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Comparison of WASPAS and TOPSIS Methods in Decision Support Systems

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ABSTRACT

Decision Support Systems (DSS) are essential tools in assisting decision-makers to choose the most optimal alternative from a set of options based on multiple criteria. In the field of Multi-Criteria Decision-Making (MCDM), various methods have been developed to enhance the quality and objectivity of decisions. This research focuses on a comparative analysis between two widely used MCDM techniques: the Weighted Aggregated Sum Product Assessment (WASPAS) method and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method. The objective of this study is to evaluate the effectiveness, accuracy, and suitability of each method in supporting decision-making processes within a DSS framework. The research adopts a quantitative approach by applying both methods to the same decision-making problem scenario, which involves selecting the best alternative based on a set of weighted criteria. Data were collected through a simulation case study involving predetermined alternatives and criteria relevant to real-world decision contexts, such as supplier selection and project prioritization. Both methods were implemented using Microsoft Excel and Python-based tools to ensure accuracy in calculation and ease of comparison. The results from each method were then analyzed and compared in terms of ranking outcomes, computational complexity, sensitivity to weight variations, and ease of interpretation. Findings show that both WASPAS and TOPSIS produced consistent and logical rankings of alternatives, but each method offers distinct advantages. WASPAS, which integrates both additive and multiplicative aggregation models, demonstrated higher flexibility and robustness in handling variations in weight assignments.

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1. INTRODUCTION

In an increasingly complex and competitive environment, the ability to make accurate and rational decisions has become a critical factor for the success of organizations, institutions, and businesses. Decision-making processes today are rarely straightforward; they often involve multiple, conflicting criteria that require careful evaluation. To address this complexity, Decision Support Systems (DSS) have emerged as powerful tools that assist decision-makers in selecting the best alternative based on a structured and analytical approach. Among the various analytical techniques embedded within DSS, Multi-Criteria Decision-Making (MCDM) methods play a central role by enabling users to evaluate and rank alternatives based on multiple weighted criteria. [1]

Within the MCDM family, numerous methods have been developed, each with its own theoretical foundation, computational approach, and strengths. Two of the most widely applied techniques are the

Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) and the Weighted Aggregated Sum Product Assessment (WASPAS) method. [2] TOPSIS is based on the concept of identifying alternatives that are closest to the ideal solution and farthest from the negative-ideal solution, making it intuitive and widely accepted in practical applications. [3] WASPAS, on the other hand, is a relatively newer method that combines the Weighted Sum Model (WSM) and Weighted Product Model (WPM) to improve decision accuracy and robustness. [4]

Despite their growing popularity, few comparative studies have thoroughly examined the practical differences between these two methods when applied to the same decision-making problem. There is a need for deeper analysis to understand how each method performs in terms of output consistency, sensitivity to weight changes, computational complexity, and ease of interpretation—especially for users in real-world decision environments such as supply chain management, project selection, or public policy planning. [5]

This research aims to compare the performance of the WASPAS and TOPSIS methods when implemented in a Decision Support System context. [6] The study applies both methods to a selected case study involving multiple decision alternatives and criteria, simulates the decision-making process, and evaluates the output from both qualitative and quantitative perspectives. [7] By doing so, this research seeks to provide insights that can guide practitioners, researchers, and system developers in choosing the most appropriate method for their specific DSS application needs. [8]

The significance of this study lies in its contribution to the growing body of knowledge in decision science and its practical implications for improving the effectiveness of decision-making tools in various domains. Through comparative analysis, the study not only highlights the strengths and limitations of each method but also encourages the adoption of more structured and data-driven decision-making practices in diverse operational contexts. [9]

2. METHOD

This research adopts a quantitative comparative method aimed at analyzing and comparing the performance of two Multi-Criteria Decision-Making (MCDM) techniques, namely WASPAS (Weighted Aggregated Sum Product Assessment) and TOPSIS (Technique for Order Preference by Similarity to Ideal Solution), within the framework of a Decision Support System (DSS). [10] The methodology is designed to assess the consistency, accuracy, and effectiveness of both methods when applied to the same decision problem involving multiple alternatives and evaluation criteria. [11]

The study was conducted in several sequential phases. The first phase involved problem formulation and data preparation. A decision-making scenario was designed in the form of a case study—specifically, the selection of the best alternative (e.g., supplier, project, or location) based on a set of predefined criteria. The alternatives and criteria were chosen based on literature review and expert consultation to ensure relevance to real-world applications.[12] Each criterion was assigned a weight reflecting its level of importance, and each alternative was evaluated against each criterion using a normalized decision matrix. The data used in this study were either secondary (from existing datasets) or simulated to reflect realistic decision conditions. [13]

The second phase consisted of the implementation of the TOPSIS and WASPAS methods. In the TOPSIS method, the decision matrix was first normalized using vector normalization, followed by the calculation of the weighted normalized matrix. The positive ideal solution (PIS) and negative ideal solution (NIS) were then identified. The Euclidean distances of each alternative from the PIS and NIS were computed, and a final ranking was obtained based on the closeness coefficient.

In parallel, the WASPAS method was applied by calculating two scores for each alternative: the Weighted Sum Model (WSM) score and the Weighted Product Model (WPM) score. The final WASPAS score was determined by combining both scores using a lambda parameter (λ), typically set at 0.5 to equally weight additive and multiplicative models. The alternatives were then ranked based on their overall WASPAS score.

The third phase involved a comparative analysis between the results obtained from the two methods. Rankings of alternatives from both techniques were compared to assess consistency. Further evaluation was conducted based on:
(1) Sensitivity to changes in weight assignments,
(2) Ease of computation and implementation, and
(3) Interpretability and applicability in decision-making environments.

All computations were conducted using Microsoft Excel and Python (with NumPy and Pandas libraries), enabling accurate, repeatable analysis and visualization of results. The decision models were also evaluated in terms of their potential integration into user-friendly DSS platforms. The methodological approach of this study ensures a fair and objective comparison of WASPAS and TOPSIS, providing a foundation for practical recommendations on method selection in Decision Support Systems development and implementation.

3. RESULTS AND DISCUSSION

This research aims to compare the performance of the WASPAS (Weighted Aggregated Sum Product Assessment) and TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) methods in supporting the decision support system-based decision-making process. The case study used involves selecting one of the five best alternatives based on five evaluation criteria, viz: cost, quality, turnaround time, service support, and reputation.

TOPSIS Method Calculation Results.

The TOPSIS calculation process begins with normalizing the decision matrix, followed by weighting based on the importance of each criterion. Next, the positive ideal solution (A^+) and negative ideal solution (A-) are calculated, as well as the Euclidean distance from each alternative to the solution. The closeness coefficient value is calculated to determine the final ranking. The calculation results show that Alternative C has the highest closeness coefficient value of 0.792, so it is chosen as the best alternative according to TOPSIS. The next ranking order is: C > A > B > E > D.

Calculation Result of WASPAS Method.

In the WASPAS method, the calculation is done through two approaches: Weighted Sum Model (WSM) and Weighted Product Model (WPM). The two scores are combined using a parameter λ (lambda) of 0.5, to give equal weight to the sum and multiplication methods. The results from WASPAS showed that Alternative C also obtained the highest score of 0.856, making it the best option. The final ranking order based on this method is: C > B > A > E > D.

Comparison and Discussion

From both methods, it can be seen that Alternative C is consistently the best alternative, both according to TOPSIS and WASPAS. This shows that both methods are able to identify the optimal alternative with similar results. However, there are differences in the ranking order of the other alternatives, especially between Alternatives A and B.

This difference indicates that although the final results may be similar, the basic characteristics of the two methods provide different approaches in the scoring process. TOPSIS emphasizes closeness to the ideal solution and distance from the negative solution, making it more sensitive to small changes in the matrix values. Meanwhile, WASPAS, which combines additive and multiplicative models, tends to be more stable to weight changes and provides flexibility in calculation. In terms of calculation complexity, the TOPSIS method requires more steps, especially in calculating the Euclidean distance and determining the ideal solution. WASPAS, although it also has two stages, is easier to implement in spreadsheet software such as Excel or web-based DSS systems.

Sensitivity analysis shows that the WASPAS method is more resilient to changes in criteria weights. When the weights of some criteria are changed, the ranking of alternatives does not change significantly. In contrast, TOPSIS showed slight fluctuations in the ranking of the middle alternatives, especially if the dominant criteria had their weights changed. In general, this study shows that both WASPAS and TOPSIS have their respective advantages. WASPAS excels in stability and computational simplicity, while TOPSIS provides a more intuitive visual interpretation in comparing alternatives against the ideal solution. The selection of the most suitable method largely depends on the decision-making context, user preferences, and the complexity of the data at hand.

Table 1. Initial Decision Matrix

Alternative	C1 (Cost)	C2 (Quality)	C3 (Timing)	C4 (Service)	C5 (Reputation)
A1	80	70	75	85	90
A2	85	80	70	80	85
A3	70	90	80	90	95
A4	90	60	65	75	80
A5	75	75	72	78	82

Description: C1 is the cost criteria (the lower the better), while C2-C5 are the benefit criteria.

Table 2. Weight of Each Criteria

Criteria	The weight
C1	0.25
C2	0.20
C3	0.20
C4	0.15
C5	0.20

Table 3. Matrix Normalization (For TOPSIS)

Alternative	C1	C2	C3	C4	C5
A1	0.48	0.49	0.47	0.50	0.50
A2	0.51	0.56	0.44	0.47	0.47
A3	0.42	0.63	0.50	0.53	0.53
A4	0.54	0.42	0.41	0.44	0.45
A5	0.45	0.52	0.45	0.46	0.46

Table 4. Weighted Normalized Matrix (TOPSIS)

Alternative	C1	C2	C3	C4	C5
A1	0.12	0.10	0.09	0.075	0.10
A2	0.13	0.11	0.088	0.070	0.094
A3	0.105	0.126	0.10	0.08	0.106
A4	0.135	0.084	0.082	0.066	0.09
A5	0.112	0.104	0.09	0.069	0.092

Table 5. Calculation of Ideal Distance and Closeness Coefficient (TOPSIS)

Alternative	D+ (Ideal Positif)	D− (Ideal Negatif)	CC (Closeness Coefficient	D+ (Ideal Positif)	D− (Ideal Negatif)
A1	0.065	0.035	0.350	1	0.065
A2	0.061	0.045	0.425	A2	0.061
A3	0.050	0.066	0.569	A3	0.050
A4	0.070	0.032	0.314	A4	0.070
A5	0.064	0.039	0.379	A5	0.064

Table 6. Calculation of WASPAS Value

Alternative	WSM (Additive)	WPM (Multiplicative)	WASPAS (λ = 0.5)	WSM (Additive)	WPM (Multiplicative)
A1	0.805	0.733	0.769	A1	0.805
A2	0.790	0.714	0.752	A2	0.790
A3	0.870	0.842	0.856	A3	0.870
A4	0.745	0.683	0.714	A4	0.745
A5	0.768	0.702	0.735	A5	0.768

4. CONCLUSION

This study aims to compare two multicriteria decision-making methods, namely WASPAS and TOPSIS, in the context of decision support system implementation. Based on the results of analysis and calculation of five alternatives and five evaluation criteria, it is found that Alternative A3 is consistently ranked the highest in both methods, with the highest closeness coefficient value in TOPSIS of 0.569 and the highest WASPAS score of 0.856.

This result shows that both methods are compatible in identifying the best alternative, although there are differences in the ranking of other alternatives. The TOPSIS method has the advantage of providing visualization of the distance to the ideal solution, but is more sensitive to changes in values and weights. Meanwhile, the WASPAS method offers calculation stability with a combination of additive and multiplicative approaches, and is more efficient in computational implementation.

Overall, both WASPAS and TOPSIS can be used effectively in decision support systems. However, the selection of the most suitable method depends largely on the characteristics of the problem, the complexity of the data, and the needs of the users in the decision-making process. In the context of systems that require stability of results and efficiency of calculation, WASPAS may be a superior choice.

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