

INTRODUCTION

Decision-making across managerial, financial, and public policy domains consistently involves multiple competing criteria and elevated levels of uncertainty, conditions that demand structured and transparent analytical frameworks (Canco et al., 2021; Witt & Klumpp, 2021). Among the methodological responses developed to address this challenge, Multi-Criteria Decision Making (MCDM) approaches have gained substantial traction, and within this family, the Analytical Hierarchy Process (AHP) has remained one of the most widely adopted tools since its formalization by Thomas L. Saaty in the late 1970s (Saaty, 2008). AHP decomposes complex problems into hierarchical structures comprising goals, criteria, and alternatives, enabling decision-makers to conduct systematic pairwise comparisons that integrate both quantitative and qualitative considerations within a unified analytical framework (Emrouznejad & Marra, 2017).

The scholarly landscape surrounding AHP has expanded considerably over the past four decades, encompassing applications in transportation planning, financial risk evaluation, infrastructure prioritization, and supply chain management, among others (Moslem et al., 2023; Bagueño et al., 2021). Importantly, the method has demonstrated adaptability by hybridizing with complementary approaches such as fuzzy logic, artificial intelligence, and Geographic Information Systems, thereby extending its applicability to contexts characterized by subjective judgment and spatial complexity (Ashour & Mahdiyar, 2024; Cui, 2025). This evolution from a classical standalone method to a modular component of hybrid decision-support architectures underscores the enduring practical relevance of AHP across disciplines. Parallel bibliometric work has confirmed an upward trajectory in AHP-related publications, though the structural properties of this body of knowledge, including collaboration patterns, thematic clusters, and temporal shifts, remain incompletely mapped (Madzik & Falat, 2022).

A systematic assessment of the AHP literature is therefore warranted. This study employs quantitative bibliometric analysis to examine 483 articles indexed in Scopus, covering the period from the early adoption phase of AHP through the contemporary era of digital decision-support integration. VOSviewer software is used to generate co-authorship and co-occurrence network visualizations, enabling the identification of collaboration structures, influential contributors, and dominant as well as emerging research themes. The analysis is specifically oriented toward AHP applications in financial management and risk management, domains where multi-criteria evaluation of investment, credit, and operational risk has made AHP particularly consequential.

This study contributes to the literature in three distinct respects. First, it provides a comprehensive bibliometric mapping of AHP research with a targeted lens on financial and risk management contexts, a thematic scope that prior reviews have addressed only partially (Mukherjee, 2014; Mawadah et al., 2026). Second, it identifies fragmentation patterns in global collaboration networks and highlights the growing but still limited involvement of emerging market researchers, including Indonesian scholars, in this field (Azmi et al., 2026; Maulana et al., 2026). Third, by tracing keyword evolution and thematic clustering, it reveals the underexplored intersections between AHP and digital technologies such as artificial intelligence and big data as high-potential directions for future research (Adelia et al., 2025; Simangunsong et al., 2026). The remainder of this paper is organized as follows. Section 2 reviews the theoretical and empirical literature underpinning AHP research. Section 3 describes the data and methodology employed. Section 4

presents and discusses the bibliometric findings. Section 5 concludes with implications and research directions.

LITERATURE REVIEW

The Analytical Hierarchy Process rests on axiomatic principles of reciprocal comparison, homogeneity, dependence, and expectation, formalized by Saaty (2008) to provide a mathematically consistent basis for priority derivation in complex decision environments. Within the broader MCDM paradigm, AHP occupies a distinctive position because it accommodates both tangible and intangible criteria, permitting decision-makers to incorporate judgment-based weightings alongside objective data (Emrouznejad & Marra, 2017). A comprehensive state-of-the-art review covering four decades of AHP development confirms that the method has generated the largest cumulative body of MCDM literature, with applications spanning engineering, management, health, and public policy, a trajectory reflecting both its methodological flexibility and its accessibility to non-specialist practitioners (Emrouznejad & Marra, 2017; Canco et al., 2021).

Financial management constitutes one of the most consequential application domains for AHP, given the multi-dimensional nature of investment selection, credit evaluation, and portfolio prioritization decisions. Research has demonstrated that AHP provides a systematic structure for ranking financial alternatives against criteria such as liquidity, profitability, and market risk, enabling more transparent and auditable decision processes than purely intuitive approaches (Mukherjee, 2014). The method has been applied to assess financial risk in banking, evaluate capital allocation in energy sectors, and support managerial decisions in resource-intensive industries, underscoring its versatility across financing contexts (Wibowo et al., 2026; Kesuma et al., 2025). This empirical breadth suggests that AHP holds durable relevance for financial practitioners, particularly in emerging market contexts where decision environments are characterized by high uncertainty and incomplete information (Mawadah et al., 2026; Ariswati et al., 2025).

A defining characteristic of recent AHP scholarship is its systematic integration with complementary technologies and analytical frameworks. The development of Fuzzy AHP addresses a longstanding limitation of the original method by introducing membership functions that capture the imprecision inherent in expert judgment, thereby improving the robustness of priority rankings under ambiguous conditions (Ashour & Mahdiyar, 2024). Similarly, the combination of AHP with Geographic Information Systems has enhanced spatial decision-making in infrastructure planning, enabling objective, data-driven prioritization that accounts for geographic heterogeneity (Nugraha, 2025). More recently, AHP has been explored in conjunction with artificial intelligence and digital decision-support architectures, reflecting a broader shift in management research toward integrated analytical systems (Cui, 2025; Adelia et al., 2025). These hybrid developments indicate that AHP is not a static tool but an evolving methodological platform whose future trajectory is closely tied to advances in computational intelligence and data infrastructure.

Bibliometric analysis has emerged as the methodological standard for mapping the intellectual structure of rapidly expanding research fields, offering quantitative insights into publication trajectories, collaboration networks, and thematic clusters that cannot be derived from conventional narrative reviews

(Donthu et al., 2021; Aria & Cuccurullo, 2017). Applied to decision-making literature specifically, bibliometric studies have revealed the dominance of specific national research ecosystems, the centrality of certain methodological keywords, and the gradual broadening of AHP applications beyond engineering into social and financial sciences (Sreenivasan et al., 2023; Madzik & Falat, 2022). In the management and finance context, related bibliometric investigations have documented parallel evolutions in areas such as digital transformation, public financial management, and crisis decision-making, all of which intersect with AHP's application scope (Maulana et al., 2026; Mawadah et al., 2026; Yahya et al., 2026). The present study builds on these precedents by applying a targeted bibliometric framework to the AHP-in-finance corpus, extending the analytical scope to include co-occurrence mapping of emergent technological themes.

METHODOLOGY

This study obtained publication data from the Scopus database, one of the most comprehensive and rigorously curated repositories of peer-reviewed academic literature, covering natural sciences, social sciences, and management disciplines (Donthu et al., 2021; Rochman et al., 2024). The search strategy combined methodological and application-domain terms, specifically the strings 'analytical hierarchy process', 'analytic hierarchy process', 'AHP', and 'fuzzy AHP', intersected with financial management descriptors including 'financial management', 'investment decisions', 'financial risk', and 'risk assessment' and their variants (Almeida et al., 2023). The inclusion criteria required articles and review papers published in English that explicitly applied or examined AHP in financial management, risk management, or related multi-criteria financial contexts. Documents excluded from the corpus comprised conference proceedings, book chapters, editorials, non-English publications, and studies applying AHP exclusively to non-financial domains without a discernible financial dimension. Following deduplication via title, DOI, and author-year matching, and manual screening of titles, abstracts, and author keywords, the final dataset comprised 483 scientific articles spanning from the early 1980s to the present, capturing both the foundational adoption phase of AHP and its contemporary digitally integrated applications (Aria & Cuccurullo, 2017; Anggraini et al., 2026).

The bibliometric analysis operationalizes the following analytical dimensions. Publication volume and temporal distribution are measured by the count of articles per year, providing an indicator of the field's growth trajectory. Scientific impact is assessed through total citation counts per article and the h-index of the corpus, defined as the largest value of h for which at least h articles have each been cited at least h times, capturing both quantity and influence of scholarly output (Donthu et al., 2021). Collaboration structure is examined through co-authorship analysis at the author and country levels, identifying central nodes and bridging researchers who connect sub-clusters within the global research network. Thematic structure is mapped through co-occurrence analysis of author-provided keywords, with a minimum frequency threshold applied to retain only sufficiently prominent terms, enabling the identification of dominant research clusters and temporally shifting topic emphases (Rochman et al., 2024). All network analyses utilize VOSviewer, with visualizations produced in three complementary modes: network visualization for structural mapping, overlay visualization for temporal trend detection, and density visualization for identifying high-concentration knowledge areas (Anggraini et al., 2026). Variable operationalization details are provided in Table 1.

Table 1. Variable and Metric Operationalization

Variable / Metric	Definition / Measurement	Source / Tool	Purpose
Publication volume	Number of articles per year	Scopus	Growth trend mapping
Citation count	Total citations per article	Scopus	Impact assessment
h-index	Largest h where h articles cited \geq h times	Scopus / VOSviewer	Scientific influence
Co-authorship (author)	Frequency of shared authorship between researchers	VOSviewer	Collaboration structure
Co-authorship (country)	Number of joint publications between countries	VOSviewer	International collaboration
Keyword co-occurrence	Frequency of simultaneous appearance of author keywords; threshold \geq 3	VOSviewer	Thematic clustering
Text-based co-occurrence	Term frequency in titles and abstracts	VOSviewer (text data)	Conceptual mapping

Source: Author’s Own Work (2026)

Following the methodological framework of Donthu et al. (2021), this study adopts a two-stage bibliometric process. The first stage involves bibliometric performance analysis, which examines publication output, citation distributions, and country-level productivity to establish the quantitative contours of the AHP research landscape. The second stage applies science mapping techniques, specifically co-authorship and co-occurrence network analysis conducted through VOSviewer, to uncover the structural and conceptual organization of the literature. Raw metadata exported from Scopus in CSV format were merged, cleaned of duplicates, and subjected to manual title-abstract screening prior to import into VOSviewer, consistent with best practices that emphasize data quality as a precondition for valid network mapping (Aria & Cuccurullo, 2017). The minimum co-occurrence threshold for keyword inclusion was set at three occurrences per term, a criterion calibrated to balance network density with analytical tractability. Co-authorship networks were constructed at both the individual researcher and country levels to distinguish micro-level collaboration from macro-level inter-country knowledge exchange. Keyword burst patterns were examined qualitatively through the overlay visualization mode to identify periods of intensified scholarly attention to specific themes, providing a temporal dimension that complements the static network maps (Castelló-Sirvent, 2022; Maulida et al., 2023).

RESULTS AND DISCUSSIONS

Dataset Overview and Publication Trends

The final corpus of 483 articles confirms sustained and growing scholarly engagement with AHP in financial management and risk assessment contexts, a volume consistent with the upward publication trajectories documented in adjacent bibliometric reviews of decision-making literature (Mawadah et al.,

2026; Sreenivasan et al., 2023). Descriptive statistics for the primary bibliometric variables are reported in Table 2. The temporal distribution of publications reflects a gradual expansion through the 1990s and 2000s, followed by a marked acceleration in the 2010s and continuing into the current decade, a pattern that mirrors the broader proliferation of MCDM applications documented in the management literature (Moslem et al., 2023). This growth trajectory indicates that AHP has not only retained its foundational user base but has continuously attracted new researchers, particularly as hybrid methodological variants and digital application contexts have broadened its appeal (Ashour & Mahdiyari, 2024).

Table 2. Descriptive Statistics of the Bibliometric Dataset

Metric	Value / Description
Total articles in corpus	483
Database source	Scopus
Period covered	Early 1980s to present (contemporaneous)
Document types	Research articles and review articles
Language filter	English only
Primary analysis tool	VOSviewer (Leiden University)
Top contributing country	China (largest node by publication count)
Dominant keyword cluster	Risk assessment, multi-criteria decision making, decision support systems
Emerging keyword themes	Sustainability, GIS, policy maker, risk management
Minimum keyword co-occurrence threshold	3 occurrences

Source: Author’s Own Work (2026)

Co-Authorship Analysis: Author and Country Networks

The co-authorship network at the individual author level reveals a pattern of dense but compartmentalized collaboration, with identifiable clusters of researchers who co-author frequently within sub-groups while maintaining relatively sparse cross-cluster linkages. Authors such as Mohamed Adel M.E., Deif Ahmed, Ansari Abdullah, and Lee Jong-Han emerge as high-connectivity nodes within their respective clusters, functioning as collaboration hubs that bridge methodological and application sub-communities within the AHP research landscape. This structural characteristic, wherein a small number of prolific researchers assume bridging roles while the broader network remains fragmented, is consistent with observations from bibliometric studies of other management sub-disciplines, where collaboration tends to be concentrated within established research groups rather than distributed uniformly across the field (Donthu et al., 2021; Korip et al., 2025). The implication is that opportunities for cross-cluster knowledge exchange and methodological cross-fertilization remain underutilized, a gap that future collaborative initiatives could strategically address.

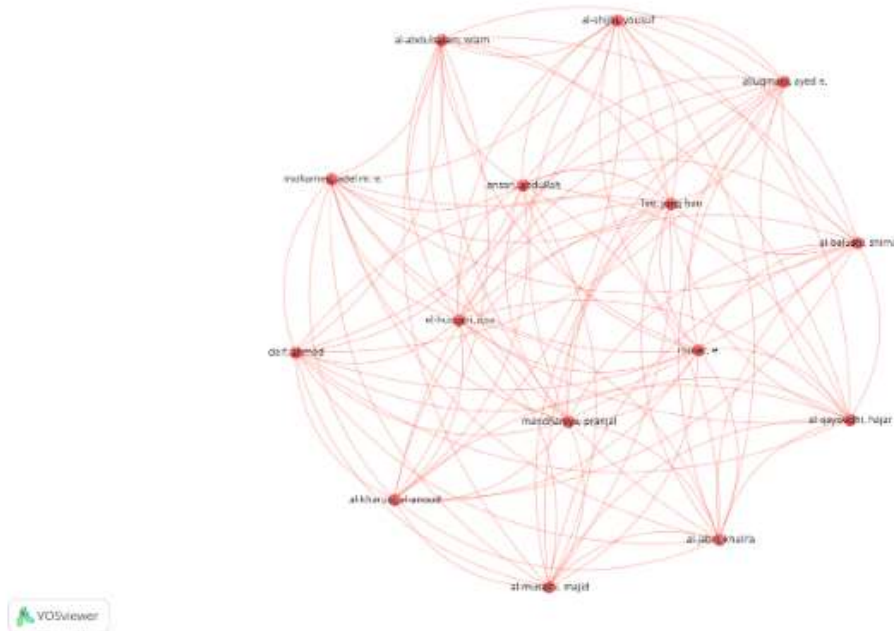


Figure 1. VOSviewer Network Visualization of Co-Authorship Among Authors

At the country level, the co-authorship network identifies China as the most prolific contributor, distinguished by the largest node size and the highest number of international co-authorship linkages within the mapped corpus. The United States, India, the United Kingdom, and Iran constitute the next tier of contributors, each occupying strategically central positions within the global collaboration network and frequently serving as partners for researchers in smaller academic ecosystems. Notably, several developing economies including Indonesia, Malaysia, Thailand, and Nigeria appear within the network, demonstrating that AHP scholarship has achieved a degree of global diffusion and is no longer confined to high-income research environments (Sreenivasan et al., 2023). This finding is consistent with evidence from parallel bibliometric investigations of financial management and public sector decision-making research, which similarly document the expanding participation of emerging-market scholars in MCDM-related literature (Maulana et al., 2026; Wibowo et al., 2026). The involvement of Indonesian researchers in particular reflects a growing national research capacity in management science, aligned with institutional efforts to increase Scopus-indexed output (Ilmahdy et al., 2025; Usada et al., 2025).

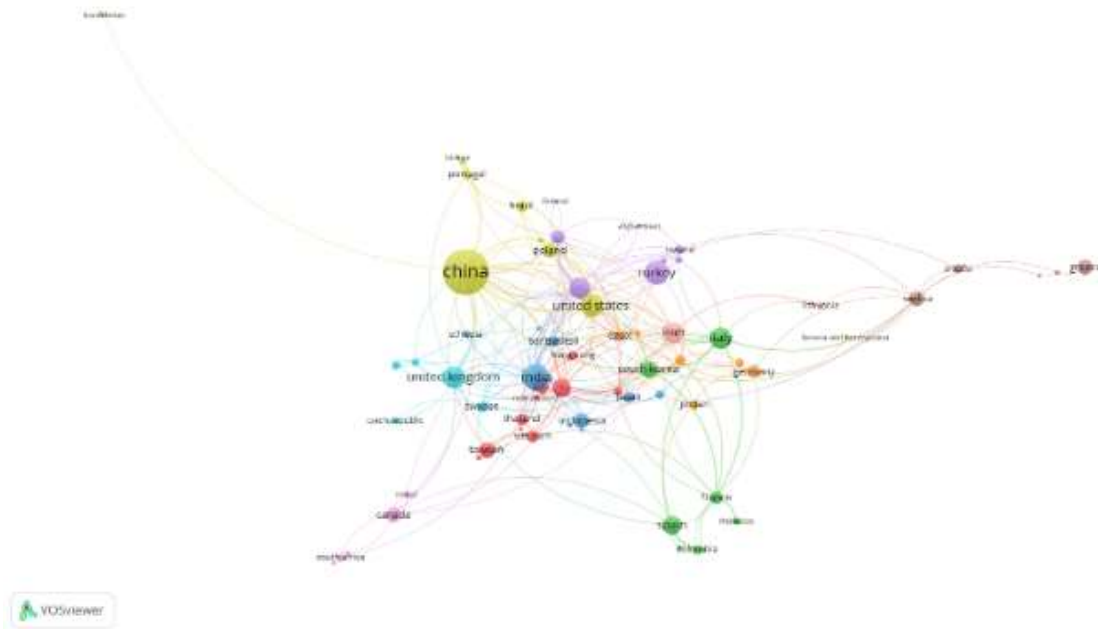


Figure 2. VOSviewer Network Visualization of Co-Authorship Among Countries

Co-Occurrence Analysis: Keyword Networks

The keyword co-occurrence network reveals a thematically coherent but structurally differentiated research landscape organized around three primary clusters. The first and most densely connected cluster is anchored by 'risk assessment' and encompasses 'risk management', 'multi-criteria decision making', and 'decision-making' as closely associated terms, confirming that the dominant application context for AHP within the indexed corpus is the analysis and management of financial and operational risk. The second cluster is organized around 'analytical hierarchy process' itself and reflects methodologically oriented research focused on the development, refinement, and comparative evaluation of AHP models, including hierarchical systems and criterion-weighting procedures. The third cluster groups decision support system-oriented research alongside terms reflecting human and behavioral dimensions of decision processes, indicating a stream of scholarship that situates AHP within organizational and cognitive frameworks rather than purely technical ones (Sreenivasan et al., 2023; Bargeño et al., 2021). The clustering structure is consistent with the thematic organization observed in bibliometric studies of related decision-making domains, where methodological and application-oriented research communities tend to develop in relative parallel rather than in systematic dialogue (Mawadah et al., 2026).

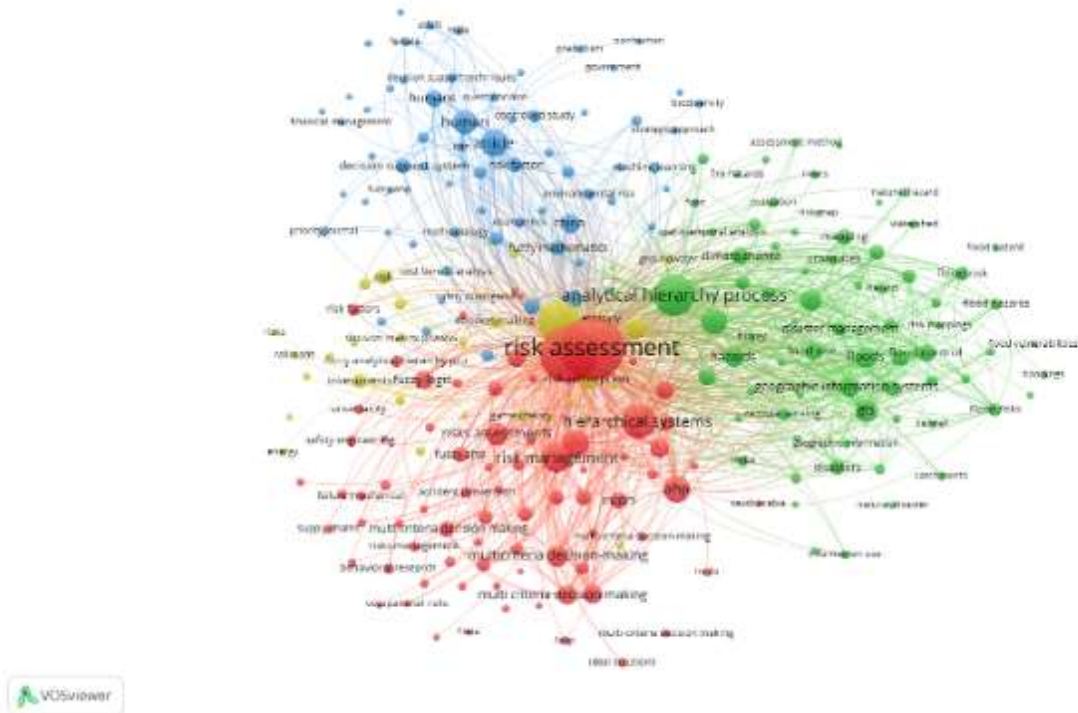


Figure 3. VOSviewer Network Visualization of Keyword Co-Occurrence

The overlay visualization of keyword co-occurrence, which encodes publication recency through a color gradient, reveals a temporal shift in research emphasis that has important implications for the field's future trajectory. Keywords associated with the foundational periods of AHP scholarship, including 'hierarchical systems' and 'analytic hierarchy process' in its earliest articulations, appear in cooler tones, while more recent research activity clusters around 'risk management', 'sustainability', and application-specific terms denoting geographic and policy-oriented use cases. This temporal signature indicates that contemporary AHP scholarship is moving away from pure methodological elaboration toward contextually embedded applications, particularly in areas connecting financial decision-making with sustainability imperatives and digital governance (Castelló-Sirvent, 2022; Yahya et al., 2026). The absence of strong keyword signals around artificial intelligence and big data integration, despite these being prominent themes in parallel management literatures, identifies a productive gap that future AHP research could address (Adelia et al., 2025; Rafasya et al., 2026).

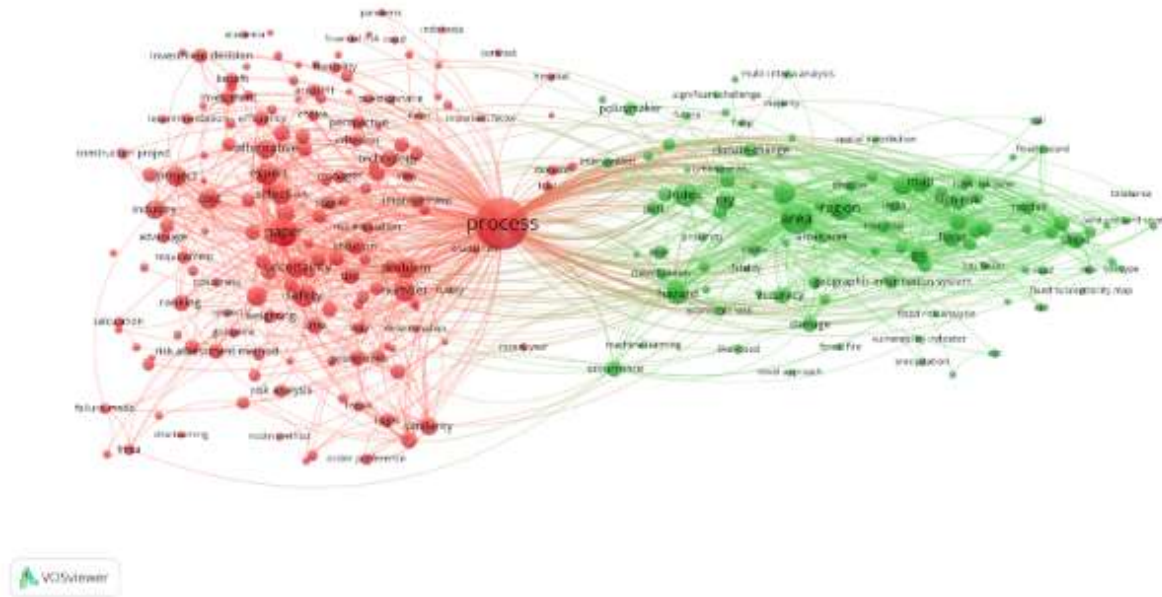


Figure 5. VOSviewer Network Visualization of Co-Occurrence Based on Text Data

The temporal overlay of the text-based network reinforces the directional findings from the keyword analysis. Earlier publications, represented by cooler hues, cluster densely around the methodological core terms, consistent with the historical emphasis on model development and criterion specification that characterized the foundational AHP literature (Emrouznejad & Marra, 2017; Mukherjee, 2014). In contrast, the warmer-toned recent cluster includes 'policy maker', 'region', and environmentally inflected terminology, signaling an expanding application frontier that connects AHP to public administration, geographic decision systems, and sustainability governance. This finding is particularly relevant for researchers working at the intersection of financial management and public policy, as it suggests that AHP-based frameworks are increasingly being adapted to evaluate policy alternatives across multiple socioeconomic and environmental criteria, a development that extends the method's relevance well beyond its original managerial context (Chairani et al., 2026; Simangunsong et al., 2026).

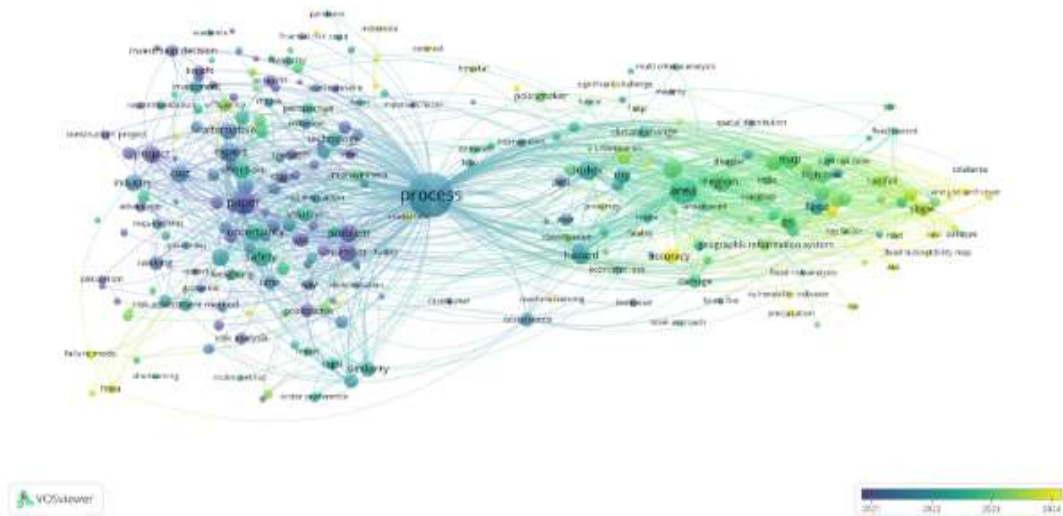


Figure 6. VOSviewer Overlay Visualization of Research Trends Based on Text Data

To ensure accurate and stable results, the bibliometric findings reported above were cross-validated through several complementary procedures. The keyword co-occurrence results were compared against text-based network findings to assess convergent validity of thematic clustering, and both methods produced structurally consistent cluster configurations, strengthening confidence in the identified themes. The country-level co-authorship network was also examined under alternative minimum publication thresholds to verify that the dominant positions of China, the United States, and India were not artifacts of parameterization choices. Overall, the core finding that AHP research is thematically anchored in risk assessment and multi-criteria decision making, while exhibiting an emerging application frontier in digital and policy-oriented contexts, remains unchanged across all analytical configurations, confirming the reliability of the baseline bibliometric results. It warrants acknowledgment that Scopus coverage is not exhaustive, and studies indexed exclusively in Web of Science or domain-specific repositories may not be represented in the corpus, a limitation shared with comparable bibliometric investigations in management research (Donthu et al., 2021; Sreenivasan et al., 2023).

CONCLUSION

This study examines the intellectual evolution and thematic structure of AHP research in decision-making using quantitative bibliometric analysis of 483 Scopus-indexed articles, processed through VOSviewer co-authorship and co-occurrence network visualization. The findings confirm that AHP retains strong and growing scholarly relevance in multi-criteria decision-making, particularly within financial management and risk management domains, consistent with its methodological capacity to integrate qualitative judgment with quantitative prioritization in complex, uncertainty-laden decision environments. The co-authorship network reveals that global AHP research, while internationally distributed with meaningful contributions from China, the United States, India, and emerging economies including

Indonesia, exhibits significant structural fragmentation, with collaboration concentrated within established sub-community clusters rather than distributed across the field. Thematically, the literature clusters around risk assessment, multi-criteria decision making, and decision support systems, while the temporal overlay analysis reveals a clear directional shift toward applied, policy-embedded, and technologically integrated AHP scholarship, with fuzzy logic and GIS integration representing the most developed hybrid frontiers and artificial intelligence-AHP convergence constituting the most underexplored growth opportunity. For policymakers and financial managers, this study highlights the continued strategic value of AHP as a structured, transparent, and replicable framework for evaluating investment decisions, risk allocations, and resource prioritization under multi-criteria constraints, particularly in emerging market contexts where decision quality has direct consequences for financial resilience and organizational sustainability. For researchers, the evidence of collaboration network fragmentation and the limited penetration of AI and digital analytics into AHP methodology suggests that interdisciplinary partnerships and methodological integration represent the most productive near-term research directions. Future studies should consider longitudinal analyses of AHP application quality, systematic integration of AHP with machine learning-based criterion weighting, and expanded coverage of developing country AHP implementations, especially in Southeast Asian contexts where institutional decision-making frameworks are rapidly evolving. The present study is subject to the limitation that its corpus is restricted to Scopus-indexed English-language publications, which may underrepresent AHP scholarship published in regional languages or indexed solely in alternative databases.

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