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OPTIMIZATION OF SUPPLIER SELECTION USING THE TOPSIS METHOD: A WEB-BASED DECISION SUPPORT SYSTEM FOR PT SENOTEXSINDO JAYA LESTARI

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Abstract: Selecting the right supplier is a strategic decision that directly affects supply chain performance and production sustainability. PT Senotexsindo Jaya Lestari requires an objective and measurable approach to evaluate multiple supplier alternatives based on diverse performance criteria. This study develops a web-based decision support system using the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method to optimize the supplier selection process. The evaluation involves five supplier alternatives assessed against five criteria, namely price, quality, production capacity, on-time delivery, and warranty. A descriptive quantitative approach was employed, with data collected through observation, interviews, and supplier documentation. The system was developed using the Software Development Life Cycle (SDLC) waterfall model and validated through black box testing and user testing. The TOPSIS computation results indicate that PT Kharindo Prakarsa achieved the highest preference score of 0.6332, followed by PT Sinar Syno Kimia (0.4991), PT Niagatama Hijau Raya (0.4382), PT Chiemstar Indonesia (0.4356), and PT Indochemical Citra Kimia (0.2252). These results demonstrate the system's ability to quantitatively rank suppliers based on their relative closeness to the ideal solution. The implementation of the system improves decision-making accuracy, processing efficiency, and transparency while enabling systematic documentation and periodic evaluation of supplier performance. The proposed system provides a practical and scalable solution for supplier selection and can be adapted to other industries facing similar multi-criteria procurement challenges.

Keywords: Decision Support System, Supplier Selection, Supply Chain, TOPSIS Method, Web Based System.

1. INTRODUCTION

In today's highly competitive and dynamic business environment, supply chain performance has become a critical determinant of organizational success. Supplier selection plays a strategic role in ensuring product quality, production continuity, and cost efficiency within the supply chain [1][2]. Inappropriate supplier decisions may lead to delayed deliveries, increased operational costs, and quality inconsistencies, which ultimately reduce a company's competitiveness [3][4]. Therefore, supplier selection is no longer a routine administrative task but a complex decision-making process that requires systematic and measurable evaluation.

Various studies have proposed multi-criteria decision-making (MCDM) approaches to address supplier selection problems. Methods such as the Analytical Hierarchy Process (AHP), TOPSIS, and hybrid models have been widely applied to evaluate suppliers based on multiple qualitative and quantitative criteria [5][6]. While AHP is effective in structuring decision hierarchies, it becomes less efficient when dealing with a large number of alternatives due to pairwise comparisons. In contrast, TOPSIS emphasizes the relative closeness of each alternative to an ideal solution, making it computationally simpler and more suitable for ranking supplier alternatives objectively [5]. However, many existing studies focus primarily on the calculation process and provide limited discussion on system implementation and practical usability.

Several recent works have implemented decision support systems (DSS) for supplier selection to improve decision consistency and reduce subjectivity [6][10]. These systems demonstrate that integrating

MCDM methods into information systems enhances efficiency and transparency in procurement decisions. Nevertheless, most studies emphasize theoretical modeling or standalone calculations, with limited attention to system scalability, data management, and real-world operational integration [7][9]. As a result, the practical adoption of such systems in industrial environments remains constrained.

PT Senotexsindo Jaya Lestari, a company operating in the textile industry, faces similar challenges in selecting reliable suppliers for raw materials essential to its production process. The company collaborates with multiple suppliers with varying performance levels in terms of price, quality, delivery timeliness, and production capacity. Currently, supplier selection is conducted using subjective judgment and managerial experience, which makes the process inconsistent, difficult to evaluate, and prone to bias. This condition highlights the need for a standardized, objective, and technology-driven decision support mechanism.

Previous studies have shown that integrating TOPSIS into computerized systems can improve decision accuracy and documentation [6][11][12]. However, there is still a lack of research that explicitly combines methodological rigor with a fully functional web-based system tailored to real organizational needs. Many studies imply contributions through system development but do not clearly articulate how their work advances both decision-making methodology and system implementation in practice.

Therefore, this research aims to develop and implement a web-based decision support system for supplier selection using the TOPSIS method at PT Senotexsindo Jaya Lestari. The explicit contributions of this study are twofold: methodologically, it demonstrates the application of TOPSIS for quantitatively ranking supplier alternatives based on multiple criteria in a real industrial context; and system-wise, it delivers an integrated, user-friendly web-based system that automates calculations, stores historical data, and supports transparent and consistent supplier evaluation. This study thus bridges the gap between theoretical MCDM approaches and their practical deployment in supply chain management.

2. METHODOLOGY

This study employs a descriptive quantitative research approach to develop and implement a web-based decision support system for supplier selection using the TOPSIS method [13]. The research stages consist of problem identification, data collection, criteria weighting determination, TOPSIS computation, system development, and system testing. The TOPSIS method was selected because of its ability to rank multiple alternatives based on their relative closeness to an ideal positive and negative solution, making it suitable for multi-criteria supplier evaluation in an industrial context [14]-[15].

The supplier evaluation involves five criteria, namely price (C1), quality (C2), production capacity (C3), on-time delivery (C4), and warranty (C5). The criteria weights were determined based on structured discussions with company management and procurement staff at PT Senotexsindo Jaya Lestari, reflecting the company's operational priorities. Price and quality were each assigned a weight of 0.25, as they directly influence production cost efficiency and product standards. Production capacity was weighted at 0.20 due to its importance in ensuring production continuity, while on-time delivery and warranty were each assigned a weight of 0.15, as they support operational reliability and post-purchase assurance. This weighting scheme represents managerial judgment aligned with the company's procurement strategy rather than arbitrary assignment.

Supplier performance scores were measured using a 1–3 ordinal scale, where 1 represents low performance, 2 represents moderate performance, and 3 represents high performance for each criterion. These scores were assigned through expert judgment, involving procurement managers and operational supervisors who possess direct experience with supplier performance. The use of a limited 1–3 scale was intended to reduce subjectivity and scoring complexity, ensuring consistency across evaluators while still capturing meaningful performance differences among suppliers. To maintain data consistency, the scoring process was conducted using the same assessment guidelines for all suppliers, and the data were cross-checked with available supplier records and historical transaction data.

The system was developed using the SDLC waterfall model and implemented as a web-based application. System validation focused on black-box testing, which was chosen because the primary objective of this study is to verify functional correctness from the user's perspective, including data input, TOPSIS calculation accuracy, ranking output, and report generation. Black-box testing is considered sufficient at this stage, as the research emphasizes decision-making accuracy and system usability rather than internal code optimization. User testing was also conducted to ensure that the system outputs were consistent with manual TOPSIS calculations and aligned with management expectations.

3. RESULTS AND DISCUSSION

After collecting supplier data covering five main criteria: Price, Quality, Production Capacity, On Time Delivery, and Warranty, the data is processed using the TOPSIS method, which is integrated into a webbased system. The system automatically calculates the criteria after the user enters the criteria values for each supplier.

Table1: Criteria data

Criteria	Description	Attribute	Weight
C1	Price	Cost	0.25
C2	Quality	Benefit	0.25
C3	Production Capacity	Benefit	0.20
C4	On Time Delivery	Benefit	0.15
C5	Warranty	Benefit	0.15

Tabel 1 presents the evaluation criteria used in the supplier selection process along with their respective attributes and weights. The five criteria consist of price (C1) as a cost criterion, and quality (C2), production capacity (C3), on-time delivery (C4), and warranty (C5) as benefit criteria. The assigned weights reflect the relative importance of each criterion in the decision-making process, with price and quality receiving the highest weights (0.25 each), followed by production capacity (0.20), while on-time delivery and warranty are each weighted at 0.15. These weights represent management priorities in balancing cost efficiency, product reliability, and operational continuity. Meanwhile, Table 2 lists the supplier alternatives evaluated in this study, consisting of five companies (A1–A5), which serve as decision alternatives in the TOPSIS analysis. Each supplier represents a potential business partner for PT Senotexsindo Jaya Lestari and is assessed consistently across all defined criteria to ensure a fair and objective comparison.

Table 2: Alternative Data

No.	Company Name
1	PT.Sinar Syno Kimia
2	PT.Niagatama Hijau Raya
3	PT.Chiemstar Indonesia
4	PT.Kharindo Prakarsa
5	PT.Indochemical Citra Kimia
…	…

Table 3 presents the performance scores of each supplier alternative against the five evaluation criteria using a 1–3 scale, where a higher score indicates better performance for benefit criteria and lower cost for the cost criterion. These scores were assigned based on expert judgment from procurement management and operational staff, ensuring that each supplier was evaluated consistently using the same assessment guidelines.

Table 3: Alternative Value

No.	Company Name	Criteria				
		C1	C2	C3	C4	C5
1	PT.Sinar Syno Kimia	2	2	3	2	3
2	PT.Niagatama Hijau Raya	2	3	2	3	1
3	PT.Chiemstar Indonesia	1	3	2	1	1
4	PT.Kharindo Prakarsa	2	3	3	3	3
5	PT.Indochemical Citra Kimia	2	2	3	1	1
…	…	…	…	…	…	…

Table 4 shows the divisor values used in the normalization process, which are obtained from the square root of the sum of squared scores for each criterion. These divisor values ensure that the decision matrix is normalized proportionally, allowing fair comparison among criteria with different measurement scales and serving as the basis for subsequent weighted normalization and distance calculations in the TOPSIS procedure.

Table 4: Divider Value

Information	Price	Quality	Production Capacity	On Time Delivery	Warranty
Divisor Value	4.1231	5.9161	5.9161	4.8990	4.8990

Normalizing the matrix:

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \tag{1}$$

Explanation:

r_{ij} : Normalized Matrix

x_{ij} : Normalized Basic Matrix

Table 5 presents the normalized decision matrix obtained by dividing each criterion value of the supplier alternatives by the corresponding divisor, as shown in Table 4. This normalization process eliminates scale differences among criteria and ensures that all values are comparable within the same range. The normalized values reflect the relative performance of each supplier for every criterion after standardization. Table 6 shows the weighted normalized decision matrix, which is produced by multiplying the normalized values in Table 5 by their respective criterion weights defined in Table 1. This step integrates both supplier performance and the relative importance of each criterion into a single matrix, providing a more representative basis for determining the positive and negative ideal solutions in the subsequent TOPSIS calculations.

Table 5: Normalized decision

No.	Company Name	Criteria				
		C1	C2	C3	C4	C5
1	PT.Sinar Syno Kimia	0.4851	0.3381	0.5071	0.4082	0.6547
2	PT.Niagatama Hijau Raya	0.4851	0.5071	0.3381	0.6124	0.2182
3	PT.Chiemstar Indonesia	0.2425	0.5071	0.3381	0.2041	0.2182
4	PT.Kharindo Prakarsa	0.4851	0.5071	0.5071	0.6124	0.6547
5	PT.Indochemical Citra Kimia	0.4851	0.3381	0.5071	0.2041	0.2182

Table 6: Weighted normalized decision

No.	Company Name	Criteria				
		C1	C2	C3	C4	C5
1	PT.Sinar Syno Kimia	0.1213	0.0845	0.1014	0.0612	0.0982
2	PT.Niagatama Hijau Raya	0.1213	0.1268	0.0676	0.0919	0.0327
3	PT.Chiemstar Indonesia	0.0606	0.1268	0.0676	0.0306	0.0327
4	PT.Kharindo Prakarsa	0.1213	0.1268	0.1014	0.0919	0.0982
5	PT.Indochemical Citra Kimia	0.1213	0.0845	0.1014	0.0306	0.0327

Table 7 presents the positive and negative ideal solutions derived from the weighted normalized decision matrix. The positive ideal solution represents the best achievable performance for each criterion, obtained by selecting the maximum value for benefit criteria and the minimum value for the cost criterion. Conversely, the negative ideal solution reflects the worst performance levels by selecting the minimum value for benefit criteria and the maximum value for the cost criterion. These ideal solutions serve as reference points for evaluating the relative closeness of each supplier alternative in the TOPSIS method.

Table 7: Ideal solution

Type	Criteria				
	C1	C2	C3	C4	C5
A^+	0.0606	0.1268	0.1014	0.0919	0.0982
A^-	0.1213	0.0845	0.0676	0.0306	0.0327

Table 8 shows the separation measures, which represent the Euclidean distance of each supplier alternative from the positive ideal solution and the negative ideal solution. A smaller distance to the positive ideal solution indicates better overall performance, while a larger distance from the negative ideal solution reflects a lower similarity to the worst-case scenario. These distance values quantify how far each supplier is from the optimal and least optimal conditions, forming the basis for calculating the final preference scores.

Table 8: Ideal distance

No.	Company Name	D_i^+	D_i^-
1	PT.Sinar Syno Kimia	0.0801	0.0798
2	PT.Niagatama Hijau Raya	0.0955	0.0745
3	PT.Chiemstar Indonesia	0.0959	0.0740
4	PT.Kharindo Prakarsa	0.0607	0.1048
5	PT.Indochemical Citra Kimia	0.1163	0.0338

Table 9 presents the preference values (Vi) and the resulting ranking of supplier alternatives. The preference value is calculated by comparing the distance of each alternative to the negative ideal solution against the total distance to both ideal solutions. A higher Vi value indicates that a supplier is closer to the positive ideal solution and farther from the negative ideal solution. Based on these results, PT Kharindo Prakarsa achieves the highest preference value and is ranked as the top supplier, demonstrating superior overall performance across the evaluated criteria compared to the other alternatives.

Table 9: Preference value (V_i)

No.	Company Name	V_i
1	PT.Kharindo Prakarsa	0.6332
2	PT.Sinar Syno Kimia	0.4991
3	PT.Niagatama Hijau Raya	0.4382
4	PT.Chiemstar Indonesia	0.4356
5	PT.Indochemical Citra Kimia	0.2252

The Figure 1 is a Use Case Diagram that shows the interaction between actors and the system. The diagram covers various usage scenarios, such as the login process, user data management, period management, criteria management, subcriteria management, supplier type management, supplier value data management, result calculation, report printing, and the logout process.

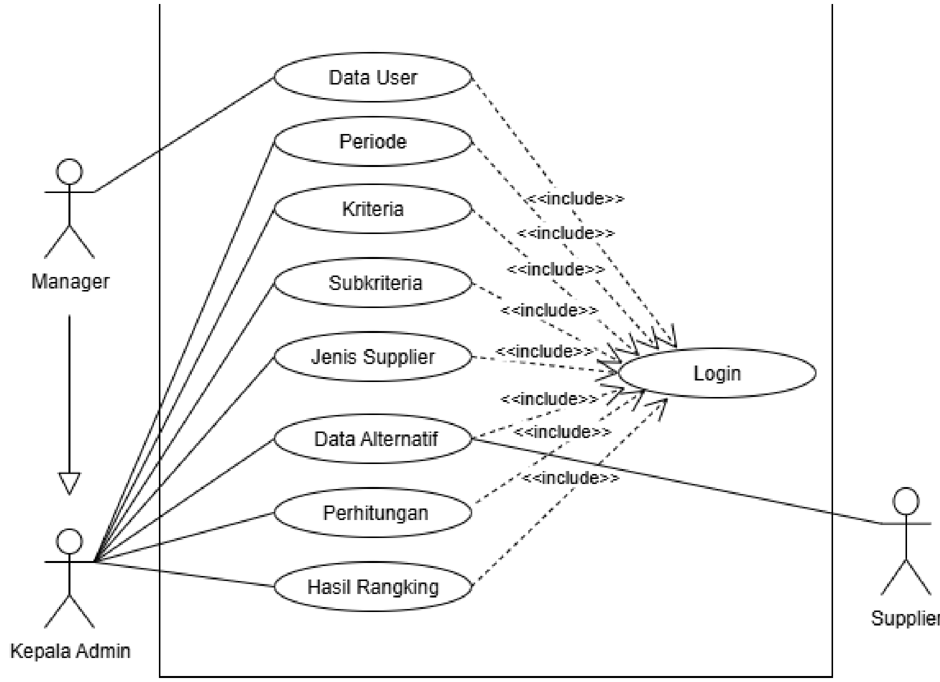

Figure 1: Usecase diagram

Figure 2 illustrates the class diagram of the proposed web-based decision support system for supplier selection, which describes the system's structural design and the relationships among its main classes. The diagram includes classes such as user, criteria, sub-criteria, supplier, supplier values, calculation results, and reporting, each with defined attributes and methods that support data management and TOPSIS computation. The relationships between classes demonstrate how supplier data and evaluation criteria are systematically linked to the calculation and ranking modules. This class diagram provides a clear representation of how data flows within the system, ensuring modularity, consistency, and maintainability in implementing the TOPSIS-based decision support process.

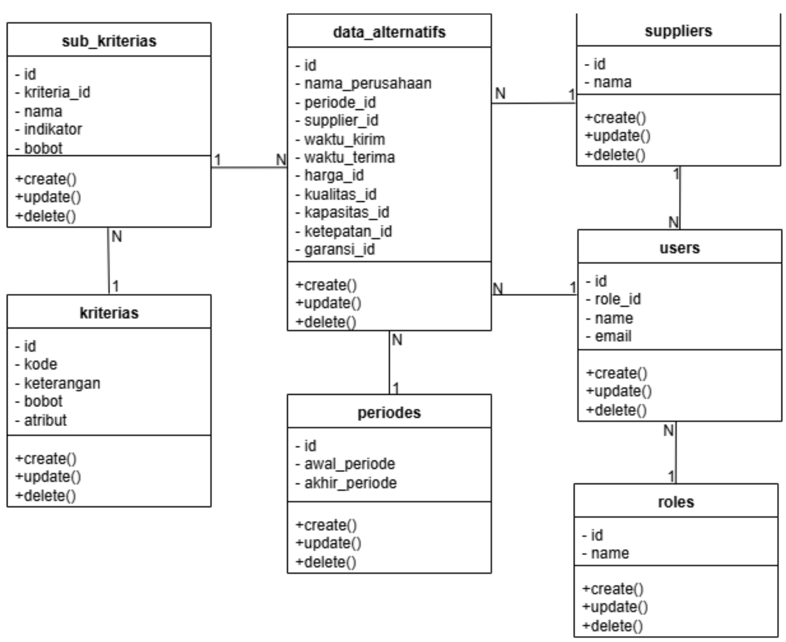

Figure 2: Class diagram

The decision support system for determining the best supplier was evaluated to ensure that each process functions optimally and produces output that meets expectations. The implementation results of the designed system, including the functions contained in the user interface, were presented. Furthermore, the author also tested each feature to ensure proper functioning and the desired results.

Figure 3 shows the dashboard page, which provides an overview of system activities and quick access to key functionalities. Figure 4 displays the criteria management page, where users can define, modify, and assign weights to evaluation criteria according to company policies. Figure 5 illustrates the alternative (supplier) data management page, enabling users to input, update, and manage supplier information and their corresponding performance scores for each criterion. These interfaces are designed to support efficient data entry, structured evaluation, and consistent application of the TOPSIS method.

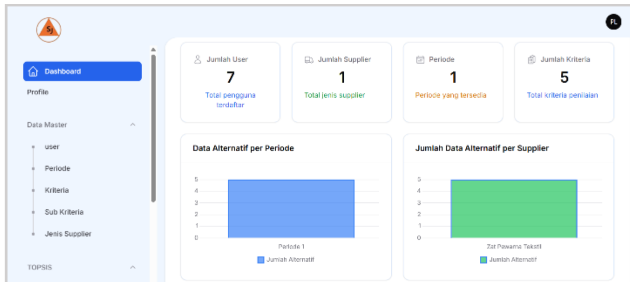

Figure 3: Dashboard

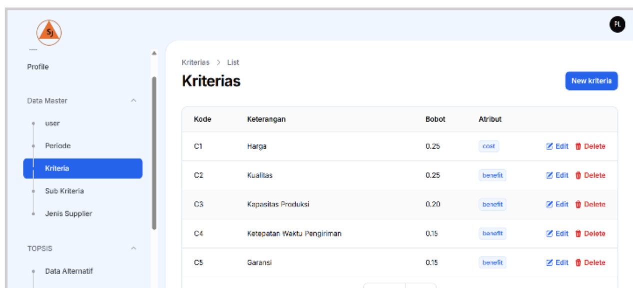

Figure 4: Criteria page

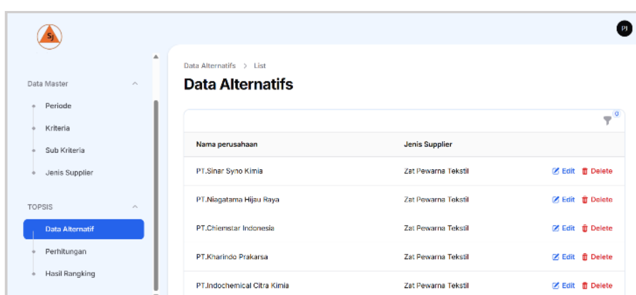

Figure 5: Alternative data page

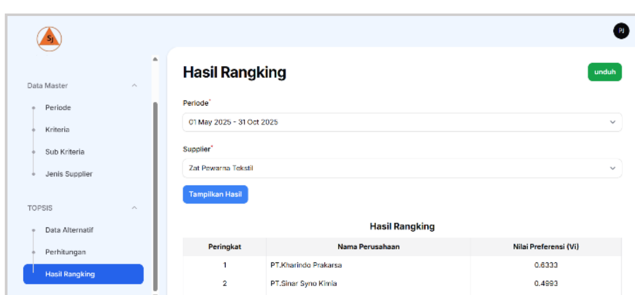

Figure 6: Ranking results

Figure 6 shows the ranking results page generated by the system after the TOPSIS calculations are completed. This page presents the preference values and ranking order of suppliers, allowing decision-makers to easily identify the best-performing alternative. The visualization of results enhances transparency and supports objective decision-making by clearly displaying the quantitative outcomes of the evaluation process. Together, these interfaces demonstrate how the system integrates data management, automated computation, and result visualization into a unified decision support platform.

Table 10 presents the results of *black box testing* conducted on the developed decision support system for supplier selection. The table lists the main testing scenarios, including login, adding, updating, and deleting data, executing TOPSIS calculations, displaying ranking results, printing reports, and logging out. For each scenario, the expected successful outcome and the potential failure outcome are specified. The testing results show that all scenarios achieved a “Succeed” status, indicating that each system function operates in accordance with the defined functional requirements.

Table 10: Results of *black box testing* conducted on the developed decision support system

No.	Testing	Success Result	Failure Result	Status
1	Login (Email Address & Password)	Login to the dashboard page	Remain on the Login page	Succeed
2	Add Data	Data successfully added	A notification appears saying "This is a required field"	Succeed
3	Change Data	Data successfully changed	Data change failed	Succeed
4	Delete Data	Data successfully deleted	Data deletion failed	Succeed
5	Calculation	Displaying TOPSIS calculation results	Calculation output not displayed	Succeed
6	Ranking Results	Displaying ranking results	Ranking results not displayed	Succeed
7	Print Ranking Results Report	Calculation results report successfully downloaded	Calculation results report failed to download	Succeed
8	Logout	Exit the system	Failed to log out of the system	Succeed

The results in Table 10 demonstrate that the system is functionally reliable and ready for operational use. The successful execution of all test cases confirms that data processing, TOPSIS calculations, result visualization, and report generation work correctly from the user’s perspective. This indicates that the system not only produces accurate decision-support outputs but also provides a stable and user-friendly interface, making it suitable for supporting supplier selection activities at PT Senotexsindo Jaya Lestari.

4. CONCLUSION

This study successfully designed and implemented a web-based decision support system using the TOPSIS method to support the supplier selection process at PT Senotexsindo Jaya Lestari. The system is able to objectively evaluate and rank suppliers based on five key criteria: price, quality, production capacity, on-time delivery, and warranty. The testing results show that the system produces accurate, consistent, and reliable calculations that align with the company’s procurement priorities, thereby reducing subjectivity in decision-making.

The application of the TOPSIS method enables the company to clearly identify the best suppliers based on their closeness to the ideal solution. Compared to the previous manual approach, the developed system improves efficiency, transparency, and documentation of the supplier selection process. In addition, the web-based implementation facilitates easier access, faster processing, and periodic evaluation of supplier performance. Overall, this system enhances the quality of procurement decisions and has the potential to be adapted by other organizations facing similar multi-criteria supplier selection challenges.

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