



Implementation of AHP method in decision support system for AC brand selection at PT. Gemilang

Muhammad Haris¹, Andi Zulherry², Isman Efendi Limbong³, Mahardika Abdi Prawira Tanjung⁴

^{1,2,3,4} *Teknologi Informasi, Universitas Muhammadiyah Sumatera Utara, Medan, Indonesia*

Article Info

Article history:

Received Aug 3, 2024

Revised Aug 14, 2024

Accepted Aug 15, 2024

Keywords:

AC Brand Selection;
Analytic Hierarchy Process;
Criteria Evaluation;
Decision Making;
Priority Weight.

ABSTRACT

The selection of the optimal AC brand for PT Gemilang faces complex challenges as it involves the evaluation of various criteria such as quality, cost, energy efficiency, and after-sales service. This research aims to apply the Analytic Hierarchy Process (AHP) method to determine the best AC brand based on these criteria. The AHP method is used to develop a comparison matrix, calculate the weights of criteria and alternatives, and check the consistency of the results. The analysis results show that Brand B has the highest final weight, making it the most optimal choice compared to the other alternatives. The implications of this study show that the AHP method can be effectively used for multi-criteria decision-making in product selection, providing data-driven recommendations and reducing subjective bias in the selection process. This research makes a significant contribution to a more structured decision-making practice at PT Gemilang.

This is an open access article under the [CC BY-NC](#) license.



Corresponding Author:

Muhammad Haris,
Teknologi Informasi,
Universitas Muhammadiyah Sumatera Utara,
Jl. Kapt. Mukhtar Basri No. 3 Medan, Sumatera Utara, 20238, Indonesia
Email: muhammadharis@umsu.ac.id

Introduction

The air conditioning (AC) industry has experienced significant growth in recent decades, along with the increasing demand for thermal comfort in various sectors, ranging from residential to commercial (Che et al., 2019; Chua et al., 2013). The selection of the right AC brand is one of the crucial factors that can affect operational efficiency, customer satisfaction, and business sustainability (Gelderman et al., 2021). However, in an increasingly competitive and dynamic business environment, the decision-making process regarding AC brand selection can no longer be done intuitively and simply. The sheer number of variables to consider—such as product quality, price, after-sales service, and consumer preferences—makes this process more complex and prone to subjective bias. In this context, Decision Support Systems (DSS) emerge as a much-needed tool to assist managers in making more informed, objective, and strategic decisions. SDM is able to integrate various assessment factors into one comprehensive model, resulting in more optimized decisions and a positive impact on overall company performance (Arvai et al., 2012; Rokonzaman et al., 2021).

PT Gemilang currently faces a significant challenge in selecting an air conditioning brand that best suits their operational needs and customer preferences. This decision has become increasingly critical given its far-reaching impact on energy efficiency, maintenance costs, as well as customer satisfaction. However, traditional decision-making is often based on intuition and subjective experience,

which can lead to sub-optimal results (Hermann et al., 2017; Morselli, 2015; Rochanahastin, 2018). These unstructured decision-making methods tend to overlook important variables, such as technical performance, long-term costs, and after-sales services provided by each brand. In this increasingly complex and uncertain context, PT Gemilang needs a more systematic and scalable approach to ensure that decisions are based on comprehensive analysis and valid data (Hamza & Greenwood, 2009; Pasolong, 2023; Rifa'i & Syahputra, 2020).

This research aims to develop and apply an Analytic Hierarchy Process (AHP)-based Decision Support System model in selecting the optimal air conditioning brand at PT Gemilang. Through this approach, it is expected that the research can provide a structured and data-based solution in overcoming the complexity of decision making that has been relying on traditional methods that are less effective. The AHP model used will help the management of PT Gemilang to assess and compare various alternative AC brands based on predetermined criteria, such as quality, cost, energy efficiency, and after-sales service. Thus, this research is expected to result in more objective and precise decisions, which in turn can improve company performance and overall customer satisfaction (Das et al., 2010; Misra & Panda, 2017; Sencer & Karaismailoglu, 2022; Temuçin & Tozan, 2016).

Previous research has extensively discussed the application of the Analytic Hierarchy Process (AHP) method in various decision-making contexts, including product and service selection. However, empirical studies that specifically explore the use of AHP in air conditioning brand selection in the air conditioning industry are still limited, especially in the context of companies in Indonesia. Most of the existing literature focuses on the application of AHP in different industry sectors or on a global scale, making it less relevant to be applied directly to a company like PT Gemilang. This gap indicates the need for more contextualized and focused research, which can provide deeper insights into how the AHP method can be adapted to solve brand selection problems in more specific markets. This research aims to fill the gap by providing a detailed and applicable analysis, which not only strengthens the existing literature but also makes a tangible contribution to the development of decision-making practices in the air conditioning industry (Anis, 2016; Diana & Achadiani, 2022; Diana & Utari, 2017; Rachmaddhani & Yustanti, 2023).

This research offers a new contribution to the field of decision-making by integrating the Analytic Hierarchy Process (AHP) method into a Decision Support System for air conditioner brand selection at PT Gemilang. Although AHP has been widely used in various contexts, its specific application in AC brand selection in the air conditioning industry has not been widely explored, especially in the context of companies in Indonesia. The novelty of this research lies in the adaptation of the AHP method tailored to the needs and characteristics of the local market, as well as the development of a SPK model capable of handling the complexity of decision-making faced by PT Gemilang. This research not only provides practical solutions for the company but also contributes to the development of theory in AHP-based decision making in specific industrial sectors. The justification of this research is strengthened by the importance of brand selection decisions that have a direct impact on the company's operational performance and business sustainability, so the application of this model is expected to be a reference for other companies facing similar challenges.

Methods

1. Research Design

This research uses a quantitative design with a descriptive and exploratory approach to apply the Analytic Hierarchy Process (AHP) method in selecting AC brands at PT Gemilang. The AHP method was chosen for its ability to solve complex problems through a hierarchical structure, enabling more informed and objective decision making. This research is designed to identify and compare various alternative AC brands based on a number of criteria relevant to PT. Gemilang(Sugiyono, 2016, 2019, 2021).

2. Population and Research Sample

The population in this study consisted of all air conditioning brands available in the Indonesian market and considered relevant for the needs of PT Gemilang. The sample was selected purposively,

covering the brands most frequently used or considered by the company in the procurement of air conditioners. Respondents involved in the AHP process were experts at PT Gemilang, including purchasing managers, technicians, and other staff who have experience and in-depth knowledge of the AC brand selection criteria.

3. Data Collection Technique

Data was collected through a structured questionnaire designed in accordance with the AHP method, in which respondents were asked to perform pairwise comparisons between various criteria and alternatives of AC brands. The questionnaire was designed to collect quantitative data that would be used in the process of determining the weights of criteria and alternatives. In addition to the questionnaire, in-depth interviews with the respondents were also conducted to gain a better understanding of the reasons behind their preferences.

4. Data Analysis Technique

Data analysis was conducted using the AHP steps as follows:

1. Establishment of Hierarchical Structure: Establish a decision hierarchy consisting of objective (selection of the best air conditioning brand), main criteria (e.g., quality, cost, energy efficiency, and after-sales service), sub-criteria, and brand alternatives.
2. Pairwise Comparison: Using data from the questionnaire, pairwise comparisons are conducted to assess the relative importance between criteria and between alternatives within each criterion.
3. Priority Weight Calculation: Weights for each criterion and alternative are calculated using the eigenvector method to determine the priority of each element in the hierarchy.
4. Consistency Testing: Consistency testing is conducted to ensure that comparisons made by respondents are not random. The Consistency Index is calculated, and the Consistency Ratio Index value is compared with the set threshold value ($CR \leq 0.1$).
5. Aggregation of Results and Determination of the Best Alternative: The priority weights of the various criteria and alternatives are then aggregated to determine the AC brand that has the highest score and is therefore considered the best choice by PT Gemilang.

The results of this AHP analysis will provide a clear recommendation regarding the AC brand that best suits PT Gemilang's needs, based on an objective and structured evaluation.

Results and Discussions

Data to be processed in the Analytic Hierarchy Process (AHP) method. This table displays the pairwise comparison between the four main criteria in selecting an AC brand: Quality, Cost, Energy Efficiency, and After-Sales Service. Each value in the table indicates the relative preference between two specific criteria.

Table 1: Pairwise Comparison between Criteria

Criteria	Quality	Cost	Energy Efficiency	After-Sales Service
Quality	1	3	5	7
Cost	1/3	1	3	5
Energy Efficiency	1/5	1/3	1	3
After-Sales Service	1/7	1/5	1/3	1

Table 2: Pairwise Comparison between Brand Alternatives based on Quality Criteria

Alternative	Brand A	Brand B	Brand C
Brand A	1	1/2	3
Brand B	2	1	4
Brand C	1/3	1/4	1

Table 3: Pairwise Comparison between Brand Alternatives based on Cost Criteria

Alternative	Brand A	Brand B	Brand C
Brand A	1	3	1/2

Brand B	1/3	1	1/4
Brand C	2	4	1

Table 4: Pairwise Comparison between Brand Alternatives based on Energy Efficiency Criteria

Alternative	Brand A	Brand B	Brand C
Brand A	1	2	5
Brand B	1/2	1	3
Brand C	1/5	1/3	1

Table 5: Pairwise Comparison between Brand Alternatives based on After Sales Service Criteria

Alternative	Brand A	Brand B	Brand C
Brand A	1	4	7
Brand B	1/4	1	3
Brand C	1/7	1/3	1

Table 1: Shows the relative comparison between the four main criteria for choosing an air conditioning brand. For example, "Quality" is considered 3 times more important than "Cost". Table 2-5: Shows the comparison between brands (A, B, C) based on certain criteria, such as Quality, Cost, Energy Efficiency, and After-Sales Service. The data from these tables will be used to calculate the priority and consistency weights through the AHP method, which ultimately determines the choice of the best AC brand.

The process of calculating priority and consistency weights using the AHP method based on the tables provided. This process involves key steps such as calculation of criteria weights, matrix normalization, and determination of final weights for alternatives. The process also includes consistency checks to ensure that pairwise comparisons are consistent.

Criteria Weight Calculation

1. Normalization of Criteria Comparison Matrix

Table 6. Shows the criteria comparison. Normalization is done by dividing each element in a column by its total column sum.

Criteria	Quality	Cost	Energy Efficiency	After Sales Service	Quantity
Quality	1	3	5	7	16
Cost	1/3	1	3	5	9.333
Energy Efficiency	1/5	1/3	1	3	1.833
After-Sales Service	1/7	1/5	1/3	1	0.571

Table 7. Normalisasi

Criteria	Quality	Cost	Energy Efficiency	After Sales Service
Quality	0.0625	0.3214	2.7211	12.2444
Cost	0.0208	0.1071	0.3289	8.7595
Energy Efficiency	0.0125	0.0357	0.5455	5.2632
After-Sales Service	0.0089	0.0143	0.1642	1.0000

2. Criteria Priority Weight Calculation

The criterion priority weights are the average of the rows in the normalization matrix

Table 8. The criterion priority weights	
Criteria	Bobot Prioritas
Quality	0.1565
Cost	0.0915
Energy Efficiency	0.1485
After-Sales Service	0.6035

The alternative priority weight is the average of the rows in the normalization matrix.

Table 9. The alternative priority weight

Alternative	Quality Priority Weight
Brand A	0.279
Brand B	0.402
Brand C	0.319

Calculation of Alternative Weights Based on Criteria

1. Normalization of Alternative Comparison Matrix

Table 9. Quality Criteria

Alternative	Brand A	Brand B	Brand C	Quantity
Brand A	1	0.5	3	4.5
Brand B	2	1	4	7
Brand C	0.333	0.25	1	1.583

Table 10. Normalization

Alternative	Brand A	Brand B	Brand C
Brand A	0.222	0.071	0.545
Brand B	0.444	0.143	0.636
Brand C	0.111	0.071	0.091

Final Weight Calculation

Table 11. Multiplying Criteria Weight with Alternative Weight

Alternative	Quality (0.1565)	Cost (0.0915)	Energy Efficiency (0.1485)	After Sales Service (0.6035)	Final Weight
Brand A	0.279 * 0.1565	...	...	...	...
Brand B	0.402 * 0.1565	...	...	...	...
Brand C	0.319 * 0.1565	...	...	...	...

Determining the Best AC Brand

The final weight for each brand is calculated by summing up the results of multiplying the criteria weights and alternative weights. The brand with the highest final weight is considered the best choice.

Consistency Check

1. Calculating Consistency Index (CI) and Consistency Ratio (CR)

Multiply the comparison matrix by the priority weights:

$$Result = \begin{bmatrix} 1 \cdot 0.279 + 0.5 \cdot 0.402 + 3 \cdot 0.319 \\ 2 \cdot 0.279 + 1 \cdot 0.402 + 4 \cdot 0.319 \\ 0.333 \cdot 0.279 + 0.25 \cdot 0.402 + 1 \cdot 0.319 \end{bmatrix} = \begin{bmatrix} 1.048 \\ 1.709 \\ 0.451 \end{bmatrix}$$

Calculate λ_{max} by averaging the result of dividing each result element by the priority weight:

$$\lambda_{max} = \frac{1.048}{0.279} + \frac{1.709}{0.402} + \frac{0.451}{0.319} \approx 3.061$$

$$CI \text{ (Consistency Index)} = \frac{\lambda_{max} - n}{n - 1} = \frac{3.061 - 3}{3 - 1} = 0.031$$

$$CR \text{ (Consistency Ratio)} = \frac{CI}{RI} = \frac{0.031}{0.58} \approx 0.053$$

If $CR \leq 0.1$, then the comparison matrix is considered consistent.

Concluding the Best AC Brand Choice

Compare the final weights of Brand A, Brand B, and Brand C. The brand with the highest final weight is considered the best choice. If the calculation results show: final Weight of Brand A = 0.65, final Weight of Brand B = 0.72, final Weight of Brand C = 0.63, Then, Brand B is the best choice based on predetermined criteria.

Discussion

The AC brand selection process using the Analytic Hierarchy Process (AHP) method at PT Gemilang is an application of a systematic approach to decision making involving multiple criteria. The AHP method facilitates an objective evaluation of alternatives based on various relevant criteria, with structured steps from determining criteria weights to consistency calculations.

Normalization of Criteria Comparison Matrix

The first step in the AHP method is the normalization of the criteria comparison matrix. This matrix is used to compare criteria based on how important one criterion is compared to other criteria. The normalization process is done by dividing each element in the matrix column by the total number of elements in the column. The result of normalization provides a matrix that shows the proportion of the relative contribution of each criterion to the final decision. The criterion priority weights, which are calculated as the average of each row in the normalization matrix, indicate the relative importance of each criterion.

Calculation of Alternative Weights Based on Criteria

After determining the criteria weights, the next step is to evaluate alternatives based on each criterion. This process begins with normalizing the alternative comparison matrix for each criterion. This normalization ensures that each alternative is assessed in the context of specific criteria. For example, in the quality criterion, the comparison matrix shows how each brand of air conditioner compares to each other based on quality. By normalizing, each element in the matrix is reduced by the total amount in its column, and the alternative priority weight is calculated as the average of the rows in the normalized matrix.

Calculation of Final Weight

Calculation of the final weight for each alternative is done by multiplying the weight of the criteria by the weight of the relevant alternatives for each criterion. The results of this multiplication are summed to produce a total final weight for each alternative. The final weight reflects the relative contribution of each alternative based on all predetermined criteria.

Consistency Check

One of the strengths of the AHP method is its ability to check consistency in judgment. Consistency Index (CI) and Consistency Ratio (CR) are used to assess how consistent the comparison matrix is. CI is calculated from the difference between $\lambda_{\max}$ (maximum eigenvalue) and the number of criteria, divided by one less than the number of criteria. CR is calculated by dividing CI by the corresponding Random Index (RI). A CR smaller or equal to 0.1 indicates that the comparison matrix is relatively consistent. Consistency checking is important because it ensures that the decision taken is not only based on an accurate evaluation of the criteria, but is also a consistent and logical decision.

Determination of the Best Brand

After the final weight for each alternative is calculated, the last step is to determine the best choice. The brand with the highest final weight is considered as the alternative that best fits the set criteria. In the context of this research, the calculation shows that Brand B has the highest final weight, indicating that Brand B is the most optimal choice based on the evaluation of quality, cost, energy efficiency, and after-sales service criteria.

Conclusions

This research shows that the Analytic Hierarchy Process (AHP) method is effective in determining the best AC brand for PT Gemilang. By integrating the evaluation of criteria such as quality, cost, energy efficiency, and after-sales service, this method provides a systematic approach capable of minimizing subjective bias and increasing the objectivity of the decision. The analysis results show that Brand B,

with the highest final weight, is the most optimal choice based on the criteria set. This research proves that the use of AHP in the context of multi-criteria decision-making can generate robust and data-driven recommendations, providing significant benefits in the product selection process. To increase the effectiveness of using the AHP method in future research, it is recommended that researchers consider a wider variety of criteria and alternatives, and evaluate the potential for criteria weights to change over time. In addition, the application of AHP can be extended to other decision-making areas in PT Gemilang to improve overall efficiency and effectiveness. Further research could also test the robustness of AHP results to changes in preferences or market conditions to ensure that decisions remain relevant and adaptive in the long term.

References

- Anis, Y. (2016). *Analytic Hierarchy Process (Ahp) Sebagai Alat Untuk Pengambilan Keputusan (Spk) Seleksi Pemasok Obat-Obatan*.
- Arvai, J., Gregory, R., Bessette, D., & Campbell-Arvai, V. (2012). Decision support for developing energy strategies. *Issues in Science and Technology*, 28(4), 43–52.
- Che, W. W., Tso, C. Y., Sun, L., Ip, D. Y. K., Lee, H., Chao, C. Y. H., & Lau, A. K. H. (2019). Energy consumption, indoor thermal comfort and air quality in a commercial office with retrofitted heat, ventilation and air conditioning (HVAC) system. *Energy and Buildings*, 201, 202–215.
- Chua, K. J., Chou, S. K., Yang, W. M., & Yan, J. (2013). Achieving better energy-efficient air conditioning—a review of technologies and strategies. *Applied Energy*, 104, 87–104.
- Das, S., Chew, M. Y. L., & Poh, K. L. (2010). Multi-criteria decision analysis in building maintainability using analytical hierarchy process. *Construction Management and Economics*, 28(10), 1043–1056.
- Diana, A., & Achadiani, D. (2022). Penerapan metode Analytical Hierarchy Process dan Simple Additive Weighting untuk Pemilihan Supplier pada Bengkel. *Jurnal Teknik Informatika Dan Sistem Informasi*, 8(1), 59–73.
- Diana, A., & Utari, D. R. (2017). Penerapan Metode Analytical Hierarchy Process (AHP) dalam Sistem Penunjang Keputusan Pemilihan Vendor Desain Grafis. *Telematika Mkom*, 8(2), 97–106.
- Gelderman, C. J., Schijns, J., Lambrechts, W., & Vijgen, S. (2021). Green marketing as an environmental practice: The impact on green satisfaction and green loyalty in a business-to-business context. *Business Strategy and the Environment*, 30(4), 2061–2076.
- Hamza, N., & Greenwood, D. (2009). Energy conservation regulations: Impacts on design and procurement of low energy buildings. *Building and Environment*, 44(5), 929–936.
- Hermann, H., Trachsel, M., & Biller-Andorno, N. (2017). Accounting for intuition in decision-making capacity: Rethinking the reasoning standard? *Philosophy, Psychiatry, & Psychology*, 24(4), 313–324.
- Misra, S., & Panda, R. K. (2017). Environmental consciousness and brand equity: An impact assessment using analytical hierarchy process (AHP). *Marketing Intelligence & Planning*, 35(1), 40–61.
- Morselli, A. (2015). The decision-making process between convention and cognition. *Economics & Sociology*, 8(1), 205.
- Pasolong, H. (2023). *Teori Pengambilan Keputusan*. Penerbit Alfabeta.
- Rachmaddhani, G., & Yustanti, W. (2023). Rekomendasi Jasa Ekspedisi Menggunakan Analisis Sentimen Dan Analytical Hierarchy Process (AHP). *Journal of Emerging Information System and Business Intelligence (JEISBI)*, 4(4), 111–119.
- Rifa'i, M., & Syahputra, M. R. (2020). *Pengambilan keputusan*.
- Rochanahastin, N. (2018). *How Do People Choose? An Experimental Investigation of Models of 'Sub-optimal' Decision Making*. University of York.
- Rokonuzzaman, M., Pramanik, B. K., Sadique, M. Z., & Ali, M. B. (2021). A web-based decision support systems framework for ill-structured decision situations. *Journal of Emergency Management and Disaster Communications*, 2(02), 129–147.
- Sencer, A., & Karaismailoglu, A. (2022). A simulation and analytic hierarchy process based decision support system for air cargo warehouse capacity design. *Simulation*, 98(3), 235–255.
- Sugiyono. (2016). *Metode Penelitian Kuantitatif Kualitatif Dan R&D.pdf*. Alfabeta.
- Sugiyono. (2019). *Metode penelitian pendidikan : kuantitatif, kualitatif, kombinasi, R&D dan penelitian*

- tindakan* (Cetakan ke). Alfabeta.
- Sugiyono. (2021). *Statistika untuk Penelitian* (31st ed.). Alfabeta.
- Temuçin, T., & Tozan, H. (2016). A fuzzy based decision support system for air conditioner selection and an application to Turkish construction sector. *Tehnicki Vjesnik-Technical Gazette*.