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Vendor Selection for Maintenance Using the Analytic Hierarchy Process (AHP) Method

(Case study: PT. Global Sarana Mediakom)

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ABSTRACT

Objective vendor selection is crucial for a company as the right decision in choosing a vendor directly impacts service quality, operational cost efficiency, and business continuity. An unmeasured and subjective selection process can lead to risks such as decreased service quality, delays in task completion, and cost overruns, which can significantly harm the company. This study discusses a case study of vendor selection for maintenance at PT Global Sarana Mediakom using the Analytical Hierarchy Process (AHP) method. PT Global Sarana Mediakom is an information technology company specializing in data communication and internet services, with an operational network spanning more than 15 cities. This research focuses on addressing inefficiencies and subjectivity in the maintenance vendor selection process, which has traditionally relied on the lowest price or direct appointment without measurable evaluation. The AHP method is employed to evaluate and select the best vendor based on three main criteria: resource capability, completion time, and maintenance service cost. Data were collected through interviews and questionnaires with the company's management. The data processing results indicate that Vendor A emerged as the best vendor with the highest priority score, followed by Vendor D, Vendor C, and Vendor B. The recommendations from this study include expanding the evaluation criteria and developing an AHP-based decision-support system to enable sustainable vendor management.

Keywords: *Analytical Hierarchy Process (AHP), Criteria, Multi-Criteria Decision Making* (MCDM), *Vendor Selection*

Introduction

Vendor selection is a crucial aspect of procurement management, as it directly impacts service quality, costs, and the company's operational continuity. [1]. Vendors not only serve as suppliers of goods or services but also act as strategic partners that can influence the company's competitive advantage through the quality, reliability, and efficiency of the services provided [2]. Therefore, errors in vendor selection can have significant consequences, including increased operational costs, reduced service quality, and decreased customer satisfaction. [3], [4]. In practice, many companies still rely on traditional approaches to vendor selection, such as focusing only on the lowest price or on historical relationships. These approaches tend to be subjective and unstructured, and they carry a high risk of leading in suboptimal decisions. [5], [6]. This condition is also present at PT Global Sarana Mediakom, where the maintenance vendor selection process is considered ineffective due to its focus on price offerings or direct appointment without a standardized evaluation methodology. As a result, various challenges arise, including non-competitive service costs, substandard work quality, and delays in task completion, leading to service downtime.

To address these issues, the company requires a more objective, measurable, and systematic decision-making approach. One relevant method is the Analytical Hierarchy Process (AHP), developed by Thomas L. Saaty [7]. AHP is part of the Multi-Criteria Decision Making (MCDM) methods that break down complex problems into a hierarchy of goals, criteria, sub-criteria, and alternatives, then assign quantitative weights to each criterion through pairwise comparisons [8], [9]. Decision-making is influenced by personal characteristics, environmental factors, and social backgrounds, with choices shaped by individuals' knowledge, experience, and assessment of risks and benefits [10]. The strength of AHP lies in its ability to systematically integrate both qualitative and quantitative factors while providing a consistency test mechanism to ensure the reliability of the analysis results [7], [11].

Several previous studies have demonstrated the effectiveness of AHP in vendor selection. For example, AHP has been shown to enhance logistics reliability in truck procurement by leading to more accurate vendor selection. [5]. Another study emphasized that product quality and timely delivery are dominant factors in determining the best supplier using AHP. [6], [12]. Moreover, the AHP method has been proven to evaluate supplier performance comprehensively and to generate reliable, justifiable supplier rankings. [13]. One study from a supply chain management perspective uses AHP to select the best vendor based on five criteria: quality, delivery, cost, service, and information technology. [14]. The study [15] Illustrates that the AHP, including its integration with the Analytic Network Process (ANP), can be effectively applied in material selection research, particularly in manufacturing and engineering studies that involve interdependent criteria for material properties and process requirements. Other research related to the AHP method is used to prioritize decision alternatives by integrating qualitative and quantitative evaluations, enabling the comparison of design solutions in high pedestrian flow areas and supporting the use of micro-simulation to understand pedestrian behaviour better[16].

In the software industry, AHP has also facilitated optimal decision-making by considering functionality, price, and vendor reputation [17]. These findings reinforce the argument that AHP can be effectively applied in the maintenance vendor selection at PT Global Sarana Mediakom. Therefore, the implementation of AHP is expected to assist the company in conducting a more comprehensive vendor evaluation based on resource capability, completion time, and maintenance costs. This approach not only reduces subjectivity in decision-making but also leads to more optimal vendor recommendations, thereby improving the effectiveness and efficiency of the company's operations [18] [19].

Research Methods

This research was conducted at PT Global Sarana Mediakom, a company engaged in information technology and telecommunications with an operational network. In its operations, the company requires vendor support for maintenance services of equipment and networks. Vendor selection is based on several criteria, namely resource capability, completion time, and maintenance service costs. Four vendor alternatives are considered in this study: Vendor A, Vendor B, Vendor C, and Vendor D.

The initial stage of the research began with a preliminary study through field observations, interviews with the Project Management and Network Operation Center (NOC) teams, and the collection of internal company data to identify issues and formulate the research objectives. The data consisted of primary data from a pairwise comparison matrix questionnaire and secondary data, including company profiles, vendor selection criteria, and maintenance vendor data. The data was then processed using the AHP method to determine the priority weights of each criterion and evaluate the vendor alternatives. A key advantage of the AHP method is its ability to integrate both objective and subjective considerations within the decision-making process [20]. The processed data was analyzed to identify the best maintenance vendor that most closely aligns with the company’s operational needs. Based on the results, recommendations and suggestions for improvement were provided to assist the company in making vendor selections in a more objective, structured, and measurable manner.

Results and Discussion

Based on the criteria and vendor alternatives in the maintenance vendor selection process, the resulting AHP hierarchical structure is presented in Figure 1.

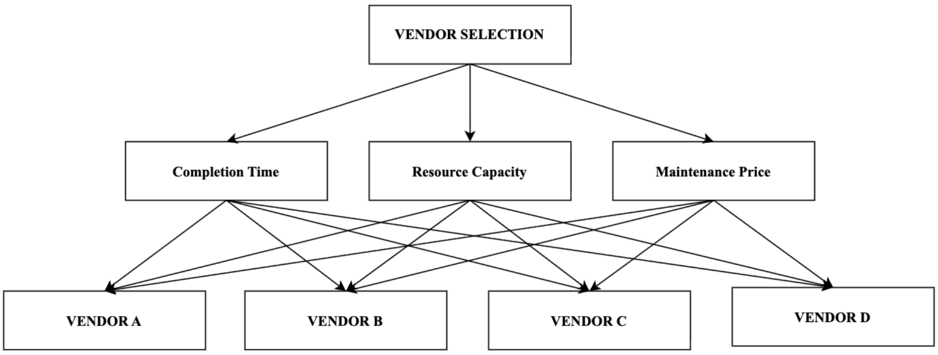

Figure 1. Vendor Selection Hierarchy Structure

AHP Calculation

The data used to assess the priority levels of the various criteria in vendor selection were obtained from questionnaires distributed to PT Global Sarana Mediakom's management. After the assessments were collected, the results were processed using the geometric mean method to generate a single comparison matrix. The following presents the pairwise comparisons among the criteria.

Table 1. Results of the Pairwise Comparison Matrix Between Criteria

Criteria	Resource Capacity	Completion Time	Maintenance Price
Resource Capacity	1	0.25	0.333
Completion Time	4	1.00	1.00
Maintenance Price	3	1.00	1.00
Total	9	2.25	2.333

After obtaining the pairwise comparison results, the normalization calculation of the pairwise comparison weights for each criterion was performed as follows:

Table 2. Normalization of Criteria Weight Assessment

Criteria	Resource Capacity	Completion Time	Maintenance Price	Weight
Resource Capacity	0.1111	0.1111	0.14286	0.121693
Completion Time	0.4444	0.4444	0.42857	0.439153
Maintenance Price	0.3333	0.4444	0.42857	0.402116
Total	1	1	1	0.962963

The following are the pairwise comparison matrices for the criteria of Resource Capability, Completion Time, and Maintenance Price.

Table 3. Pairwise Comparison Matrix for the Resource Capability

Resource Capacity	Vendor A	Vendor B	Vendor C	Vendor D	Total
Vendor A	0.6481	0.6818	0.6944	0.4375	2.4619
Vendor B	0.1296	0.1364	0.1389	0.1875	0.5924
Vendor C	0.1296	0.1364	0.1389	0.3125	0.7174
Vendor D	0.0926	0.0455	0.0278	0.0625	0.2283
Total	1	1	1	1	4

Table 4. Pairwise Comparison Matrix for the Completion Time

Completion Time	Vendor A	Vendor B	Vendor C	Vendor D	Total
Vendor A	0.5769	0.6667	0.5556	0.5	2.2991
Vendor B	0.1154	0.1333	0.2222	0.1667	0.6376
Vendor C	0.1154	0.0667	0.1111	0.1667	0.4598
Vendor D	0.1923	0.1333	0.1111	0.0667	0.6034
Total	1	1	1	1	4

Table 5. Pairwise Comparison Matrix for the Maintenance Price

Maintenance Price	Vendor A	Vendor B	Vendor C	Vendor D	Total
Vendor A	0.0952	0.2222	0.0769	0.0897	0.4841
Vendor B	0.0476	0.1111	0.1538	0.1256	0.4381
Vendor C	0.1905	0.1111	0.1538	0.1570	0.6124
Vendor D	0.6667	0.5556	0.6154	0.6278	2.4654
Total	1	1	1	1	4

For each pairwise comparison matrix, the pairwise comparison weights were normalized, following the same procedure used for the criterion-to-criterion comparison matrix. The following are the AHP calculation results derived from each pairwise comparison table.

Table 6. Eigenvalue Results of the Pairwise Comparisons Between Criteria and Alternatives

Overall Composite Height	Criteria	Vendor A	Vendor B	Vendor C	Vendor D
Resource Capacity	0.12169	0.07490	0.02802	0.2183	0.00695
Completion Time	0.43915	0.25242	0.07000	0.05048	0.06625
Maintenance Price	0.40212	0.04866	0.04405	0.06156	0.24785
Weighted sum		0.375998	0.13207	0.13387	0.32104

Table 7. Pairwise Comparison Matrix for the Maintenance Price

Vendor	Total Score	Rank
Vendor A	0.37598	1
Vendor B	0.32104	2
Vendor C	0.13387	3
Vendor D	0.13207	4

Table 8. Results of CI and CR Calculations for Each AHP Computation

Criteria	CI	CR
Resource Capacity	0.080	0.089
Completion Time	0.043	0.048
Maintenance Price	0.077	0.086

The data are considered consistent if the Consistency Ratio (CR) is less than 0.1 (10%); otherwise, if the CR exceeds 10%, the decision-making process requires revision [21]. Based on the calculation, all CR values for the three criteria are below the acceptable threshold of 0.10, indicating that the pairwise comparison judgments are consistent and the AHP results are reliable.

Discussion

The consistency of the pairwise comparison judgments is a critical aspect of the AHP as it ensures the reliability and logical coherence of the decision-makers' evaluations. Based on the results presented in Table 8, the Consistency Ratio (CR) values for all three main criteria, Resource Capability (0.089), Completion Time (0.048), and Maintenance Price (0.086), are below the acceptable threshold of 0.10. This indicates that the pairwise comparison matrices used in this study are consistent and that the judgments provided by the management respondents are reliable, reflecting a clear and stable preference structure in evaluating the criteria and vendor alternatives.

Furthermore, the acceptable CR values support the robustness and validity of the final vendor ranking, in which Vendor A emerges as the most suitable maintenance vendor. Since inconsistencies in pairwise comparisons may lead to biased or misleading results, the consistency achieved in this study ensures that the selection outcomes are methodologically sound and can be confidently used as a basis for managerial decision-making. Consequently, the AHP-based vendor selection framework applied in this research provides a reliable, transparent, and systematic decision-support mechanism for PT Global Sarana Mediakom.

In the AHP results, the Resource Capability criterion (weight 0.12169) indicates that Vendor A obtained the highest score (0.6155). This indicates that the vendor has competent personnel and adequate equipment to deliver high-quality maintenance services that meet the company's standards. Resource capability is a crucial factor in ensuring work quality and enhancing network operation reliability.

Project completion time is crucial to align with the client's strategic objectives and planned facility use. [22]. In line with this perspective, the Completion Time criterion (weight 0.43915) is the company's highest priority, as maintenance delays can cause downtime that negatively impacts operational performance. Vendor A achieves the highest score in this aspect with a score of 0.5748, demonstrating its ability to complete tasks promptly and efficiently. Timeliness is an essential factor that must be ensured to maintain service continuity and customer satisfaction. This finding is consistent with previous studies in project-based procurement, which highlight delivery or completion time as a dominant criterion in vendor selection, as delays can significantly affect operational continuity and service performance. [23].

The Maintenance Price criterion (weight 0.40212) is also identified as an essential factor in vendor selection to ensure cost efficiency. Vendor D obtained the highest score for this criterion (0.6164), reflecting a competitive pricing offer that aligns with the company's budget. This approach supports the company in minimizing operational costs without compromising service quality. Based on the overall results, Vendor A emerges as the best vendor because it effectively balances sufficient resource capability and timely completion, which are the company's two main priority criteria. Vendor D ranks second, with a significant advantage in competitive pricing.

The application of the AHP method in this vendor selection process provides an objective, transparent decision-making framework that integrates multiple strategic criteria. This approach enables PT Global Sarana Mediakom to optimize operational performance through the selection of a vendor that is high-quality, timely, and cost-efficient. Suppliers play a critical role in project outcomes, as their performance directly affects the success or failure of overall business activities. [23], [24], [25].

Conclusion

The case study examines maintenance vendor selection using the Analytic Hierarchy Process (AHP) method, with three main criteria: resource capability, completion time, and maintenance cost. Using quantitative data from management interviews, the AHP was applied to compare vendor alternatives that meet the company's operational needs, ensuring consistency in the evaluation process. The results indicate that Vendor A ranks as the best maintenance vendor, followed by Vendor D, Vendor C, and Vendor B. Vendor A is considered the most suitable choice because it provides an optimal balance between superior resource capability and timely completion, which are the two primary criteria prioritized by the company. This combination enables Vendor A to deliver high-quality and efficient maintenance services. By applying the AHP method, the vendor selection process becomes more measurable, transparent, and accountable.

Future studies are recommended to include additional criteria, such as project experience and after-sales service quality, to improve the accuracy of vendor evaluation. The use of longitudinal data is also essential to assess the consistency of vendor performance over the long term. Furthermore, implementing an AHP-based system is necessary to ensure recommendations can be applied effectively in practice, enabling continuous monitoring and evaluation, as well as adjustments to the vendor selection method based on real-world outcomes.

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