to the alternatives, we can derive an overall score for each option, taking into account all relevant criteria and sub-criteria. This process facilitates the ranking of alternatives based on their overall scores, helping to identify the most favorable options and enabling informed decision making (SONAR; KULKARNI, 2021). The alternative values for each sub-criterion are presented in Table 8, with the comprehensive results summarized in Table 9.

Based on the analysis in Tables 8 and 9, DM (X5) is the best vendor with the highest score, particularly in the sub-criteria of Quality (Material and Printing) and Delivery (Timeliness). Although DM has a lower score in Payment Method, their strengths in quality and timely delivery make them the most advantageous choice for a mid-sized manufacturing company in furniture. Vendor SMB (X1) also performs well in terms of competitive pricing but faces challenges in Quantity Accuracy and Payment Method, which diminishes their appeal. TB (X3) shows balanced performance but needs improvement in delivery accuracy.

Meanwhile, CA (X2) and DS (X4) demonstrate lower performance, with CA having poorer quality in Size and Printing, and DS showing weaknesses in Price Competitiveness. Although DS performs well in Size and Timeliness, the lack of price competitiveness and weaknesses in payment methods make it less ideal. Overall, these insights suggest that a mid-sized manufacturing company in furniture should prioritize vendors that meet quality and timeliness standards while also considering pricing and operational reliability (MATHEW et al., 2022).

Table 8. Alternative values are assessed for each sub-criterion.

Tabela 8. Valores alternativos avaliados para cada subcritério.

Alternative	Code	Quality (K1)				Delivery (K2)		Price (K3)	
		0.333				0.333		0.333	
		SK1.1	SK1.2	SK1.3	SK1.4	SK1.2	SK2.1	SK3.1	SK3.2
		0.083	0.083	0.083	0.083	0.256	0.078	0.300	0.033
SMB	X1	0.20	0.15	0.24	0.12	0.12	0.03	0.44	0.13
CA	X2	0.20	0.03	0.03	0.12	0.13	0.24	0.14	0.24
TB	X3	0.20	0.15	0.24	0.12	0.12	0.24	0.23	0.19
DS	X4	0.20	0.33	0.24	0.18	0.15	0.24	0.12	0.19
DM	X5	0.20	0.34	0.24	0.46	0.48	0.24	0.07	0.25

Table 9. Result of alternative values assessed for each sub-criterion.

Tabela 9. Resultado dos valores alternativos avaliados para cada subcritério.

Alternative	Code	(SK1.1)	(SK1.2)	(SK1.3)	(SK1.4)	(SK2.1)	(SK2.2)	(SK3.1)	(SK3.2)
		0.083	0.083	0.083	0.083	0.256	0.078	0.300	0.033
SMB	X1	0.017	0.013	0.020	0.010	0.031	0.003	0.132	0.004
CA	X2	0.017	0.002	0.002	0.010	0.033	0.019	0.043	0.008
TB	X3	0.017	0.012	0.020	0.010	0.031	0.019	0.069	0.006
DS	X4	0.017	0.028	0.020	0.015	0.038	0.019	0.036	0.006
DM	X5	0.017	0.028	0.020	0.038	0.122	0.019	0.021	0.008

3.3. Alternative Vendor Evaluation

The final weights were applied to evaluate vendor alternatives (SMB, CA, TB, DS, DM) based on their performance across the criteria and sub-criteria. The overall AHP scores were calculated for each vendor, as shown in Table 10.

Table 10. Result of AHP method calculations.

Tabela 10. Resultado dos cálculos do método AHP.

Alternative	Code	AHP Score	Percentage	Rank
DM	X5	0,274	27,4%	1
SMB	X1	0,229	22,9%	2
TB	X3	0,185	18,5%	3
DS	X4	0,178	17,8%	4
CA	X2	0,134	13,4%	5

Based on the AHP scores, DM is the most favorable vendor, with the highest score of 27.4%, followed by SMB with 22.9%, and TB, DS, and CA ranked accordingly (DULEBA, 2022).

4. DISCUSSION

4.1. Vendor Selection Based on Timeliness and Competitive Pricing Criteria

The AHP analysis clearly favored Vendor DM (X5), which achieved the highest score of 0.274 (27.4% of the total score). This strong performance can be attributed to its excellent results in two highly weighted criteria: Timeliness (SK2.1) and Competitive Price (SK3.1). These factors are particularly crucial for mid-sized manufacturing companies in the furniture sector, as timely delivery and competitive pricing directly impact operational efficiency and profitability. This finding aligns with previous studies, such as (PISHCHULOV et al., 2019), which emphasizes the importance of Timeliness in operational efficiency, especially in manufacturing industries.

In this study, the respondents, including the Head of Purchasing, General Manager, and Purchasing Staff, played a crucial role in identifying the key criteria and sub-criteria for evaluating packaging material vendors (ABADI; WIDYARTO, 2018). Their combined industry-specific experience significantly enhanced the credibility and relevance of the criteria used in this study (LUKMANDONO et al., 2019). Based on prior studies on vendor evaluation and selection (Hosseini et al., 2022), three primary criteria were identified: quality, delivery, and price. Each of these criteria was further broken down into specific sub-criteria that align with industry best practices in packaging and supply chain management (HOSSEINI et al., 2022).

In contrast, Vendor SMB (X1) secured the second position with a score of 0.229 (22.9%) but showed slightly weaker performance in criteria such as Quantity Accuracy and Payment Method. This suggests that for mid-sized manufacturing companies in the furniture industry, focusing on vendors with proven strengths in timely delivery and competitive pricing is essential for ensuring supply chain efficiency and cost savings (ALHAMDA et al., 2025).

4.2. The Influence of Criteria Weighting in AHP

Sensitivity analysis in this study revealed that changing the weights of the criteria could significantly alter vendor rankings. For example, when Delivery was prioritized (weight

increased to 0.5, while others were adjusted proportionally), vendors excelling in Timeliness gained higher scores. This highlights the flexibility of AHP in adjusting to dynamic operational priorities, providing more tailored insights for decision-makers. This finding supports previous research, such as (Yu et al., 2019), which showed that altering criteria weighting in AHP can influence vendor selection decisions, particularly in contexts where operational priorities shift.

4.3. The Relationship Between Timeliness and Quantity Accuracy in the Furniture Industry

Vendor performance was further differentiated when comparing sub-criteria under Delivery: Timeliness (weight: 0.77) and Quantity Accuracy (weight: 0.23). The significantly higher weight for Timeliness reflects its critical importance in the furniture industry, where delays can disrupt production schedules and increase costs. However, when the weights for these two sub-criteria were adjusted to 0.5 each, the comparative advantage of vendors excelling in Timeliness decreased, giving an advantage to vendors that performed better in Quantity Accuracy. This finding is consistent with research by (Ho et al., 2021), which indicates that companies focusing on Quantity Accuracy can reduce production costs and improve customer satisfaction.

4.4. Comparison with Previous Studies

When compared with earlier studies, this research adopts a more balanced approach by giving equal weight to Quality, Delivery, and Price, in contrast to studies such as (BIANCHINI et al., 2019), which placed greater emphasis on Quality as the main criterion for vendor selection. Additionally, this study differs from research by (MISHRA; PUNDIR; GANAPATHY, 2017), which focused primarily on Price as the dominant factor. In comparison, this study emphasizes a more holistic approach, providing a balanced perspective on vendor performance that is particularly relevant for the operational needs of mid-sized manufacturing companies in the furniture sector.

4.5. Practical Implications and Recommendations

The findings of this study suggest that Vendor DM is the most favorable supplier due to its strengths in Timeliness and Competitive Pricing, which align with the company's operational goals. However, vendors like SMB, which demonstrate balanced performance across various criteria, serve as viable alternatives when priorities change, such as prioritizing Quantity Accuracy over Timeliness. Lower-performing vendors, such as CA (X2), highlight areas for improvement, particularly in delivery reliability and pricing strategies (DARKO et al., 2019).

This research underscores the value of AHP in enabling flexible vendor selection, adapting to changing business priorities. Managers are advised to periodically reassess criteria and their corresponding weights to align with evolving business needs and external conditions, ensuring that vendor selection processes remain effective and relevant (MANIVEL; RANGANATHAN, 2019).

4.6. Recommendations for Future Research

This study emphasizes the critical importance of Timeliness and Competitive Pricing in vendor selection for mid-sized furniture manufacturers. Vendor DM emerged as the best choice due to its superior performance in these areas, which support the company's goals of meeting delivery

deadlines without compromising cost or quality. In contrast, vendors TB (X3) and DS (X4) performed adequately but lacked a competitive edge. Vendor CA (X2), with the lowest score of 0.134, underperformed across all criteria, particularly in Timeliness and pricing. The study reinforces the flexibility of AHP as a robust tool for vendor evaluation and decision-making. Future research could explore AHP applications in other industries and investigate how variations in criteria weighting might impact vendor selection decisions across different operational contexts (DJOHAN et al., 2018).

5. CONCLUSIONS

Conclusions from the study, which aimed to evaluate and select the primary packaging vendor for a mid-sized furniture manufacturing company using the Analytical Hierarchy Process (AHP). The study offers a structured and systematic framework for vendor selection, providing critical insights into the key criteria (quality, delivery, and price) that influence vendor selection decisions within the furniture industry.

The research identifies that Vendor DM (X5) is the most suitable choice, driven by its superior performance in the critical areas of Timeliness and Competitive Pricing, aligning closely with the company's operational and strategic priorities. By adopting a balanced approach to criteria weighting, the study contributes to existing literature by emphasizing a holistic evaluation of vendor performance, rather than focusing on a single criterion. This approach ensures that quality, cost efficiency, and delivery performance are adequately balanced, optimizing procurement outcomes and enhancing supply chain efficiency.

A key contribution of this research lies in integrating stakeholder input into the weighting of criteria, ensuring that the decision-making process reflects the specific goals and operational requirements of the company. The findings underscore the importance of balancing these criteria to develop a comprehensive and effective vendor selection framework.

While the study provides valuable insights, it acknowledges certain limitations. Stakeholders' perspectives and experience could influence the reliance on subjective judgments during the AHP's pairwise comparison process. Additionally, the study's findings are specific to the context of a mid-sized furniture manufacturing company, which may not be directly applicable to other industries or larger organizations. Therefore, future research should consider incorporating additional factors, such as sustainability, innovation, and vendor reliability, as well as examining the sensitivity of criteria weights in dynamic business environments. Incorporating these factors could better align vendor selection processes with evolving industry trends and environmental considerations.

Finally, the study emphasizes the importance of continuous vendor evaluation. To sustain high performance, it is recommended that the company adopt Vendor DM (X5) as its primary supplier, fostering long-term partnerships and engaging stakeholders in an ongoing decision-making process. Regular reassessment of vendor selection criteria will enable the company to adapt to changing market conditions, thereby maintaining an efficient, cost-effective, and high-quality supply chain. The research provides a robust, transparent decision-making framework that offers actionable insights for the broader furniture industry.

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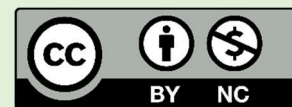
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Data availability: Study data can be obtained by email from the corresponding author or first author upon request.

Conflict of interest: The authors declare that they have no conflict of interest.



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