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Implementation of the Analytical Hierarchy Process and Technique for Order of Preference by Similarity to Ideal Solution in Supplier Performance Measurement: A Case Study in Private Hospital

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Abstract: The assessment and selection of suppliers is a crucial and strategic decision in hospitals. This decision must be objective and clearly measurable, minimizing intuition and habitual factors. The Equipment and Material Procurement Section (PPM) in Hospital, tasked with managing the procurement of equipment and materials, including office supplies (ATK) and printing, medical and non-medical inventories, nutritional needs, technical procurement, and household procurement, has been evaluating suppliers. However, these evaluations have not yet employed a clear and structured method. Therefore, a systematic, structured, and accountable method is needed to assess supplier performance. This study aims to evaluate the performance of vegetable suppliers for nutritional needs at Immanuel Hospital. Using an exploratory qualitative method with a case study approach, it implements a decision support system model based on the Analytical Hierarchy Process (AHP) combined with the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS). The AHP Consistency Ratio was found to be 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%). 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.

Keyword: AHP, TOPSIS, Supplier Assessment, Supplier Performance

INTRODUCTION

Every business engaged in production processes requires suppliers. Generally, a supplier, whether an individual or a company, plays a critical role in the supply chain management by providing and delivering resources to a company or other parties (Cahya & Wulandari, 2022). According to Dong Li & Nagurney (2014), as cited in Cahya & Wulandari (2022), suppliers are

essential in providing components and resources for finished goods, which are 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. For instance, if the supplier's lead time is long, it can disrupt the production process, causing delays in fulfilling customer demands. Moreover, if the raw materials supplied do not meet production requirements, it can result in delays in meeting customer demands (Pujotomo et al., 2018). Poor supplier performance can disrupt company activities, while good supplier performance positively impacts the company's success (Cahya & Wulandari, 2022).

Similarly, hospitals require suppliers to function effectively as healthcare institutions. To support excellent hospital services and performance, the selection and evaluation of suppliers are necessary. In this era of free competition, institutions like hospitals need to recognize that enhancing healthcare services is closely linked to the role of suppliers. The role of suppliers in hospitals influences the quality of services, such as medications and various medical equipment

The quality of these service facilities is highly dependent on the quality or performance of the suppliers. Yuliawati & Sanusi (2015), as cited in Cahya & Wulandari (2022), state that supplier quality is a crucial factor in improving patient service quality. Supplier management is addressed in the 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. One non-medical service is the procurement of nutritional needs, which involves acquiring, maintaining, and providing appropriate and adequate food, ensuring that patients receive food intake according to their needs. The procurement of vegetable foodstuffs, managed by the Equipment and Material Procurement Section (PPM), is part of this nutritional needs procurement. The PPM ensures quality, timeliness, and cost-efficiency in procuring nutritional needs (vegetables).

To ensure the quality, timeliness, and cost- effectiveness of vegetable nutritional procurement, the 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. 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 to rank the vegetable suppliers.

METHOD

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 was collected through field studies, including interviews followed by questionnaire completion. The instruments used are structured interview guidelines and supplier evaluation sheets (weighting sheets/comparative judgment). Data sources, referred to as informants or experts, were intentionally selected based on the research topic. The criteria used in this case study are: having experience in supplier evaluation and being responsible for assessing supplier performance as part of their job.

The main respondents in this study are 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). The supplier performance assessment covers the period from May to June 2023.

RESULTS AND DISCUSSION

1. The first step is to determine the objective. The goal is to solve the problem of evaluating and determining supplier performance.
2. Criteria and Sub-Criteria Determination 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).

   Result The required supplier evaluation criteria (level 1) are:

   a. Quality: The supplier's ability to provide high-quality raw materials.
   b. Cost: The expenses incurred by the hospital to obtain vegetable raw materials.
   c. Service Level/Responsiveness: The supplier's responsiveness regarding delivery.
   d. Flexibility: The supplier's ability to meet changes in quantity and timing.
   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	suppliers' ability to provide vegetables in the requested size and shape
4	Price Consistency	The supplier's ability not to change the price when ordering until the goods arrives.
5	Ability to adjust market prices	supplier's ability to provide stable prices
6	Delivery timeliness	supplier's ability to deliver on time
7	Quantity accuracy upon delivery	ability to ship goods according to order quantity
8	Change in quantity	supplier's ability to cope with changes in order quantities without changing capability of suppliers of damaged goods prices
9	Ability to handle time change	supplier's ability to cope with changes in order time without changing prices
10	Ability to handle reject good	capability of suppliers of damaged goods
11	Quantity change response	supplier's ability to handle changes in order quantities quickly
12	Delivery time change response	supplier's ability to handle changes in order time quickly

Measure the distance of alternatives to the positive ideal solution using the formula $Si+= \sum(vij- vj+)2$ The results of the positive ideal distance calculation are shown in Table 2

Tabel 2. Results of the Distance to the Positive Ideal Solution

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

The next step is to measure the distance of alternatives to the negative ideal solution using the formula Si- = ∑(vij-vj-)2. The results of the negative ideal distance calculation are shown in Table 3.

Table 3 Results of the Distance to the Negative Ideal Solution

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

Calculate the relative closeness or CiC_iCi and the supplier ranking to the ideal solution using the formula Ci = (Si-) / (Si -+Si +) The results of the relative closeness calculation and supplier ranking are shown in Table 4.

Table 4. Calculation of Relative Closeness and Supplier Ranking

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

Based on Table 4, the supplier rankings are as follows: Supplier 1 (SP1) ranks first, Supplier 2 (SP2) ranks second, and Supplier 3 (SP3) ranks third.

CONCLUSION

1. There are 5 criteria used in supplier performance appraisal, namely: Responsiveness, Delivery, Cost, Flexibility, and Quality
2. There are 12 sub-criteria set out in the supplier performance appraisal, namely: 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, Response to Time Changes

3. The highest weighting of the supplier performance assessment criteria is supplier responsiveness to change (*Responsiveness)* with a weighting of 38.6%, delivery reliability (*Delivery*) with a weighting of 28.2%, cost (*Cost*) with a weighting of 11.7%, Supplier flexibility (*flexibility*) with a weighting of 11.3%, and quality (*quality*) with a weighting of 10.1%.
4. The ranking of vegetable suppliers with the best performance (first), with the best benefit value and lowest cost is SP 1, the second is SP2, and the last is SP3

Recommendation:

1. Hospitals should continue to work with SP1 suppliers, as they perform best among other suppliers. Hospitals should apply this supplier performance assessment model continuously and periodically so that the company's business processes improve.
2. This study can be refined by taking respondents (experts) from several decision makers with a geomean calculation.
3. This research can be refined with further research by continuing the results of the decision matrix normalization iteration with the sensitivity method, to test the results of the supplier determination decision

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