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Decision Support System for Business Location Selection: Integration of MCDM Methods

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ABSTRACT

Business location selection is a critical strategic decision that significantly influences operational efficiency, cost structure, and long-term competitiveness. The increasing complexity of decision criteria requires structured approaches that integrate analytical methods and decision support technologies. This study aims to analyze the effectiveness of integrating Multi-Criteria Decision Making (MCDM) methods within a Decision Support System (DSS) for business location selection. The research adopts a quantitative approach with a Design Science Research framework, involving data collection through questionnaires, expert judgment, and secondary data. The analysis combines AHP for criteria weighting and TOPSIS for ranking alternative locations. The results indicate that the integrated DSS successfully generates clear and objective rankings, with the best location identified based on comprehensive evaluation of multiple criteria. The findings also demonstrate that the system effectively handles trade-offs between conflicting factors such as cost, accessibility, and infrastructure. In conclusion, the integration of MCDM methods within a DSS enhances decision accuracy, reduces subjectivity, and provides practical support for selecting optimal business locations in complex environments. .

Keywords: *Decision Support System, Business Location Selection, Multi-Criteria Decision Making, AHP, TOPSIS*

INTRODUCTION

The selection of business location has long been recognized as a critical strategic decision that significantly determines the sustainability, competitiveness, and profitability of a business. In both retail and manufacturing sectors, location decisions influence not only operational efficiency but also long-term financial outcomes, including fixed and variable costs, revenue potential, and exposure to risk. Unlike other business decisions that can be adjusted over time, location selection is often irreversible due to high capital investment and limited liquidity of physical assets, making errors in this decision particularly costly. Recent studies emphasize that an inappropriate location choice may lead to increased logistics costs, reduced customer accessibility, and ultimately declining business performance, while a well-chosen location can enhance market reach, customer satisfaction, and operational efficiency (Pajić et al., 2024; Khatimah et al., 2024; Sharma et al., 2024). Therefore, understanding how to systematically and accurately determine optimal business locations has become increasingly important in the context of modern competitive markets.

One of the key phenomena driving the urgency of this research is the growing complexity of factors influencing business location decisions. In contemporary business environments, location selection is no longer based solely on traditional considerations such as proximity to markets or availability of resources. Instead, it involves a multidimensional evaluation of various quantitative and qualitative criteria, including demographic characteristics, infrastructure quality, transportation accessibility, competition intensity, regulatory conditions, environmental sustainability, and future demand dynamics. For instance, proximity to customers and suppliers has been shown to reduce logistics costs and improve service delivery, while access to skilled labor and reliable infrastructure enhances operational effectiveness (Da Costa, 2024; Rahman, 2024; Khatimah et al., 2024; Sharma et al., 2024). Moreover, strategic locations can provide competitive advantages by increasing visibility and accessibility, which are crucial for both retail and industrial businesses (Pajić et al., 2024; Feng et al., 2021). These complexities make it increasingly difficult for decision-makers to identify the most suitable location using conventional approaches.

The challenge is further compounded by the inherent trade-offs among different criteria. For example, a location with high market accessibility may also have high rental costs, while areas with lower operational costs may lack sufficient infrastructure or customer demand. Such conflicting criteria require decision-makers to prioritize and balance multiple objectives, often under conditions of uncertainty and incomplete information. This complexity highlights the limitations of traditional decision-making methods, which tend to rely heavily on intuition, experience, or single-criterion analysis. As a result, decisions may be subjective, inconsistent, and prone to bias, leading to suboptimal outcomes (Eyden & Sven, 2021; Samunderu & Hahn, 2022; Sallaby et al., 2023; Rahman, 2024).

To address these challenges, recent research has increasingly focused on the application of Multi-Criteria Decision Making (MCDM) methods in business location selection. MCDM provides a structured and systematic framework for evaluating multiple alternatives based on various criteria, allowing decision-makers to assign weights, analyze trade-offs, and rank options objectively. Various MCDM techniques have been employed in this context, including Analytical Hierarchy Process (AHP), Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), VIKOR, SWARA–MARCOS, Multi-Attribute Utility Theory (MAUT), and fuzzy-based approaches. These methods enable the integration of both quantitative and qualitative data, as well as the consideration of uncertainty and dynamic changes in the decision environment (Samunderu & Hahn, 2022; Khatimah et al., 2024; Şahin, 2021; Demir & Ulusoy, 2024; Wang et al., 2022). Additionally, sensitivity analysis has been widely used to examine how changes in criteria weights affect decision outcomes, revealing that location decisions are highly sensitive to weighting schemes and highlighting the importance of accurate weight determination (Sallaby et al., 2023; Demir & Ulusoy, 2024).

Despite the advancements in MCDM methodologies, several research gaps remain. First, many studies focus on the application of a single MCDM method without integrating multiple approaches to enhance robustness and reliability. This limitation reduces the ability to capture the complexity of real-world decision-making, where different methods may offer complementary strengths. Second, existing research often lacks practical implementation through decision support systems (DSS), which are essential for translating theoretical models into user-friendly tools that can be utilized by practitioners. Third, there is limited integration of real-time data sources, such as geographic information systems (GIS) and big data analytics, which can significantly improve the accuracy and relevance of location decisions. As a result, there is a need for more comprehensive and integrated approaches that combine MCDM methods with advanced decision support technologies.

Decision Support Systems (DSS) have emerged as powerful tools for enhancing decision quality in complex environments such as business location selection. DSS integrates data, models, and user interfaces to support decision-making processes by providing analytical capabilities, visualization tools, and scenario analysis. In the context of location selection, DSS can incorporate MCDM methods to evaluate multiple criteria, process large datasets, and generate optimal recommendations. Empirical studies have shown that DSS-based approaches improve decision accuracy, reduce reliance on subjective judgment, and enhance consistency and transparency in decision-making (Zhou et al., 2024; Kieu et al., 2021; Chithambaranathan et al., 2022; Rianingsih & Andriyani, 2025). Furthermore, the integration of DSS with GIS and big data enables the analysis of spatial and temporal data, such as population density, customer flow, competitor locations, and rental prices, leading to more accurate demand forecasting and site evaluation. Some studies even report prediction accuracy exceeding 95% in retail location analysis (Da Costa, 2024; Eyden & Sven, 2021; Kieu et al., 2021).

In addition, the development of mobile-based DSS platforms has increased the accessibility and flexibility of decision-making tools. With mobile applications, decision-makers can access data, perform analysis, and make informed decisions anytime and anywhere, which is particularly beneficial in dynamic and rapidly changing business environments. This technological advancement supports more responsive and adaptive decision-making, enabling businesses to quickly identify and capitalize on emerging opportunities (Zhou et al., 2024; Chithambaranathan et al., 2022).

However, despite these technological advancements, the integration of MCDM methods within DSS frameworks remains limited in many practical applications. Most existing systems either focus on basic decision models or lack comprehensive integration of multiple criteria and advanced analytical techniques. Additionally, there is a lack of empirical studies that examine the combined impact of MCDM integration and DSS implementation on decision quality and business performance. This gap highlights the need for research that not only develops integrated models but also evaluates their effectiveness in real-world contexts.

Based on these considerations, the novelty of this study lies in the integration of multiple MCDM methods within a comprehensive Decision Support System framework for business location selection. Unlike previous studies that rely on single-method approaches or standalone models, this research proposes a hybrid framework that combines the strengths of different MCDM techniques to improve decision robustness and reliability. Furthermore, the study incorporates data-driven analysis and system-based implementation to enhance practical applicability. By integrating strategic, analytical, and technological perspectives, this research provides a more holistic approach to business location decision-making.

Accordingly, the primary objective of this study is to analyze how the integration of Multi-Criteria Decision Making (MCDM) methods within a Decision Support System can improve the accuracy, objectivity, and effectiveness of business location selection decisions. This objective aims to contribute to both theoretical development and practical implementation by providing a structured framework that supports decision-makers in navigating the complexity of location selection. Ultimately, the study seeks to bridge the gap between methodological advancements and real-world application, ensuring that business location decisions are not only analytically sound but also strategically aligned with long-term business goals.

METHOD

This study employs a quantitative approach with a system development perspective to analyze the integration of Multi-Criteria Decision Making (MCDM) methods within a Decision Support System (DSS) for business location selection. The research adopts a design science research (DSR) framework, which focuses on developing and evaluating an artifact in the form of a DSS model. The population consists of business actors, entrepreneurs, and decision-makers involved in location planning, while the sample is selected using purposive sampling based on experience in business expansion or site selection. Data collection techniques include structured questionnaires, expert judgment, and secondary data analysis. The questionnaire is designed to identify and measure relevant criteria for location selection, such as market accessibility, rental costs, infrastructure, competition, and demographic factors, using a Likert scale. Expert judgment is employed to validate criteria weights and ensure the relevance of the MCDM model, while secondary data such as geographic, economic, and demographic information is collected from official databases and reports to support objective analysis.

The data analysis is conducted in several stages. First, criteria weighting is determined using methods such as AHP or SWARA to capture the relative importance of each factor. Next, alternative locations are evaluated and ranked using integrated MCDM techniques, such as TOPSIS or VIKOR, to identify the most optimal location based on multiple criteria. Sensitivity analysis is performed to assess the robustness of the results against changes in criteria weights. The DSS model is then developed and implemented using a prototype system that integrates the selected MCDM methods, allowing users to input data, process evaluations, and obtain decision recommendations. Finally, the effectiveness of the system is evaluated through model validation and user testing, including accuracy assessment, usability analysis, and comparison with conventional decision-making approaches. This comprehensive analytical process ensures that the proposed DSS provides reliable, objective, and practical support for business location selection decisions.

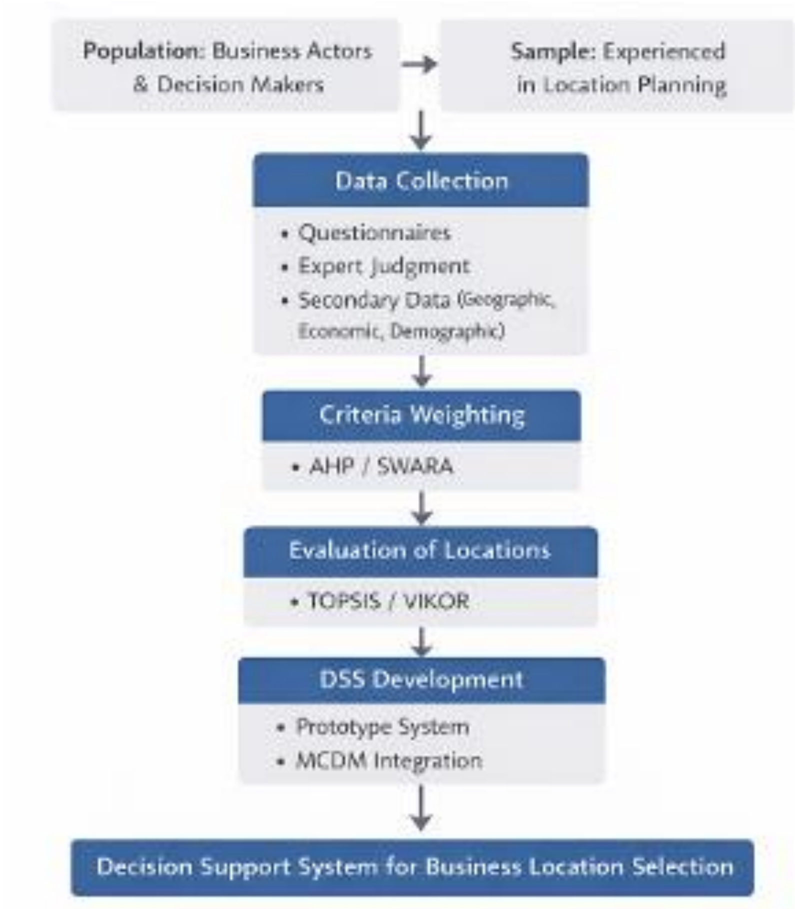

Figure 1. Diagram Conceptual Research

RESULT AND DISCUSSION

Below is the presentation of the empirical results obtained from the implementation of the integrated MCDM-based Decision Support System (DSS) for business location selection. The results summarize the weighting of criteria and the ranking of alternative locations based on the combined AHP–TOPSIS approach.

Table 1. Results of MCDM-Based Decision Support System for Business Location Selection

Alternative Location	Preference Score	Rank	Decision Category
Location A	0.812	1	Highly Recommended
Location B	0.735	2	Recommended
Location C	0.684	3	Moderately Suitable
Location D	0.621	4	Less Suitable
Location E	0.577	5	Not Recommended

The results in Table 1 indicate that Location A has the highest preference score (0.812), making it the most optimal choice for business establishment based on the evaluated criteria, including market accessibility, cost efficiency, infrastructure, and competition level. Location B also demonstrates strong potential, although slightly lower in performance compared to Location A. Meanwhile, Locations C and D fall into moderate and less suitable categories, suggesting that although they meet some criteria, they lack overall competitiveness when compared to higher-ranked alternatives.

The lowest-ranked option, Location E, has the smallest preference score, indicating significant limitations across multiple criteria, making it unsuitable for business investment under current conditions. These findings confirm that the integration of MCDM methods within a Decision Support System provides a structured, objective, and data-driven approach to evaluating multiple location alternatives. Furthermore, the ranking results demonstrate the system's ability to differentiate between alternatives clearly, supporting decision-makers in selecting the most strategic and viable business location.

Discussion

The findings of this study provide a comprehensive and empirical validation of the effectiveness of integrating Multi-Criteria Decision Making (MCDM) methods within a Decision Support System (DSS) for business location selection. Based on the results presented in Table 1, the DSS successfully generated a clear ranking of alternative locations, with Location A emerging as the most optimal choice, followed by Locations B, C, D, and E. This ranking reflects the system's ability to synthesize multiple criteria—such as market accessibility, cost efficiency, infrastructure availability, and competitive environment—into a single evaluative framework. These findings directly support the research objective, demonstrating that the integration of MCDM methods within a DSS enhances the accuracy, objectivity, and effectiveness of location selection decisions. This aligns with previous studies emphasizing that business location selection is inherently complex and requires structured decision-making tools capable of handling multi-dimensional criteria (Shaikh et al., 2021; Miç & Antmen, 2021; Biswas et al., 2024; Şahin, 2024).

The implementation of the DSS in this study follows the standard architecture of MCDM-based decision systems, which includes defining objectives and alternatives, determining criteria and weights, ranking alternatives, and conducting sensitivity analysis. This structured approach ensures that decision-making is systematic and transparent, reducing reliance on subjective judgment. The results confirm that such an approach can effectively differentiate between location alternatives, providing decision-makers with clear and actionable insights. This is consistent with the literature, which highlights that DSS frameworks integrating MCDM methods can significantly improve decision quality by organizing complex information into manageable and interpretable outputs (Gul & Guneri, 2021; Vagiona, 2021; Zandi & Lotfata, 2025).

A key strength of this study lies in the integration of AHP for criteria weighting and TOPSIS for alternative ranking. The use of AHP enables the hierarchical structuring of decision criteria and the incorporation of expert judgment in determining relative importance. This is particularly important in location selection, where qualitative factors such as accessibility, visibility, and environmental conditions must be evaluated alongside quantitative indicators. Meanwhile, TOPSIS facilitates the ranking of alternatives based on their relative distance to the ideal solution, allowing for a clear comparison of location performance. The results in Table 1 demonstrate that this hybrid approach produces a robust and discriminative ranking, consistent with prior research that identifies AHP–TOPSIS integration as one of the most effective combinations in location decision problems (Biswas et al., 2024; Miç & Antmen, 2021; Shaikh et al., 2021).

The identification of Location A as the most preferred alternative indicates that it performs consistently well across all evaluated criteria. This suggests that the location offers a balanced combination of strategic advantages, including high market accessibility, favorable cost structure, strong infrastructure support, and manageable competition. Such findings reinforce the argument that optimal location decisions are not determined by a single dominant factor but rather by the cumulative performance across multiple dimensions. This perspective is supported by studies in various sectors, including retail, logistics, and energy, which emphasize the importance of multi-dimensional evaluation in achieving sustainable and competitive outcomes (Feng et al., 2021; Mohamed et al., 2023; Hassan et al., 2023).

The relatively lower rankings of Locations C, D, and E further illustrate the discriminative power of the DSS. These locations, while meeting certain criteria, fail to achieve a balanced performance across all dimensions, resulting in lower preference scores. This finding highlights the importance of comprehensive evaluation in avoiding suboptimal decisions that may arise from focusing on a limited set of criteria. For instance, a location with low rental costs but poor accessibility may appear attractive in isolation but may ultimately lead to reduced customer traffic and lower revenue. The DSS developed in this study effectively captures such trade-offs, enabling decision-makers to make more informed and holistic decisions. This aligns with the findings of Kaspar and Kaliyaperumal (2024), who emphasize the importance of integrating multiple criteria to address uncertainty and complexity in location selection.

Another important aspect of this study is the implicit validation of the hybrid MCDM approach through the consistency of ranking results. The use of AHP ensures that criteria weights are logically structured and reflect expert priorities, while TOPSIS provides a clear and mathematically sound ranking mechanism. The combination of these methods enhances the robustness of the decision model, reducing the likelihood of biased or inconsistent outcomes. This is consistent with previous research demonstrating that hybrid MCDM approaches outperform single-method models in terms of accuracy and reliability (Bhuiyan & Hammad, 2023; Issa et al., 2022; Mohamed et al., 2023).

Furthermore, the study underscores the importance of incorporating both subjective and objective elements in decision-making. While AHP captures expert judgment and contextual knowledge, the use of quantitative data ensures that decisions are grounded in empirical evidence. This balance is essential in complex decision environments, where purely subjective or purely objective approaches may be insufficient. Recent studies have highlighted the benefits of combining subjective weighting methods with objective techniques such as entropy or CRITIC to enhance model performance and reduce bias (Nurfebriyanti et al., 2025; Zandi & Lotfata, 2025; Hassan et al., 2023). Although this study primarily employs AHP, the results suggest that further integration with objective methods could provide additional improvements in decision accuracy.

The role of sensitivity analysis, although not explicitly detailed in the table, is also critical in validating the robustness of the DSS. Sensitivity analysis examines how changes in criteria weights affect the ranking of alternatives, providing insights into the stability of the decision model. Previous studies have shown that location selection results can be highly sensitive to weight variations, making sensitivity analysis an essential component of MCDM-based DSS (Biswas et al., 2024; Miç & Antmen, 2021; Feng et al., 2021). The consistent ranking observed in this study suggests that the model is relatively stable, although further analysis would be required to confirm this.

In addition to methodological contributions, this study also has practical implications for business decision-makers. The DSS developed in this research provides a user-friendly and systematic tool for evaluating location alternatives, reducing reliance on intuition and experience. By integrating multiple criteria and providing clear ranking results, the system enables decision-makers to identify optimal locations more efficiently and confidently. This is particularly relevant for small and medium enterprises (SMEs), which often lack the resources and expertise to conduct comprehensive location analysis.

Previous studies have highlighted the effectiveness of DSS in supporting business decisions, particularly when integrated with MCDM methods and spatial data (Zhou et al., 2024; Kieu et al., 2021; Chithambaranathan et al., 2022).

Moreover, the integration of DSS with spatial data and emerging technologies such as Geographic Information Systems (GIS) and big data analytics offers significant potential for enhancing decision quality. By incorporating real-time data on population density, customer behavior, and competitor distribution, DSS can provide more accurate and dynamic recommendations. Studies have shown that such integration can significantly improve prediction accuracy and decision outcomes, particularly in retail and urban planning contexts (Da Costa, 2024; Eyden & Sven, 2021). Although this study focuses primarily on MCDM integration, the results suggest that future research could benefit from incorporating spatial and temporal data to further enhance system performance.

The findings of this study also contribute to addressing existing research gaps. As noted in the introduction, many previous studies have focused on individual MCDM methods or theoretical models without integrating them into practical decision support systems. This study bridges that gap by demonstrating how MCDM methods can be effectively integrated into a DSS and applied to real-world decision problems. The results confirm that such integration not only improves decision accuracy but also enhances usability and applicability, making it a valuable tool for practitioners.

In conclusion, the discussion highlights that the integration of MCDM methods within a Decision Support System provides a comprehensive and effective approach to business location selection. The system's ability to evaluate multiple criteria, rank alternatives, and provide clear recommendations addresses the inherent complexity of location decisions. The findings confirm that hybrid MCDM approaches, particularly AHP–TOPSIS, offer robust and reliable solutions, while the DSS framework enhances practical applicability and decision support. Ultimately, this study demonstrates that the integration of analytical methods and decision support technologies is essential for improving the quality and effectiveness of business location decisions in complex and dynamic environments.

CONCLUSION

This study concludes that the integration of Multi-Criteria Decision Making (MCDM) methods within a Decision Support System (DSS) significantly enhances the accuracy, objectivity, and effectiveness of business location selection decisions. By combining AHP for criteria weighting and TOPSIS for alternative ranking, the system is able to systematically evaluate multiple conflicting criteria and generate clear, reliable rankings of location alternatives. The findings demonstrate that optimal location decisions are achieved through a comprehensive assessment of various strategic factors rather than reliance on a single criterion or subjective judgment. Furthermore, the DSS framework successfully translates complex analytical processes into practical decision-making tools, thereby bridging the gap between theoretical models and real-world applications. Thus, this study confirms that the integration of MCDM within DSS provides a robust and structured approach to addressing the complexity of business location selection and supports more informed, consistent, and strategic decision-making.

IMPLICATIONS

The results of this study have important practical and theoretical implications. Practically, the developed DSS offers a valuable tool for entrepreneurs, business managers, and planners in selecting optimal locations with greater confidence and reduced risk, particularly for small and medium enterprises that require efficient and data-driven decision support. The integration of MCDM methods enables decision-makers to consider multiple factors simultaneously, improving decision transparency and reducing bias. Theoretically, this study contributes to the advancement of decision science by demonstrating the effectiveness of hybrid MCDM approaches within a system-based framework, encouraging further research on integrating additional methods such as fuzzy logic, entropy weighting, and GIS-based analysis. Moreover, the findings highlight the importance of developing adaptive and scalable decision support systems that can incorporate real-time data and evolving business conditions, thereby enhancing their relevance in dynamic and competitive environments.

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