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Mapping the Evolution of Multi-Criteria Decision-Making and Simple Additive Weighting Research: A Comprehensive Bibliometric and Science Mapping Analysis from 2000 to 2025

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Abstract−The increasing complexity of decision-making environments driven by digital transformation, sustainability challenges, and technological advancements has significantly accelerated the adoption of Multi-Criteria Decision-Making (MCDM) methods across diverse scientific and practical domains. Among these approaches, the Simple Additive Weighting (SAW) method has gained substantial attention due to its simplicity, transparency, and effectiveness in evaluating alternatives based on multiple criteria. Despite the rapid growth of MCDM-SAW studies, the existing body of knowledge remains fragmented across disciplines, institutions, and application areas, creating a need for a comprehensive assessment of its intellectual and thematic development. Therefore, this study aims to systematically map the evolution, intellectual structure, and emerging research trends of MCDM and SAW research from 2000 to 2025. A bibliometric research design combined with science mapping techniques was employed using data retrieved from the Scopus database. A total of 381 English-language publications were selected through a PRISMA-based screening process. Data analysis was conducted using the Scopus Analysis Tool for performance analysis and VOSviewer for network visualization, including publication trend analysis, subject area distribution, co-citation analysis, and keyword co-occurrence mapping. The findings reveal a substantial increase in scientific production, particularly after 2015, indicating the growing relevance of MCDM and SAW in contemporary decision-support research. Engineering and Computer Science emerged as the most dominant subject areas, while leading publication sources included Expert Systems with Applications, Mathematics, Sustainability, and IEEE Access. Co-citation analysis identified influential scholars and foundational theories that shape the field, whereas keyword co-occurrence analysis highlighted the growing integration of sustainability, optimization, artificial intelligence, and hybrid MCDM frameworks. The novelty of this study lies in its integrated examination of publication performance, intellectual structure, and thematic evolution within the MCDM-SAW domain. The study contributes by providing a comprehensive knowledge map that supports future theoretical development, interdisciplinary collaboration, and methodological innovation in decision-support research.

Keywords: Multi-Criteria Decision-Making; Simple Additive Weighting; Bibliometric Analysis; Science Mapping; Decision Support Systems

1. INTRODUCTION

The growing complexity of decision-making processes has emerged as one of the most crucial challenges for governments, industries, and organizations in the digital transformation and sustainable development era [1]. Current decision-making environments are characterized by large amounts of heterogeneous information, competing stakeholder interests, resource constraints and multiple conflicting objectives that require systematic evaluation frameworks [2]. While societies do not ignore the need for environmental sustainability and social responsibility, they also recognize the need for economic growth; thus, decision-makers are expected to consider multiple criteria simultaneously and not single factors [3]. This increasing complexity has led to the increasing application of Multi-Criteria Decision-Making (MCDM) techniques in various fields such as engineering, transportation, healthcare, manufacturing, supply chain management, and energy planning [4]. MCDM methods assist decision-makers in assessing multiple alternatives under conflicting criteria and uncertain conditions, resulting in improved quality, transparency, and consistency in decision outcomes [5]. Recent studies have shown the importance of MCDM techniques in providing decision support for sustainable development of infrastructure, renewable energy planning, intelligent transport systems, and smart city projects [6]. The growing reliance on evidence-based decision support has underscored the importance of MCDM as a scientific and pragmatic framework for solving complex real-world problems [7]. Consequently, the field has grown substantially in the last 20 years, leading to an increasing body of knowledge and methodological innovation [1]. The rapid development implies the need for a full understanding of the intellectual development and research evolution in the MCDM field [2].

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The Simple Additive Weighting (SAW) method has become one of the most popular methods within the MCDM family due to its computational simplicity, transparency, and effectiveness in ranking alternatives across multiple criteria [8]. SAW provides a simple manner of combining weighted criteria into an overall performance score, which is highly appealing for academic research and practical applications as compared to more advanced optimization-based methods [9]. The method has been successfully applied in supplier selection, manufacturing optimization, transportation planning, educational assessment, environmental management, and healthcare decision-making processes [10]. In addition, the conventional SAW framework has recently been augmented by integrating with fuzzy logic, entropy weighting, PSI, CRITIC, LOPCOW and other hybrid decision-making models to enhance robustness and decision accuracy [11]. Such developments suggest that SAW has transformed from a basic ranking tool into an integral part of advanced decision-support systems [12]. The advent of machine learning, artificial intelligence and intelligent analytics has also increased the applicability of SAW in dynamic and data-intensive environments [13]. As a result, the research on SAW has developed quickly and now is a considerable portion of the contemporary MCDM studies [12]. This development has resulted in a voluminous and fragmented scientific literature in numerous disciplines and methodological traditions [14]. Therefore, understanding the evolution of SAW research within the larger MCDM ecosystem has become increasingly crucial for both researchers and practitioners [1].

Over the last two decades, scientific production on MCDM and SAW has significantly increased due to the growing interest in decision support technologies and sustainability development initiatives [5]. Researchers have proposed many methodological improvements, hybrid frameworks, and domain-specific applications that constantly add to the theoretical and practical foundations of the field [12]. The combination of MCDM methods with artificial intelligence, machine learning, optimization algorithms and sustainability assessment frameworks has led to new interdisciplinary research streams which were largely missing in previous periods [4]. This exponential growth is indicative of the dynamism of the field, but it has also contributed to the scattering of scientific knowledge across journals, disciplines, institutions, and geographical areas [2]. Consequently, it is often hard for researchers to identify influential studies, research themes, collaboration networks, and new areas of inquiry [15]. The growing volume of publications has also made it challenging to track the evolution of methodologies and to evaluate the relative impact of different research communities [1]. Furthermore, the development of hybrid SAW models and intelligent decision-support systems has modified the conceptual limits of the field, rendering traditional narrative reviews unable to fully capture its complexity [11]. In these situations, bibliometric methods provide a systematic way to examine the scientific evolution through quantitative and visual analyses of publishing and citation patterns [5]. Therefore, a science mapping perspective is needed to reveal the intellectual structure and development path of MCDM and SAW research.

Despite some studies addressing specific applications and methodology of MCDM and SAW, comprehensive bibliometric assessments are still relatively rare [1]. Most of the existing review studies revolve around algorithm comparison, performance evaluation, or application-oriented discussions, without delving into the broader scientific structure of the field [2]. Furthermore, many studies do not examine the influence of collaboration networks among authors, institutions and countries on the evolution of knowledge production in the MCDM-SAW domain [15]. Likewise, little consideration has been given to understanding the intellectual foundations and the changes in themes that occur over time [5]. The increasing prevalence of sustainability-driven decision-making, hybrid MCDM models, and AI-based analytical frameworks has significantly transformed the research landscape, yet the extent of their impact on the field's development remains unclear [7]. Therefore, at present, there is no integrated perspective that considers publication performance, collaboration patterns, citation structures, thematic evolution, and emerging research fronts in MCDM-SAW studies simultaneously. This lack of comprehensive evidence leaves a critical knowledge gap, hampering the strategic planning of research and theory development [1]. Thus, a systematic bibliometric analysis is required to offer a holistic perspective on the evolution of the field and the emerging future opportunities [2].

2. RESEARCH METHODOLOGY

The present study uses a bibliometric research design and science mapping techniques for a systematic review of the development of Multi-Criteria Decision-Making (MCDM) and Simple Additive Weighting (SAW) research during the period 2000-2025. Bibliometric analysis is a robust quantitative method for the assessment of scientific output, identifying key contributors and revealing the intellectual structure of a research area. The method allows researchers to churn out large volumes of academic papers using statistical and network analysis. Bibliometric techniques have been chosen for the present study because of their ability to reveal publication patterns, thematic developments and collaboration structures in the MCDM-SAW domain. Moreover, science mapping was used to visualize the relationships between keywords and to detect emerging research topics and knowledge clusters. This combined approach provides a complete picture of how the field has evolved over time and where future opportunities for research may lie. Figure 1 displays the general methodological workflow followed in the present study. It depicts the PRISMA-based screening and selection process utilized for building the final dataset.

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The data were obtained from the Scopus database, which is one of the most comprehensive and widely used sources of peer-reviewed scientific literature. We selected Scopus for its wide multidisciplinary coverage and the availability of reliable citation and bibliographic metadata suitable for bibliometric research. A structured search query was constructed to retrieve publications relevant to the research topic using keywords relevant to the two core concepts of the study, Multi-Criteria Decision-Making and Simple Additive Weighting. The search string in Scopus was (TITLE-ABS-KEY (mcdm) AND TITLE-ABS-KEY (saw)) AND (LIMIT-TO (LANGUAGE, "English"). The purpose of this query was to find publications with the words “MCDM” and “SAW” in title, abstract or author keywords and limited the results to documents written in English. The search was limited to English language publications to ensure consistency in data analysis and to maximize the inclusion of internationally accessible research. On December 10, 2025, the first search returned 383 records (2000–2025) (Figure 1).

The identification, screening and selection of publications were done following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework in order to ensure transparency and methodological rigor. For the identification phase, all the records retrieved from the Scopus database with their bibliographic metadata (authors, titles, affiliations, abstracts, keywords, citations, source information) were exported together. The initial search yielded 383 records as depicted in Figure 1. No duplicate records were observed in the dataset. Similarly, during the identification phase, there were no records discarded by automated screening tools and no documents excluded for technical reasons. All the records passed through the screening process after the initial retrieval process for further assessment. Screening was based mainly on the relevance of the documents to the objectives of the study and consistency of language. By applying these criteria, the dataset produced was an accurate reflection of the scientific literature on MCDM and SAW research.

After the initial screening process, the retrieved publications were evaluated according to predefined inclusion and exclusion criteria. The primary inclusion criterion required that publications explicitly address topics related to MCDM and SAW as indicated by the search query. In addition, only publications written in English were considered eligible for inclusion because English remains the dominant language of international scientific communication. As illustrated in Figure 1, two records were excluded during the screening stage because they were written in Persian and therefore did not satisfy the language requirement. No publications were excluded based on publication type, source type, or subject area because the objective of the study was to capture the broadest possible representation of the MCDM-SAW research landscape. Following the exclusion process, 381 records remained eligible for bibliometric analysis. Consequently, the final dataset comprised 381 publications that formed the basis for all subsequent performance analyses and science mapping procedures presented in this study.

The bibliographic data was analyzed using two complementary analytical platforms, namely the Scopus Analysis tool and VOSviewer software. The Scopus Analysis tool was employed to generate descriptive statistics and performance indicators related to scientific production within the MCDM-SAW research domain. Specifically, this platform was used to examine annual publication growth, publication distribution across subject areas, and the most influential journals, conference proceedings, and scientific documents. These indicators provide valuable insights into the development trajectory of the field and the relative contribution of different research disciplines. In addition, publication trends were analyzed to identify periods of accelerated growth and changing research interest over time. Subject area analysis was conducted to determine the multidisciplinary nature of MCDM-SAW studies and to identify dominant academic domains contributing to literature. The results of these analyses provide an empirical overview of the scientific performance and expansion of the field represented by the publications included in Figure 1.

To complement the descriptive analysis, science mapping techniques were performed using VOSviewer, a specialized software package designed for constructing and visualizing bibliometric networks. VOSviewer was selected because of its ability to generate high-quality visual representations of relationships among scientific concepts and research topics. In this study, the software was used to conduct co-occurrence network analysis based on author keywords extracted from the selected publications. The co-occurrence approach enables the identification of thematic clusters by examining the frequency with which keywords appear together within the same documents. Through this procedure, major research themes, conceptual relationships, and emerging topics within the MCDM-SAW field can be identified and interpreted. The resulting network visualization provides a graphical representation of the intellectual structure of the domain and highlights the thematic evolution of research over time. The dataset used for these network analyses consisted exclusively of the 381 publications retained after the PRISMA selection process presented in Figure 1, ensuring consistency between the screening procedure and the subsequent bibliometric investigations.

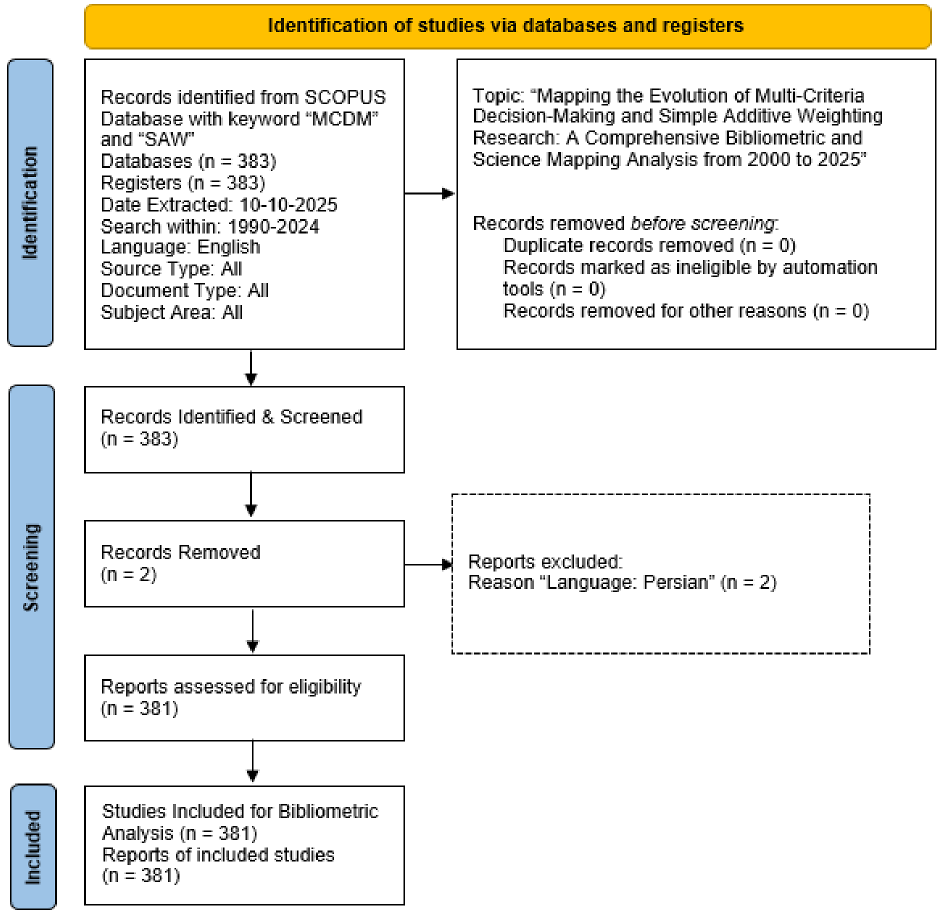

Figure 1. PRISMA Flow Diagram for the Selection of Publications on MCDM and SAW Research (2000–2025)

3. RESULT AND DISCUSSION

3.1 Meta-Analysis

3.1.1 Publication Trend by Year

Before analyzing the intellectual and conceptual structure of the MCDM-SAW research domain, it is important to examine the temporal development of scientific publications. Publication trends provide valuable insights into maturity, growth dynamics, and research attractiveness of a particular field. The annual distribution of publications related to MCDM and SAW from 1990 to 2025 is presented in Figure 2. This analysis enables the identification of growth phases, turning points, and research momentum that have shaped the evolution of the field over time. Moreover, publication trajectories often reflect broader technological developments, societal demands, and methodological innovations that influence scholarly attention. Understanding these temporal patterns is essential for contextualizing subsequent bibliometric findings and assessing the future prospects of the research area. Therefore, the publication trend analysis serves as a foundational component of the present bibliometric investigation.

As illustrated in Figure 2, the development of MCDM and SAW research can be divided into three distinct phases characterized by different levels of scientific activity. During the initial phase from 1990 to approximately 2007, publication output remained extremely limited, with only occasional contributions appearing in the literature. This pattern suggests that MCDM and SAW were still emerging concepts primarily explored within specialized decision-support and operational research communities. The second phase, spanning roughly from 2008 to 2015, demonstrates a gradual increase in publication activity, indicating growing recognition of MCDM approaches across engineering, management, and computational disciplines. A notable acceleration occurred after 2015, marking the beginning of the third phase characterized by sustained and rapid growth. The number of publications increased from fewer than fifteen annual documents in the mid-2010s to nearly sixty publications by 2025. Particularly significant growth is visible between 2017 and 2025, where publication output more than doubled within a relatively short period. This substantial increase reflects the expanding relevance of decision-support technologies in addressing complex real-world problems involving multiple

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evaluation criteria. The trend also suggests that MCDM and SAW have evolved from niche analytical techniques into widely adopted methodologies across diverse scientific domains.

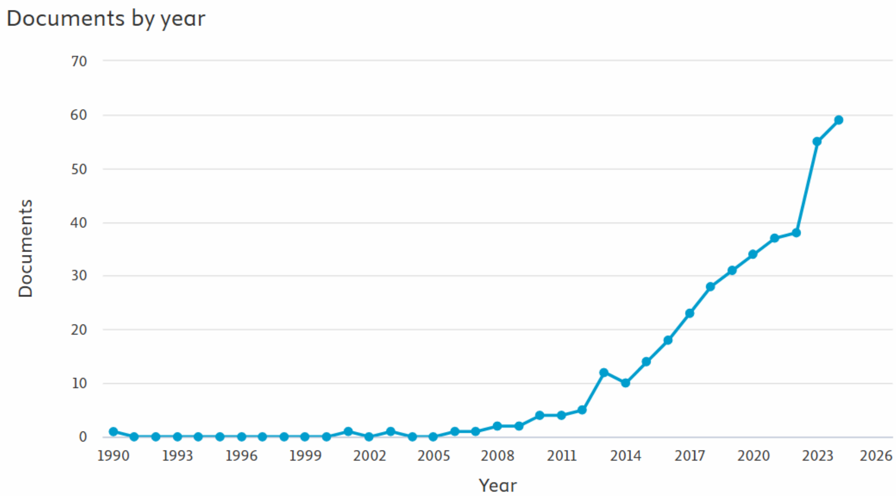

Figure 2. Annual Scientific Production on Multi-Criteria Decision-Making and Simple Additive Weighting Research (1990–2025)

The strong upward trajectory observed in Figure 2 can be attributed to several interrelated factors that have transformed the contemporary research landscape. First, increasing digitalization and the availability of large-scale datasets have created greater demand for systematic decision-making frameworks capable of handling multiple and often conflicting criteria. Second, the growing emphasis on sustainability, smart systems, renewable energy planning, and intelligent manufacturing has encouraged the adoption of MCDM methods for evaluating complex alternatives. Third, methodological advancements involving hybrid SAW models, fuzzy systems, optimization techniques, and artificial intelligence have broadened the applicability of traditional decision-making approaches. The remarkable increase observed after 2023 may also indicate intensified academic interest in integrating MCDM frameworks with emerging technologies such as machine learning and intelligent decision analytics. From a bibliometric perspective, the continuous growth without evidence of decline suggests that the field has not yet reached maturity and remains in an expansionary stage. Consequently, future publication output is expected to continue increasing over the coming years. Emerging topics such as explainable artificial intelligence, sustainable decision analytics, smart city governance, and Industry 5.0 applications are likely to become major drivers of future research activity. Therefore, the publication trend presented in Figure 2 indicates a vibrant and continuously evolving research field with substantial opportunities for theoretical and methodological innovation.

3.1.2 Publication by Subject Area

The disciplinary distribution of publications provides important insights into the academic foundations and interdisciplinary nature of MCDM-SAW research. Subject area analysis reveals which scientific domains contribute most significantly to the development of the field and illustrates how knowledge is disseminated across different research communities. The distribution of publications according to Scopus subject classifications is presented in Figure 3. Examining subject area patterns is particularly relevant because MCDM methodologies are inherently cross-disciplinary and frequently applied in diverse decision-making contexts. The analysis also helps identify dominant research traditions and emerging application domains that shape scientific progress. Furthermore, understanding disciplinary diversity provides evidence of the field's adaptability to different scientific and practical challenges. Consequently, the subject area analysis contributes to a broader understanding of the intellectual scope of MCDM and SAW research.

As shown in Figure 3, Engineering represents the largest subject area, accounting for approximately 21.3% of the total publications, closely followed by Computer Science with 21.2%. The dominance of these two disciplines highlights the methodological and technological orientation of MCDM and SAW research, particularly in optimization, decision-support systems, intelligent computing, and engineering design applications. Mathematics constitutes another significant subject area with 8.7%, reflecting the analytical and algorithmic foundations that underpin decision-making methodologies. Environmental Science and Decision Sciences contribute 7.6% and 7.3%, respectively, indicating the increasing use of MCDM approaches in sustainability assessment and strategic decision analysis. The presence of Business, Management, Energy, Social Sciences, Physics, and Materials Science further demonstrates the broad applicability of these methods across multiple sectors. This multidimensional distribution suggests that MCDM-SAW

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research has evolved beyond its original mathematical roots and now functions as an interdisciplinary framework supporting diverse scientific inquiries. The relatively balanced contribution of several subject areas also indicates strong knowledge transfer between technical and non-technical disciplines. From an academic perspective, the dominance of Engineering and Computer Science reflects the growing integration of decision-making models with digital technologies, intelligent systems, and computational analytics. Therefore, the subject area distribution presented in Figure 3 confirms the interdisciplinary maturity and expanding scientific influence of the MCDM-SAW research domain.

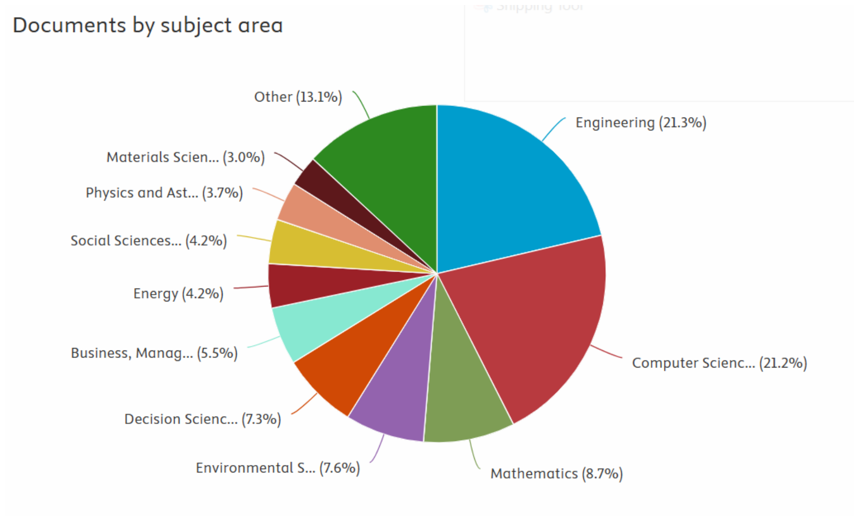

Figure 3. Distribution of Publications by Subject Area in MCDM and SAW Research

3.1.3 Top Sources and Documents

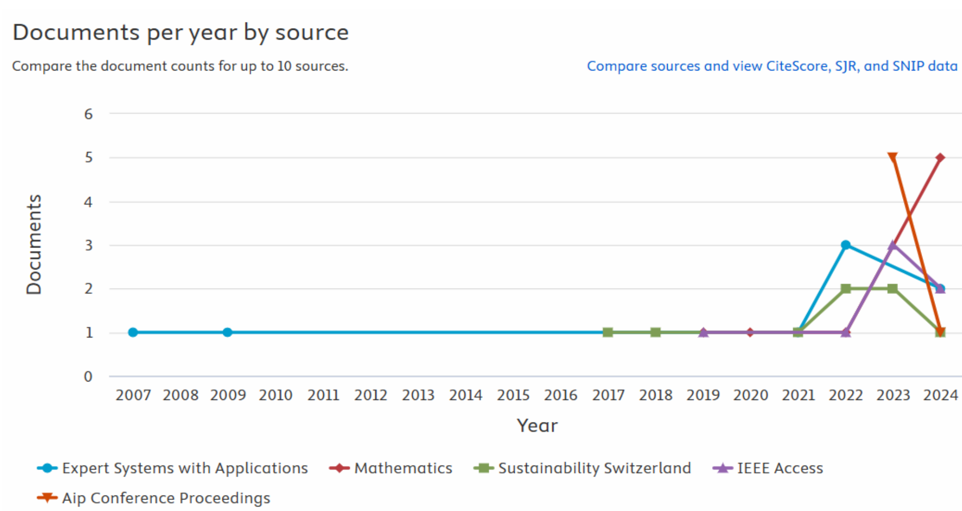

Figure 4. Leading Publication Sources in MCDM and SAW Research

Identifying the most productive publication sources is essential for understanding the dissemination patterns and scholarly influence of a research field. The leading publication sources for MCDM and SAW research are presented in Figure 4, which highlights the annual contributions of major journals and conference proceedings. The results indicate that Expert Systems with Applications, Mathematics, Sustainability, IEEE Access, and AIP Conference Proceedings constitute the primary publication outlets within the field. The prominence of Expert Systems with Applications reflects the strong connection between MCDM methodologies and intelligent decision-support systems, while the presence of Mathematics underscores the theoretical and methodological foundations of decision analysis. Similarly, Sustainability and IEEE Access demonstrate the growing relevance of MCDM approaches in sustainability assessment, technological innovation, and interdisciplinary research. The inclusion of AIP Conference Proceedings further suggests that the field remains highly dynamic, with ongoing methodological developments frequently disseminated through scientific conferences. Notably, most of these sources possess strong international reputations and are indexed in major citation databases, indicating the high scientific visibility of MCDM-SAW research. The dominance of these journals reflects the

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convergence of computational intelligence, optimization, engineering applications, and sustainability-oriented decision-making. Therefore, the publication patterns observed in Figure 4 suggest that the evolution of MCDM and SAW research is closely linked to advances in intelligent systems, mathematical modeling, and interdisciplinary problem-solving frameworks.

3.1.4 Co-Citation Network

Co-citation analysis provides insights into the intellectual structure of a research field by identifying references that are frequently cited together in the scientific literature. The co-citation network generated using VOSviewer is presented in Figure 5, revealing the foundational works and influential scholars that have shaped the development of MCDM and SAW research. The visualization indicates several interconnected clusters representing distinct yet related theoretical traditions within decision analysis. Prominent nodes such as Saaty and Triantaphyllou occupy central positions within the network, reflecting their substantial influence on multi-criteria decision-making theory and methodology. The strong connectivity among these authors suggests that foundational concepts derived from the Analytic Hierarchy Process, decision theory, and comparative evaluation frameworks continue to serve as core references in contemporary research. Additional clusters involving scholars such as Voon, Chatterjee, Opricovic, and Rezaei indicate the integration of various MCDM methodologies, including VIKOR, Best-Worst Method, and other comparative decision models. The network structure demonstrates that current MCDM-SAW research is grounded in a rich and interconnected body of knowledge rather than a single dominant theoretical perspective. This intellectual diversity contributes to methodological innovation and facilitates the emergence of hybrid decision-making frameworks. Therefore, the co-citation network presented in Figure 5 highlights the strong theoretical foundations and evolving intellectual architecture of the MCDM-SAW research domain.

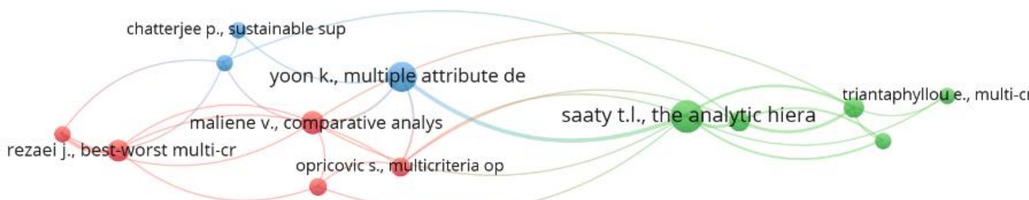

Figure 5. Co-Citation Network of Influential Authors in MCDM and SAW Research

3.1.5 Co-Occurrence Network

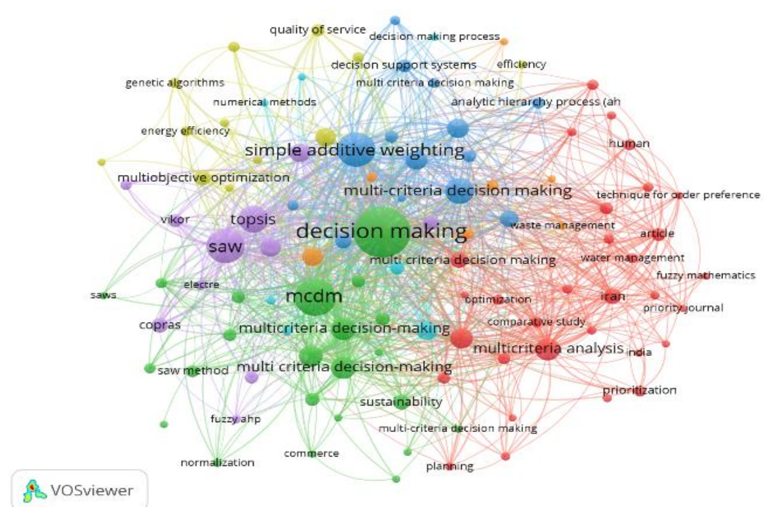

Figure 6. Keyword Co-Occurrence Network in MCDM and SAW Research

Keyword co-occurrence analysis is widely used to explore the conceptual structure and thematic composition of a research field. The co-occurrence network shown in Figure 6 illustrates the relationships among author keywords that frequently appear together within the selected publications. The largest and most central nodes correspond to "decision making", "multi-criteria decision making", "simple additive weighting", "MCDM", and "SAW" confirming their fundamental role within the research landscape. The strong interconnections among these keywords indicate a highly cohesive knowledge structure centered on decision-support methodologies and alternative evaluation processes. Several thematic clusters can also be identified, including sustainability-oriented applications, optimization techniques, decision-support systems, prioritization methods, and hybrid MCDM frameworks. Keywords such as "TOPSIS", "AHP",

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"sustainability", "optimization", and "multi-objective optimization" reveal the increasing integration of SAW with complementary analytical approaches. The presence of terms associated with computational intelligence and advanced decision analytics further suggests an ongoing transition toward more sophisticated and technology-driven research directions. Moreover, the prominence of sustainability-related keywords indicates that environmental and social considerations are becoming increasingly important within decision-making research. Overall, the conceptual network presented in Figure 6 demonstrates that MCDM and SAW research has evolved into a multidisciplinary and innovation-oriented field characterized by strong thematic interconnectedness and continuous methodological diversification.

3.2 Research Implications and Future Research Directions

The findings of this bibliometric study provide several important theoretical contributions to the development of MCDM and SAW research. First, the analysis reveals that the field has experienced sustained growth over the past decade and continues to expand across multiple disciplinary domains. The publication trend, subject area distribution, co-citation structure, and keyword network collectively demonstrate that MCDM and SAW have evolved from relatively specialized analytical tools into broadly applicable decision-support frameworks. The intellectual structure identified through co-citation analysis highlights the continued influence of foundational decision-making theories while simultaneously illustrating the emergence of new methodological paradigms. Furthermore, the conceptual evolution reflected in the keyword network indicates increasing integration between traditional MCDM approaches and contemporary technological developments such as artificial intelligence, optimization algorithms, and sustainability assessment. These findings contribute to the theoretical understanding of how scientific knowledge evolves within interdisciplinary research environments. From a methodological perspective, the study demonstrates the usefulness of combining performance analysis with science mapping techniques to capture both the quantitative growth and conceptual transformation of a research field. Consequently, this research provides a comprehensive knowledge base that can guide future theoretical development and interdisciplinary collaboration within the MCDM-SAW domain.

From a practical standpoint, the results offer valuable guidance for researchers, practitioners, and policymakers seeking to apply decision-making methodologies in complex environments. The increasing prominence of sustainability, optimization, and intelligent systems suggests that future research should focus on integrating SAW with emerging computational approaches capable of handling uncertainty, dynamic data, and large-scale decision scenarios. Nevertheless, several research gaps remain evident. Most existing studies continue to emphasize methodological applications rather than investigating explainability, transparency, and adaptive learning capabilities within decision-support systems. In addition, the bibliometric analysis was limited to publications indexed in Scopus and written in English, which may exclude relevant contributions from other databases and linguistic contexts. Future studies should therefore consider integrating multiple databases, such as Web of Science and Dimensions, to provide broader coverage of the scientific landscape. Further research may also explore longitudinal thematic evolution using advanced bibliometric techniques and machine learning-based topic modeling approaches. Significant novelty opportunities exist in areas such as explainable artificial intelligence for MCDM, hybrid SAW-based decision frameworks, sustainable smart-city planning, Industry 5.0 decision ecosystems, and intelligent multi-objective optimization systems. Accordingly, future investigations that combine traditional decision-making methodologies with emerging digital technologies are likely to represent the next major frontier in MCDM and SAW research.

4. CONCLUSION

This study provides a comprehensive bibliometric and science mapping analysis of Multi-Criteria Decision-Making (MCDM) and Simple Additive Weighting (SAW) research, revealing a substantial and continuous increase in scientific production, particularly after 2015, which reflects the growing importance of decision-support methodologies across diverse disciplines. The findings demonstrate that Engineering and Computer Science are the dominant subject areas, while leading publication outlets such as Expert Systems with Applications, Mathematics, Sustainability, and IEEE Access play a pivotal role in advancing knowledge and disseminating innovations within the field. The co-citation analysis highlights a well-established intellectual foundation built upon influential scholars and seminal decision-making theories, whereas the co-occurrence network reveals the emergence of interconnected themes involving sustainability, optimization, hybrid MCDM models, and intelligent decision-support systems. These results indicate that MCDM and SAW research has evolved from a traditional evaluation framework into a multidisciplinary domain that increasingly integrates advanced computational techniques and real-world problem-solving applications. The study contributes theoretically by clarifying the intellectual structure and thematic evolution of the field and practically by providing researchers, practitioners, and policymakers with a clearer understanding of influential research streams and emerging opportunities. Nevertheless, this research is limited by its reliance on the Scopus database and English-language publications, which may not fully capture the entire global body of knowledge related to MCDM and SAW. Future studies are encouraged to incorporate additional databases such as Web of Science and Dimensions, apply advanced bibliometric approaches including thematic evolution and topic modeling, and investigate the integration of SAW with artificial intelligence, explainable decision-support systems, Industry 5.0, and sustainability-oriented analytics. Overall, the findings suggest that the convergence of MCDM methodologies with emerging digital technologies and sustainability challenges will continue to shape the future direction of research and create significant opportunities for theoretical advancement and methodological innovation.

REFERENCES

[1] Y. Li, X. He, L. Martínez, J. Zhang, D. Wang, and X. A. Liu, "Comparative analysis of three categories of multi-criteria decision-making methods," *Expert Syst. Appl.*, vol. 238, p. 121824, Mar. 2024, doi: 10.1016/j.eswa.2023.121824.

[2] P. Villalba, A. J. Sánchez-Garrido, and V. Yepes, "A review of multi-criteria decision-making methods for building assessment, selection, and retrofit," *J. Civ. Eng. Manag.*, vol. 30, no. 5, pp. 465–480, Jun. 2024, doi: 10.3846/jcem.2024.21621.

[3] Z. N. Shehab, R. M. Faisal, and S. W. Ahmed, "Multi-criteria decision making (MCDM) approach for identifying optimal solar farm locations: A multi-technique comparative analysis," *Renew. Energy*, vol. 237, p. 121787, Dec. 2024, doi: 10.1016/j.renene.2024.121787.

[4] P. Kumar *et al.*, "Optimizing Electric Mobility: A Multi-Criteria Decision-Making Approach for Sustainable Future of Electric Vehicles Through Smart Motor Choices," *J. Eur. Systèmes Autom.*, vol. 57, no. 6, pp. 1825–1845, Dec. 2024, doi: 10.18280/jesa.570630.

[5] Ž. Stević, N. Ersoy, E. E. Başar, and M. Baydaş, "Addressing the Global Logistics Performance Index Rankings with Methodological Insights and an Innovative Decision Support Framework," *Appl. Sci.*, vol. 14, no. 22, p. 10334, Jan. 2024, doi: 10.3390/app142210334.

[6] A. Al Masri, A. N. Haddad, and M. K. Najjar, "Comparative Analysis of Energy Efficiency in Conventional, Modular, and 3D-Printing Construction Using Building Information Modeling and Multi-Criteria Decision-Making," *Computation*, vol. 12, no. 12, p. 247, Dec. 2024, doi: 10.3390/computation12120247.

[7] K. Nabiollahi *et al.*, "Assessment of Land Suitability Potential Using Ensemble Approaches of Advanced Multi-Criteria Decision Models and Machine Learning for Wheat Cultivation," *Remote Sens.*, vol. 16, no. 14, p. 2566, Jan. 2024, doi: 10.3390/rs16142566.

[8] D. V. Thanh, V. D. Binh, V. Duong, L. A. Tung, and T. Q. Hung, "Application of SAW Technique for Finding the Best Dressing Mode for Surface Grinding Hardox 500," *Int. J. Mech.*, vol. 18, pp. 17–20, Jun. 2024, doi: 10.46300/9104.2024.18.3.

[9] V.-T. Dinh, H.-D. Tran, D.-B. Vu, D. Vu, N.-P. Vu, and A.-T. Luu, "Application of a Multi-Criterion Decision-Making Method for Solving the Multi-Objective Optimization of a Two-Stage Helical Gearbox," *Machines*, vol. 12, no. 6, p. 365, Jun. 2024, doi: 10.3390/machines12060365.

[10] Sumanto *et al.*, "Improved LOPCOW-SAW Method for Optimal Supplier Selection in Supply Chain Management," in *2024 12th International Conference on Cyber and IT Service Management (CITSM)*, Oct. 2024, pp. 1–5. doi: 10.1109/CITSM64103.2024.10775429.

[11] T. Porchudar, A. M. Anita, M. A. J. Shalini, and J. J. Jesintha, "An MCDM Based on Neutrosophic Fuzzy SAW Method for New Entrepreneurs in Organic Farming," in *Recent Developments in Algebra and Analysis*, H.-H. Leung, R. Sivaraj, and F. Kamalov, Eds., Cham: Springer International Publishing, 2024, pp. 67–75. doi: 10.1007/978-3-031-37538-5_7.

[12] T. V. Dua, "PSI-SAW and PSI-MARCOS Hybrid MCDM Methods," *Eng. Technol. Appl. Sci. Res.*, vol. 14, no. 4, pp. 15963–15968, Aug. 2024, doi: 10.48084/etasr.7992.

[13] S. Khodabakhshi, M. A. A. Habib, and W. Peng, "A Decision-Making System for Medical Transportation Mode Using Machine Learning Methods," *Eng. Proc.*, vol. 76, no. 1, p. 74, 2024, doi: 10.3390/engproc2024076074.

[14] V. Grybaitė and A. Burinskienė, "Assessment of Circular Economy Development in the EU Countries Based on SAW Method," *Sustainability*, vol. 16, no. 21, p. 9582, Jan. 2024, doi: 10.3390/su16219582.

[15] N. Ersoy and N. Keleş, "Comparison of multi-criteria decision-making methods with the same normalization procedure based on real-life applications," *Oper. Res. Decis.*, vol. 34, no. 3, 2024, doi: 10.37190/ord240305.