

DEVELOPMENT OF A DECISION SUPPORT SYSTEM FOR SUPPLIER SELECTION USING AHP-TOPSIS INTEGRATED MODEL

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Abstract

The selection of suppliers is a critical strategic decision in supply chain management that directly influences organizational efficiency and competitiveness. In recent years, multi-criteria decision-making (MCDM) methods have been extensively employed to support this complex decision-making process. This literature-based study aims to explore and conceptualize the development of a Decision Support System (DSS) for supplier selection by integrating the Analytic Hierarchy Process (AHP) and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS). Through a systematic review of existing academic literature, this research identifies key criteria commonly used in supplier evaluation, assesses the methodological strengths of AHP and TOPSIS, and proposes a structured framework for their integration in a DSS environment. The findings suggest that the AHP-TOPSIS model offers a balanced combination of qualitative judgment and quantitative analysis, enhancing decision consistency and accuracy. This integrated approach is particularly suitable for dynamic procurement environments requiring robust, transparent, and scalable decision support mechanisms. The study contributes to the theoretical foundation of MCDM applications in supply chain management and provides guidance for practitioners in designing intelligent, criteria-sensitive DSS for supplier selection.

Keywords: Decision support system, supplier selection, ahp, topsis, multi-criteria decision making, supply chain management

INTRODUCTION

In the modern business world, characterized by global competition, supply chain complexity, and ever-increasing customer expectations, supplier selection is one of the most crucial strategic decisions for companies.

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Successful supply chain management is heavily influenced by the quality of supplier selection decisions, as reliable suppliers can significantly contribute to operational efficiency, cost control, and end-customer satisfaction. Conversely, poor supplier selection can result in supply disruptions, reduced product quality, delivery delays, and even significant financial losses (Ali et al., 2020). Therefore, supplier selection should no longer be based solely on intuition or historical relationships, but rather on a structured, systematic, and data-driven decision-making process.

Amid these challenges, the need arises to develop decision support systems (DSS) capable of assisting decision-makers in objectively assessing and selecting suppliers. DSS are computer-based systems designed to assist in the decision-making process by utilizing data, models, and analytical methods (Masudin et al., 2024). In the context of supplier selection, a DSS enables companies to evaluate supplier alternatives based on various relevant criteria and sub-criteria, and provide accountable recommendations. The role of a DSS becomes particularly crucial when companies are faced with numerous supplier alternatives and conflicting evaluation criteria, such as price, quality, timeliness, production capacity, and financial stability.

However, to produce optimal decisions, a DSS needs to be integrated with an appropriate multi-criteria decision-making (MCDM) method. One approach widely used in decision-making studies is the Analytic Hierarchy Process (AHP) and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS). AHP is a method used to determine the relative weights or priorities of various criteria based on expert judgment. AHP enables hierarchical decision-making and accommodates both qualitative and quantitative assessments. It also has a mechanism for measuring the consistency of the assessment logic. TOPSIS, on the other hand, is used to rank alternatives based on their proximity to the positive ideal solution and their distance from the negative ideal solution. The combination of these two methods allows the supplier selection process to be carried out with accurate weighting (from AHP) and a thorough evaluation of supplier alternatives (with TOPSIS), resulting in more comprehensive and rational decisions (Asemi et al., 2022).

The integration of AHP and TOPSIS in a supplier selection decision support system offers significant methodological advantages. AHP helps manage the complexity of the criteria and sub-criteria structure and takes into account the importance of each aspect in the decision. Once the criteria weights are determined using AHP, TOPSIS utilizes this information to

evaluate and rank suppliers based on their performance on each criterion. This approach is particularly useful in real-world situations where multiple factors must be considered simultaneously and are often uncertain or ambiguous (Ha et al., 2024). Previous literature reviews have shown that the AHP-TOPSIS integration can improve the accuracy and validity of the supplier selection process compared to a single approach.

Although numerous studies have examined the use of AHP and TOPSIS in decision-making contexts, there remains a need to develop an integrated system in the form of an information technology platform that is accessible and practical for users across various industrial sectors. In practice, companies often face challenges implementing these methods manually due to the complex, time-consuming process and the need for specific technical knowledge (Septiani et al., 2023). Therefore, developing an automated decision support system based on AHP-TOPSIS will significantly improve the efficiency and effectiveness of decision-making. This system not only provides transparent and replicable evaluation results but also supports documentation, reporting, and historical analysis.

During development, this system needs to be designed with user needs in mind, flexibility across industry types, and ease of data management (Jiménez-Delgado et al., 2020a). Usability, an intuitive user interface, and integration with supplier databases are also key considerations in the design process. Furthermore, the system must be capable of handling both quantitative and qualitative data and support regular data updates to ensure the accuracy of information in supplier evaluations. The use of technologies such as the Python programming language, relational databases, and web-based interfaces or desktop applications are relevant approaches to building an adaptive and modern DSS (Yu et al., 2019).

This research stems from the urgent need for a system capable of combining the advantages of MCDM methods in a computerized supplier selection decision-making process. This research aims to develop a Decision Support System integrated with the AHP-TOPSIS method to facilitate the complex and multidimensional supplier selection process. In developing the system, a literature-based approach was used, systematically evaluating previous studies on DSS, AHP, TOPSIS, and supplier selection to identify conceptual frameworks, implementation steps, and the challenges and advantages of integrating these models. The literature review method enabled researchers to summarize findings and best practices from previous

research to design a system that meets practical needs and is based on a strong theoretical foundation.

By adopting a literature review approach, this research provides both theoretical contributions to the development of integrated decision-making models and practical contributions through the design of a system that can be implemented by organizations. This research is also expected to address the gap between theory and practice in the use of MCDM methods in industry. Furthermore, with the increasing advancement of information technology, the development of a DSS that integrates AHP and TOPSIS aligns with the trend of business process digitalization and decision-making automation, which supports company efficiency and competitiveness in the global marketplace. In the long term, this system can be enhanced by integrating other methods such as fuzzy logic, machine learning-based methods, or big data analytics to address greater complexity and rapidly changing market dynamics.

Overall, the background of this research reflects the importance of a systematic, data-driven, and computerized approach to the supplier selection process, which has traditionally been conducted conventionally. By integrating the AHP-TOPSIS method into a Decision Support System, it is hoped that a mechanism can be created that can assist procurement managers in making strategic decisions more accurately, quickly, and responsibly. This research is not only relevant for manufacturing and distribution companies but can also be adapted by various other sectors such as services, logistics, and government that require a partner or vendor selection system based on various complex evaluation criteria. Therefore, the development of this system represents a strategic step towards digital transformation in supply chain management and organizational decision-making in general.

RESEARCH METHOD

The research method used in this study is a literature review, which aims to identify, analyze, and synthesize various scientific references related to the development of a decision support system for supplier selection using the integrated AHP-TOPSIS model. This approach was chosen to gain a deep understanding of the conceptual and methodological frameworks used in previous research, allowing for the formulation of an integrative model suitable for application in the context of supplier selection decision-making objectively and systematically. The literature sources reviewed included

scientific journals, conference proceedings, textbooks, and relevant research reports from the past ten years.

The review process was conducted by searching the literature using keywords such as "decision support system," "supplier selection," "Analytic Hierarchy Process," "Technique for Order Preference by Similarity to Ideal Solution," and "AHP-TOPSIS integrated model" through various scientific databases such as Scopus, ScienceDirect, IEEE Xplore, and Google Scholar. Each document obtained was then evaluated for relevance, methodological contribution, and academic quality, ensuring that only credible and appropriate sources were included in the analysis. The results of this evaluation are organized thematically to identify common patterns, differences in approaches, and challenges that arise in implementing the AHP-TOPSIS model for decision-making in a supply chain context.

Based on the literature review, this study develops a framework for developing a decision support system that integrates the AHP method for determining criteria weights and the TOPSIS method for ranking supplier alternatives. This study also outlines the advantages of combining both methods in improving decision accuracy and reliability compared to either method alone. Using a literature review approach, this study not only produces a conceptual framework and process flow for an AHP-TOPSIS-based decision support system but also provides implementation recommendations that can serve as a basis for future practical system development.

RESULT AND DISCUSSION

AHP Method: Concept, Advantages, and Application

The Analytical Hierarchy Process (AHP) method is a quantitative approach developed by Thomas L. Saaty in the early 1970s. AHP was designed to assist decision-makers in dealing with complex situations involving multiple conflicting criteria or dimensions. This method is based on a hierarchical structure and a process of assessment and pairwise comparison that allows users to determine the weights or priorities of a number of alternatives or criteria. AHP is not only used in academic settings but has also been widely applied in various industrial, government, and business management sectors due to its ability to combine subjective and objective aspects in the decision-making process (Taherdoost & Madanchian, 2023).

The basic concept of the AHP method involves decomposing a complex problem into a hierarchical structure consisting of a primary objective, criteria, sub-criteria, and alternatives. Once the hierarchical structure is established,

the next step is to conduct pairwise comparisons between elements at each level of the hierarchy based on the question: "To what extent is element A more important than element B in relation to the objective at the level above it?" This process uses a numeric preference scale ranging from 1 to 9, representing relative importance. This scale is subjective, but it is very helpful in converting qualitative considerations into quantitative values. The results of these pairwise comparisons are then summarized in a matrix and analyzed using the eigenvector method to determine the relative priority weights of each element (Khan & Ali, 2020).

One of the main strengths of the AHP lies in its ability to assess the consistency of decision-makers' judgments. In many other decision-making methods, inconsistencies in judgments are often overlooked, but AHP provides a consistency testing mechanism through the calculation of a consistency ratio. A CR value below 0.1 indicates that judgments are within acceptable consistency limits, while a value above this limit indicates a need to review the comparisons (Munier & Hontoria, 2021b). In this way, AHP encourages a more logical and systematic decision-making process.

Another advantage of the AHP method is its flexibility in accommodating various types of data, both quantitative and qualitative. This method does not require complex statistical data, making it accessible to users with diverse backgrounds. In the context of organizations or work teams, AHP is also very useful because it enables collective decision-making by aggregating opinions from various stakeholders. This is crucial for strategic decision-making involving diverse perspectives and values. Furthermore, the hierarchical structure used by AHP helps decision-makers better understand and comprehensively map problems, thus making the priority-setting process more transparent and structured (Munier & Hontoria, 2021a).

In its application, AHP has been widely used in various fields. In the human resource management sector, AHP can be used to assess and select the best candidates for a position based on several criteria such as work experience, technical competence, communication skills, and organizational culture fit. In the context of goods and services procurement, this method is used to select the best suppliers or vendors by considering various aspects such as price, product quality, production capacity, and reputation. Even in the public sector, AHP is often applied to formulate development policies, determine project priorities, and develop public service strategies.

In education, AHP is used to evaluate curriculum effectiveness, assess the quality of educational institutions, or assist in the accreditation process. In

engineering and industry, AHP is applied in technology selection, facility siting, and project risk management. Even in the environmental field, this method is useful in environmental impact assessments and decision-making for sustainable natural resource management. The success of AHP in these various contexts demonstrates the method's adaptive characteristics, its ability to adapt to diverse problem complexities, and its methodologically sound results.

However, AHP is not without its limitations. One criticism of this method is the high potential for subjective bias, especially if the decision-maker lacks a thorough understanding of the criteria being assessed or if the comparison process is not conducted carefully. Furthermore, when the number of criteria and alternatives is large, the pairwise comparison process can be quite complex and time-consuming. To address this, researchers and practitioners often combine AHP with other methods such as fuzzy logic or optimization methods to improve accuracy and efficiency.

In some cases, AHP has also been integrated with other methods to produce a more comprehensive decision-making approach. One popular integration is the combination of AHP with the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS). This integration combines AHP's strengths in determining criteria weights with TOPSIS's ability to evaluate alternatives based on their distance from the ideal solution. Thus, the AHP-TOPSIS combination enables decision-makers not only to determine the relative importance of each criterion but also to select the best alternative based on a comprehensive, data-driven evaluation.

The application of AHP in the digital world is also growing. Many software and decision support systems (DSS) have integrated the AHP method to facilitate technology-based decision-making. In the era of big data and artificial intelligence, AHP remains relevant as a methodological framework that can complement data-driven analysis with a logical decision-making structure. Its ease of use and interpretation of results make AHP a favorite among practitioners and researchers who require a structured approach to address complex problems (Jurík et al., 2022).

Developments in information technology have also expanded the scope of AHP's use to various digital platforms, both desktop and web-based applications. These systems allow users to construct hierarchies, perform comparisons, and analyze results automatically using intuitive interfaces. This not only accelerates the decision-making process but also improves the accuracy and documentation of decision results. In an increasingly competitive

and dynamic business world, the ability to make decisions quickly, accurately, and measurably is a crucial asset. Therefore, the AHP method will continue to be a vital part of modern decision-making frameworks.

The widespread acceptance of AHP in various parts of the world also demonstrates the method's cross-cultural appeal. The concepts of hierarchy and paired assessment are easily understood by a wide range of groups, both academics and practitioners. The universality of this approach makes AHP a suitable method for use in multinational, multicultural, and multidisciplinary contexts. In international projects, AHP enables more effective communication between parties with diverse backgrounds due to its systematic and transparent structure and process.

With all its advantages and flexibility, AHP makes a significant contribution to strengthening decision-makers' capacity to manage uncertainty, prioritize, and select the best solution from among available alternatives. AHP is not only a technical tool but also a crucial instrument in strategy development, long-term planning, and policy evaluation. AHP's ability to bridge intuition and quantitative analysis makes it relevant amidst the complexities of the modern world, which is filled with multidimensional challenges.

In the academic realm, AHP is often used as a research framework to answer questions about preferences, choices, and evaluation. Many studies have used AHP to formulate robust and applicable decision-making models. This demonstrates that AHP is not only a practical method but also has a solid theoretical foundation. With the growing need for rational, evidence-based decision-making methods, AHP is predicted to remain relevant in the future.

In conclusion, AHP is a systematic and logical decision-making method that can be applied across various fields to solve complex problems involving multiple criteria. With advantages such as ease of use, data flexibility, and consistency analysis capabilities, AHP has proven to be an effective tool in helping individuals and organizations make better decisions. Despite its limitations, this method remains a primary choice in multi-criteria decision-making, especially when applied carefully and combined with other supporting approaches.

Designing an Integration of the AHP-TOPSIS Methods in a System

Designing an integration of the Analytical Hierarchy Process (AHP) and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) methods in a decision support system is a strategic approach that combines

the advantages of two multi-criteria decision-making methods that have been widely proven in practice. In the context of system development, this integration not only aims to improve the accuracy of the best alternative selection results but also strengthens complex decision-making structures involving multiple conflicting criteria. Designing this system requires a deep understanding of the characteristics of each method and how they can complement each other in an integrated workflow (Arslan et al., 2021).

In general, the AHP method plays a role in determining the weights or relative importance between criteria through a hierarchical and systematic pairwise comparison process. A key advantage of AHP is its ability to capture the subjectivity of decision-makers and generate consistent criterion weights based on their assessments (Jiménez-Delgado et al., 2020b). This is crucial in the context of decision support systems because it allows the system to represent human preferences in a structured manner. However, AHP has limitations when used to evaluate a large number of alternatives, as the pairwise comparison process becomes increasingly complex and time-consuming. This is where TOPSIS plays a crucial role, namely, assessing existing alternatives based on their proximity to the positive ideal solution and the negative ideal solution.

Within an integrated framework, the system design process begins with the development of a hierarchical decision structure consisting of the primary objective, assessment criteria, and available alternatives. Once this structure is established, the AHP method is applied to obtain the weights for each criterion. This assessment can be conducted through input from experts or system users using an appropriate comparison scale, for example, the 1-9 scale developed by Saaty. The weights obtained from the AHP are then integrated into the TOPSIS calculation as part of the normalization and weighting of the decision matrix. In the TOPSIS process, each alternative is assessed based on its value for each criterion, then its distance from the ideal solution and the negative ideal solution is calculated, and finally ranked based on the relative proximity index (Liu et al., 2021).

This integration offers two-pronged benefits. AHP provides strong theoretical justification for the importance of each criterion, while TOPSIS provides a more operational and efficient alternative evaluation framework. In system implementation, this integration must be facilitated by an interface design that allows users to easily input criteria comparisons and alternative performance values. The system must also be able to calculate eigenvector values in AHP and automatically integrate them into TOPSIS calculations,

allowing users to focus solely on decision-making based on the informatively displayed final results.

The design of an AHP-TOPSIS integration system also includes the development of algorithmic modules that can handle mathematical calculations accurately and consistently. The AHP module will include consistency validation to ensure that user input is not too deviant and remains logically acceptable. The TOPSIS module, on the other hand, will facilitate the calculation of decision matrix normalization, weighting, determination of ideal solutions, and calculation of relative closeness indices. All these modules need to be designed to be automatically interconnected, with the final result, a ranking of alternatives, displayed in an easily understood format that supports decision-making (Anser et al., 2020).

In addition to technical aspects, the design of this integration must also consider the system's user acceptability. Therefore, during the system testing phase, a usability evaluation and validation process is required by comparing the system's output with decisions made manually by experts. This testing not only ensures the accuracy of the results but also assesses the system's reliability in real-world situations. The interface design also needs to be responsive, intuitive, and able to provide real-time feedback to help users understand the decision-making process and results (Wang et al., 2020).

In a real-world application context, this AHP-TOPSIS integrated system can be applied in various fields, such as supplier selection, employee selection, project location determination, strategic management decision-making, and performance assessment. Its ability to adapt to various criteria makes this method flexible in dealing with dynamic and complex problems. Therefore, the success of the system design depends heavily on accurately translating user needs into a relevant hierarchical structure, selecting appropriate criteria, and the system's ability to efficiently manage data.

In other words, integrating AHP and TOPSIS into a single system is an effective approach to addressing the limitations of each method individually, resulting in a more objective, systematic, and transparent decision-making process. In the long term, the development of this system also opens up opportunities to expand the method's scope through integration with other technologies such as machine learning, cloud computing, or web-based and mobile systems that can increase accessibility and scalability. Therefore, designing an AHP-TOPSIS integrated system is a crucial step toward creating a more intelligent and adaptive decision support system that meets the

demands of the ever-changing business and organizational environment (Kumar et al., 2020).

Decision Support System Design

Decision Support System design is a crucial process in information system development that aims to assist in complex, unstructured decision-making that requires in-depth data analysis. In the context of modern organizations facing rapidly changing business environments, the need for systems capable of providing accurate, relevant, and timely information is increasing. These systems are not only tasked with providing data but also processing and analyzing it to generate decision alternatives that support management in selecting the best solution (Sutton et al., 2020). Therefore, DSS design requires a systematic and multidisciplinary approach, encompassing technical, organizational, and cognitive aspects of decision-makers.

The initial step in designing a Decision Support System is identifying user needs. This stage aims to understand the problems faced by system users, including managers, analysts, and other decision-makers. Needs analysis is conducted through interviews, observations, or surveys to gather information regarding the types of decisions made, the frequency of decision-making, and commonly used data sources. This phase also maps out limitations and constraints that may impact the system design. These requirements will later form the basis for determining system specifications, such as the type of input required, the expected output format, and the analysis method or model to be applied. By understanding the decision-making context in depth, DSS designers can build a system that truly supports the process, not simply serves as a data presentation tool.

Furthermore, in the DSS design process, selecting a decision model is crucial. This model can be a quantitative model such as the Analytical Hierarchy Process (AHP) method, the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), regression, simulation, or other methods appropriate to the characteristics of the problem. Model selection must consider the complexity of the problem, data availability, and the user's competence in understanding the model used. This decision model will serve as an analytical engine that processes input into accountable recommendations. In some cases, a combination of several methods can also be applied to increase the reliability of the results (Vasey et al., 2022). For example, a combination of the AHP method for criteria weighting and TOPSIS

for ranking decision alternatives. The selected model then needs to be implemented in an interactive and user-friendly system interface so that decision-makers can easily input data, understand analysis results, and make decisions based on the system output.

Another important aspect of DSS design is the system architecture design. This architecture encompasses data structures, processes, and integration between system components, both software and hardware. At this stage, efficient data collection, storage, and processing mechanisms are also designed. Data can come from internal organizational sources, such as management information systems, financial systems, or production databases, or from external sources such as market data, weather, or social media. Therefore, system designers need to develop a database system that is reliable, secure, and capable of handling large data volumes with high access speeds (Antoniadi et al., 2021). Furthermore, data processing is carried out through processing modules that have been integrated with the previously selected decision model. The system also needs to be designed flexibly to adapt to changing needs and technological developments. In the ever-changing business world, overly rigid systems will not be sustainable.

System implementation and testing are the next phases in DSS design. Once the system design is complete, the next step is to implement the system in a real-world environment and thoroughly test it. Testing is conducted to ensure that the system operates as intended, produces accurate output, and is easily usable by users. The testing process involves simulating decision-making scenarios with various input data, analyzing errors, and evaluating system responses. If inconsistencies or errors are found, corrections are made until the system operates optimally. Furthermore, user training is a crucial part of DSS implementation, as the system's success depends heavily on how effectively users can utilize it. Therefore, developing system documentation and user guides is a strategic step to support the system's adoption by end users.

In the long term, system evaluation and maintenance are integral parts of the DSS lifecycle. Implemented systems need to be periodically evaluated to measure their performance, suitability to changing user needs, and effectiveness in supporting decision-making. Developments in information technology, such as the emergence of artificial intelligence, big data, and cloud computing, also provide opportunities for continuous system refinement to make them more adaptive, intelligent, and efficient. For example, machine learning integration can provide enhanced predictive

capabilities for DSS (Chen et al., n.d.). Furthermore, regular maintenance is necessary to ensure the system is free from technical glitches, secure from cyberattacks, and remains compliant with organizational standards and policies. In an increasingly data-driven world, the existence of a reliable Decision Support System is no longer an option but a necessity for organizations seeking to compete strategically and sustainably.

Advantages of AHP-TOPSIS Integration in Decision Support

The integration of the Analytic Hierarchy Process (AHP) and the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) methods in decision-making support significantly improves the quality of complex analysis results, particularly in the context of multi-criteria decision-making. This combined approach combines the analytical power of AHP in determining hierarchical and logical criterion weights with the ability of TOPSIS to identify the best alternative based on relative proximity to the ideal solution and distance from the worst-case solution. With the synergy of these two methods, the decision support system is capable of producing more objective, structured, and responsive decisions to the real needs of various decision-making scenarios in the business, manufacturing, healthcare, education, and government sectors (Sharma et al., 2020).

The primary advantage of the AHP and TOPSIS integration lies in its ability to systematically handle problems involving multiple criteria. AHP provides a robust framework for constructing a hierarchical problem structure, allowing decision-makers to break down complex problems into smaller, more easily evaluated elements. Using the AHP's unique pairwise comparison technique, the weight of each criterion can be determined based on the subjective preferences and considerations of experts or decision-makers, which are then tested for consistency to ensure the validity of the results. This step is crucial because the resulting weights will influence the calculations in the TOPSIS stage. This process ensures that more important criteria are given greater influence in the final evaluation, in accordance with rational perceptions and judgments (Darzi, 2024).

Meanwhile, TOPSIS complements the strengths of AHP by providing a mathematical approach capable of ranking alternatives based on the concept of positive and negative ideal solutions. The best alternative is the one with the closest distance to the ideal solution and the furthest distance from the negative solution. The clarity of this principle makes TOPSIS highly intuitive and easy for decision-makers to interpret. Furthermore, TOPSIS's ability to

handle both quantitative and qualitative weighted data makes it a flexible and adaptable method for a wide range of problems, including competitive business environments, development projects, and operational scenarios in public institutions. Therefore, when these two methods are combined, the advantages of AHP in determining weights and hierarchical structures blend perfectly with the reliability of TOPSIS in ranking alternatives based on their proximity to the ideal state.

The advantages of AHP-TOPSIS integration are also evident in increased transparency and accountability in the decision-making process. Explicit procedures at each calculation stage provide a traceable analytical trail, facilitating validation and auditing of the resulting decisions. This is particularly important in organizations or institutions that uphold good governance principles, as it allows stakeholders to understand the rationale behind decisions. Furthermore, this integration reduces the dominance of subjectivity because each decision is based on a systematic, data-driven evaluation process. While subjective considerations remain, especially in initial assessments in AHP, their impact can be minimized through consistency testing and quantification processes in TOPSIS (Jiménez-Delgado et al., 2020c).

In the context of technology implementation, the AHP-TOPSIS integration is highly suitable for use in digital-based decision support systems. The computations required in both methods can be easily automated, whether in the form of desktop applications, web applications, or cloud-based systems. This opens up opportunities for use in real-time and collaborative decision-making across various industrial sectors. For example, in supplier selection, project risk evaluation, technology selection, or organizational performance assessment, the AHP-TOPSIS integration can filter numerous alternatives and provide accurate rankings in a relatively short time. The reliability of the results generated by this combination of methods also makes it a highly useful tool in situations where decisions must be made quickly while remaining accurate and accountable.

From a decision-making model development perspective, the AHP-TOPSIS integration also facilitates adaptation to the dynamic changes in criteria and alternatives that frequently occur in the real world. When new criteria emerge or priorities change, the AHP structure can be easily adjusted and weight calculations updated, while TOPSIS can still be used to reevaluate alternatives based on these new parameters. This flexibility makes the integration of these methods relevant in the long term, as the decision-making

model can evolve with changes in the business environment or policies. This is certainly a strategic advantage for organizations seeking to maintain their competitiveness and remain responsive to external challenges.

Furthermore, the combined use of AHP and TOPSIS can bridge differences of opinion in group decision-making. In situations where there are many decision-makers with differing views, AHP can accommodate collective judgment through preference aggregation, resulting in criterion weights that reflect consensus. TOPSIS can then be used to process these weights in the alternative assessment, resulting in a more widely accepted final result. Thus, this method is not only technically effective but also capable of supporting social decision-making processes, which is crucial in the context of collaborative and participatory organizations (Nazarov, 2025).

Overall, the integration of the AHP-TOPSIS method offers numerous advantages that are highly relevant to decision-making processes in the complex information age. The combination of the power of hierarchical analysis and ideal-solution-based mathematical evaluation creates a framework capable of producing more precise, measurable, and accountable decisions. The ability to handle multiple criteria, flexibility in adapting to change, ease of interpretation of results, and potential integration with information technology systems make this approach one of the best solutions for addressing modern decision-making challenges. In the long term, implementing this method has the potential to improve organizational efficiency, strengthen stakeholder trust, and encourage smarter and more sustainable data-driven management practices.

CONCLUSION

This research aims to develop a decision support system for supplier selection by integrating the Analytic Hierarchy Process (AHP) and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) methods. The literature review shows that integrating these two methods can address the complexity of multi-criteria decision-making, particularly in the context of supplier selection involving various factors such as quality, price, reliability, and delivery time. AHP is used to weight criteria based on the decision maker's preferences, while TOPSIS is used to rank alternatives based on their proximity to the positive and negative ideal solutions.

The use of the integrated AHP-TOPSIS model enables more systematic, objective, and transparent decision-making. This model also improves supplier selection accuracy by providing a clear analysis of each alternative based on

predetermined criteria. Furthermore, this system can be adapted to various industries and organizational needs, making its flexibility an added value in real-world implementation. With the support of information technology, this system can be integrated into web-based or desktop software to facilitate its use in dynamic business environments.

Overall, the development of a decision support system for supplier selection using the AHP-TOPSIS model has proven effective and relevant in supporting strategic management processes. The integration of these two approaches not only simplifies the complex selection process but also increases decision-makers' confidence in the final results. This research makes a significant contribution to the development of analytical-based decision support systems and opens up opportunities for further research in developing similar systems using other, more adaptive and intelligent hybrid approaches.

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