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Implementation of AHP and TOPSIS for Supplier Performance Measurement in a Private Hospital Case Study

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Abstract

Purpose: This study aimed to evaluate the performance of vegetable suppliers in meeting the nutritional needs of Immanuel Hospital.
Research Methodology: Using an exploratory qualitative method with a case study approach, a decision support system model is implemented based on the Analytical Hierarchy Process (AHP) combined with the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS).
Results: The AHP Consistency Ratio was less than 0.01, indicating consistent criteria determination. The criteria for evaluating supplier performance included Supplier Responsiveness to Changes (38.6%), Delivery Reliability (28.2%), Cost Factor (11.7%), Supplier Flexibility (11.3%), and quality (10.1%).
Conclusions: Based on the supplier ranking determined by the TOPSIS method, SP 1 was identified as the supplier with the best performance, followed by SP 2 in second place and SP 3 in third place.
Limitations: This study is limited to three vegetable suppliers for a private hospital and a small group of PPM managers as respondents. This may limit the generalizability of the results to other hospitals, suppliers, or procurement contexts.
Contributions: The research provides a systematic method for assessing supplier performance using AHP combined with TOPSIS, offering hospitals a structured, accountable, and objective tool to evaluate and rank suppliers.

Keywords: *AHP, Supplier Assessment, Supplier Performance, TOPSIS*

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1. Introduction

Every business involved in production processes requires suppliers. Generally, a supplier, whether an individual or a company, plays a critical role in supply chain management by providing and delivering resources to a company or other parties (Cahya & Wulandari, 2022; Dwiyana et al., 2017). According to Cahya and Wulandari (2022) and Esmaeili et al. (2023), suppliers are essential for providing components and resources for finished goods, which is crucial in today's global supply chain network.

Evaluating supplier performance is necessary to achieve company efficiency and effectiveness. An incorrect supplier selection can lead to losses for the company (Hadiwijaya & Sundari, 2021; Muliyati et al., 2023). For example, if the supplier's lead time is long, it can disrupt the production process, causing delays in fulfilling customer demands (Abandika, 2022; Gustina & Mutiara, 2017). Moreover,

if the supplied raw materials do not meet production requirements, it can result in delays in meeting customer demands. Poor supplier performance can disrupt company activities, whereas good supplier performance positively impacts a company's success (Ahmadun et al., 2023; Cahya & Wulandari, 2022; Dinulescu & Dobrin, 2022).

Similarly, hospitals require suppliers to function effectively as healthcare institutions (Hamidah et al., 2022). To support excellent hospital services and performance, the selection and evaluation of suppliers are necessary. In this era of free competition, institutions such as hospitals must recognize that enhancing healthcare services is closely linked to the role of suppliers (Nabilla & Soehaditama, 2023). The role of suppliers in hospitals influences the quality of services, such as medications and various medical equipment (Afandi, 2018).

The quality of these service facilities is highly dependent on the quality or performance of the suppliers. Cahya and Wulandari (2022) and Wijayanti and Santoso (2022) state that supplier quality is a crucial factor in improving patient service quality. Supplier management is addressed in Hospital Supply Chain Management under the Hospital Governance Standards (TKRS) 7.1. Immanuel Hospital, as a private general hospital, provides health services in the form of medical and paramedical services, nursing and midwifery services, and non-medical services to support medical services (Saribanon et al., 2023; Widyastuti, 2023).

One non-medical service is the procurement of nutritional needs, which involves acquiring, maintaining, and providing appropriate and adequate food to ensure that patients receive food intake according to their needs (Abidin et al., 2022; Christiana & Mailoa, 2022). The procurement of vegetable foodstuffs, managed by the Equipment and Material Procurement Section (PPM), is part of the nutritional needs procurement. The PPM ensures quality, timeliness, and cost-efficiency in procuring nutritional needs (vegetables) (Alvira & Rusdah, 2020; Amnur et al., 2022).

To ensure the quality, timeliness, and cost-effectiveness of vegetable nutritional procurement, PPM must select and evaluate suppliers or partners who supply vegetable raw materials. At the time of this study, there were three suppliers: Supplier 1 (SP1), Supplier 2 (SP2), and Supplier 3 (SP3). Although supplier performance evaluation has been conducted, it has not used a systematic or structured method yet. This lack of systematic and structured performance assessment can lead to less objective evaluations and can become complex due to various criteria considerations, potentially impacting the quality of nutritional needs (vegetable) services. This study aims to determine the criteria and sub-criteria for assessing vegetable supplier performance and ranking vegetable suppliers.

2. Literature Review

2.1 Supplier Performance Assessment

Evaluating supplier performance is crucial for hospital operations, as it ensures timely delivery of high-quality goods and prevents service disruptions (Cahya & Wulandari, 2022). A systematic assessment of suppliers enables hospitals to measure quality, cost, and reliability objectively, reducing reliance on intuition or habitual choices. Proper evaluation supports operational efficiency, minimizes financial losses, and maintains high standards in patient care (Gudda et al., 2023).

In addition, supplier performance assessment provides a basis for continuous improvement. By identifying strengths and weaknesses in supplier services, hospitals can establish performance targets, implement corrective actions, and strengthen contractual agreements. This approach also enhances transparency and accountability in procurement, ensuring that all parties adhere to agreed standards and timelines (Dwiyana et al., 2017).

2.2 Analytical Hierarchy Process (AHP)

The Analytical Hierarchy Process (AHP) is a structured method for decision-making that decomposes complex problems into a hierarchy of objectives, criteria, and alternatives (Dinulescu & Dobrin, 2022; Hadiwijaya & Sundari, 2021). It allows decision-makers to assign relative weights to criteria through pairwise comparisons, ensuring consistency and rational prioritization. In supplier evaluation, AHP provides a systematic framework for evaluating multiple qualitative and quantitative aspects, such as quality, price, delivery reliability, and service (Goepel, 2018; Nuraeni et al., 2022).

Moreover, AHP facilitates consensus among decision-makers. By quantifying expert judgments and converting them into numerical scores, AHP reduces bias and subjectivity (Goepel, 2018). This makes it particularly suitable for hospital procurement, where multiple stakeholders—including procurement officers, managers, and technical staff—must agree on supplier rankings and selection criteria (Jufri et al., 2022).

2.3 Technique for Order Preference by Similarity to Ideal Solution (TOPSIS)

TOPSIS is a multi-criteria decision-making method used to rank alternatives based on their distance from an ideal solution (Christiana & Mailoa, 2022). The positive ideal solution represents the best possible performance, while the negative ideal solution represents the worst. By calculating the relative closeness of each supplier to the ideal solution, decision-makers can objectively identify the best-performing suppliers (Forozandeh, 2021, 2022).

Integrating TOPSIS with AHP enhances decision-making by combining weighted criteria with an objective ranking system (Kaluku & Pakaya, 2017). The method ensures that suppliers are evaluated not only according to priority criteria but also in terms of overall performance relative to other alternatives. This approach is especially useful in hospital procurement, where multiple suppliers compete on quality, cost, and service delivery (Chamid & Murti, 2017; Dwiyana et al., 2017).

2.4 Integration of AHP-TOPSIS in Hospital Procurement

The combination of AHP and TOPSIS provides a robust and practical approach for supplier evaluation in hospitals (Jufri et al., 2022; Octavianus & Mursanto, 2018). AHP ensures that evaluation criteria are systematically weighted based on importance, while TOPSIS ranks suppliers according to their performance relative to an ideal solution (Salomon & Gomes, 2024). This integration enables hospitals to make informed procurement decisions that balance multiple considerations (Abusaeed et al., 2023; Effendi & Siallagan, 2025; Goepel, 2018).

In practice, using AHP-TOPSIS allows hospital management to evaluate suppliers for critical materials, such as vegetables, medical supplies, or pharmaceuticals, in a transparent and accountable manner (Yaralioglu & Kara, 2024). By providing a clear ranking of suppliers, the method supports performance improvement, negotiation, and strategic supplier selection, ultimately enhancing operational efficiency and service quality (Abubakar et al., 2025; Christiana & Mailoa, 2022).

3. Methodology

This study employs a qualitative approach to explore methods or models for solving a specific problem (case study), namely, the assessment of supplier performance for nutritional needs (vegetables). Primary data were collected through field studies, including interviews, followed by questionnaire completion. The instruments used were structured interview guidelines and supplier evaluation sheets (weighting sheets/comparative judgment). Data sources, referred to as US informants or experts, were deliberately selected based on the research topic. The criteria used in this case study were having experience in supplier evaluation and being responsible for assessing supplier performance as part of their job. The

main respondents in this study were the managers of the Equipment and Material Procurement Section (PPM). The objects of this study are the vegetable suppliers to the PPM, consisting of three suppliers: Supplier 1 (SP1), Supplier 2 (SP2), and Supplier 3 (SP3). Supplier performance assessment covered the period from May to June 2023 (Abubakar et al., 2025; Chamid & Murti, 2017).

4. Results and Discussion

4.1 Results

1. The first step was to determine the objective. The goal is to solve the problem of evaluating and determining supplier performance.
2. The next step is decomposition, which involves breaking down the significant problem or decision in the AHP method into a hierarchical structure containing the goal, criteria, sub-criteria, and alternatives (Dinulescu & Dobrin, 2022).
3. The required supplier evaluation criteria (level 1) are as follows:
   (a) Quality: The supplier's ability to provide high-quality raw materials.
   (b) Cost: The expenses incurred by the hospital to obtain raw vegetable materials.
   (c) ervice Level/Responsiveness: The supplier's responsiveness regarding delivery.
   (d) Flexibility: The supplier's ability to meet changes in quantity and timing of delivery.
   (e) Responsiveness: The supplier's ability to respond to problems and requests. The established sub-criteria for supplier evaluation (level 2) are presented in Table 1.

Table 1. Sub Criteria (Level 2)

No	Sub Criteria	Explanation of Sub Criteria
1	Order Quantity	The supplier's ability to provide goods (vegetables) as ordered
2	Fresh	The supplier's ability to provide fresh vegetables as ordered
3	Shape Compatibility	The supplier's ability to provide vegetables in the requested size and shape
4	Price Consistency	The supplier's ability to maintain the price from ordering until the goods arrive
5	Ability to Adjust Market Prices	The supplier's ability to provide stable prices
6	Delivery Timeliness	The supplier's ability to deliver on time
7	Quantity Accuracy upon Delivery	The supplier's ability to ship goods according to the order quantity
8	Change in Quantity	The supplier's ability to cope with changes in order quantities without changing prices
9	Ability to Handle Time Change	The supplier's ability to cope with changes in order time without changing prices
10	Ability to Handle Reject Goods	The supplier's capability to handle damaged goods
11	Quantity Change Response	The supplier's ability to handle changes in order quantities quickly
12	Delivery Time Change Response	The supplier's ability to handle changes in order time quickly

Measure the distance of alternatives to the positive ideal solution using the following formula: $S_i+ = \sum(v_{ij} - v_j^+)^2$. The results of the positive ideal distance calculation are shown in Figure 1 .

max	0,0023	0,0074	0,0126	0,0280	0,0056	0,0355
A+	**VP1**	**VP2**	**VP3**	**VP4**	**VP5**	**VP6**
SP1	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
SP2	4,09E-06	6,87E-06	1,27E-04	6,23E-04	2,49E-05	1,57E-04
SP3	3,05E-06	1,08E-05	9,47E-05	4,65E-04	1,86E-05	2,45E-04

max	0,0125	0,0072	0,0070	0,0079	0,0668	0,0125	S +
A+	**VP7**	**VP8**	**VP9**	**VP10**	**VP11**	**VP12**	
SP1	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
SP2	8,23E-05	4,10E-05	6,18E-06	3,27E-05	7,56E-04	9,63E-05	0,0020
SP3	1,13E-04	6,28E-06	9,66E-06	4,50E-05	3,19E-03	3,05E-05	0,0042

Figure 1. Positive Ideal Distance Calculation

The next step is to measure the distance of alternatives to the negative ideal solution using the formula $Si- = \sum(vij - vj-)2$. The results of the negative ideal distance calculations are presented in Table 2.

min	0,0002	0,0042	0,0014	0,0030	0,0006	0,0198
A-	**VP1**	**VP2**	**VP3**	**VP4**	**VP5**	**VP6**
SP1	4,091E-06	1,075E-05	1,269E-04	6,232E-04	2,493E-05	2,453E-04
SP2	0,00E+00	4,32E-07	0,00E+00	0,00E+00	0,00E+00	9,86E-06
SP3	7,580E-08	0,000E+00	2,351E-06	1,155E-05	4,619E-07	0,000E+00

min	0,0019	0,0008	0,0039	0,0012	0,0103	0,0027	S -
A-	**VP7**	**VP8**	**VP9**	**VP10**	**VP11**	**VP12**	
SP1	1,134E-04	4,095E-05	9,662E-06	4,504E-05	3,193E-03	9,630E-05	0,00453
SP2	2,49E-06	0,00E+00	3,89E-07	9,88E-07	8,41E-04	0,00E+00	0,00086
SP3	0,000E+00	1,516E-05	0,000E+00	0,000E+00	0,000E+00	1,843E-05	0,00005

Figure 2. Negative Ideal Distance Calculation

The relative closeness or C_i and the supplier ranking to the ideal solution are calculated using the following formula: $C_i = \frac{S_i^-}{S_i^- + S_i^+}$

The results of the relative closeness calculation and supplier rankings are presented in Table 3.

Pemasok	S+	S-	Ci
SP1	0,000	4,534E-03	1,000
SP2	0,002	8,555E-04	0,304
SP3	0,004	4,803E-05	0,011

Figure 3. Calculation of Relative Closeness and Supplier Ranking

Based on Table 3, the supplier rankings in the US are as follows: Supplier 1 (SP1) ranks first, Supplier 2 (SP2) ranks second, and Supplier 3 (SP3) ranks third.

5. Conclusions

There are five criteria used in supplier performance appraisal, namely responsiveness, delivery, cost, flexibility, and quality. In addition, there are twelve sub-criteria applied in the supplier performance assessment, including number of orders, freshness, shape conformity, price consistency, ability to adjust market prices, timeliness of delivery, conformity of quantity at delivery, ability to handle quantity changes, ability to handle time changes, ability to handle damage to goods, response to quantity changes, and response to time changes. The results of the weighting analysis indicate that the highest criterion in supplier performance assessment is responsiveness with a weighting of 38.6%, followed by delivery with 28.2%, cost with 11.7%, flexibility with 11.3%, and quality with 10.1%. Furthermore, the ranking results show that the supplier with the best performance, providing the highest benefit value and the lowest cost, is SP1 in the first position, followed by SP2 in the second position, while SP3 is ranked last.

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Author Contributions

RT contributed to conceptualization, methodology, and writing of the original draft. Y was responsible for data collection, analysis, validation, and review.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this study. This research was conducted independently, and no financial or personal relationships influenced the results or interpretation of the findings.

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