Evolution and Trends in Flexibility Management Research: A Bibliometric Analysis (1971-2025)

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Abstract

This study employs a quantitative method with a bibliometric analysis of flexibility management literature from 1971 to 2025, examining key trends, influential authors, major subject areas, and evolving research focuses. The analysis reveals that publication activity remained low until the early 2000s, followed by a significant increase around 2005, peaking between 2018 and 2022. This surge reflects the growing importance of flexibility management in addressing technological, organizational, and environmental challenges. The most prolific authors, including Ford, J.D., and Johnson, F.A., have made substantial contributions to the field, while the most cited articles primarily focus on resilience, adaptive capacity, and risk management. A subject area analysis highlights the interdisciplinary nature of flexibility management, with Environmental Science (35.2%) and Social Sciences (18.4%) as the dominant fields. An overlay visualization of research evolution indicates a shift from foundational resilience concepts to AI-driven adaptability, digital transformation, and real-time decision-making. Future research should explore AI-driven flexibility models, resilience in digital transformation, adaptive energy systems, and interdisciplinary approaches integrating behavioural economics and cognitive decision-making. This study provides insights into the historical development of flexibility management research and identifies emerging areas warranting further investigation, offering valuable guidance for future studies and practical applications.

Keywords: *Flexibility Management, Bibliometric Analysis, Resilience, Adaptive Capacity, Digital Transformation*

INTRODUCTION

In an era characterized by rapid technological advancements, globalization, and unprecedented disruptions, the ability of organizations to remain flexible has become a defining factor for success (Koutroukis et al., 2022). Flexibility management, which encompasses strategies for adapting to changing environments, optimizing resource allocation, and enhancing organizational resilience, has gained significant attention in academic and professional circles (Miceli et al., 2021). Businesses (Adobor & Kudonoo, 2025), governments (Allen et al., 2023), and institutions alike recognize that rigid structures are ill-suited to today's dynamic market conditions, necessitating a shift toward more adaptive

and agile management approaches. Despite the growing importance of flexibility management, there remains a need to systematically analyze how this field has evolved, which areas have garnered the most scholarly attention, and what gaps persist in the literature (Agostini et al., 2023).

While prior research has explored various aspects of flexibility management—ranging from workforce adaptability to agile supply chains and digital transformation (Srivastava et al., 2025)—There is a lack of comprehensive, data-driven insights into the field's intellectual structure and trajectory. Existing studies primarily focus on theoretical frameworks or case-based applications, leaving a gap in understanding the broader research landscape. Bibliometric analysis can provide a valuable contribution by identifying key trends, influential authors, and emerging research themes, offering a macroscopic perspective on the field's development.

This study aims to fill this gap by conducting a bibliometric analysis of flexibility management literature, mapping its evolution, and uncovering critical areas for future investigation. By analyzing publication trends, citation networks, and keyword co-occurrence, this research not only contextualizes the progression of flexibility management studies but also highlights emerging directions that demand scholarly attention. The novelty of this study lies in its ability to synthesize vast amounts of bibliographic data, offering a systematic review of the field's trajectory and providing insights that can guide future research and practice. Through this analysis, we contribute to a deeper understanding of flexibility management, positioning it as an essential component of modern organizational strategy.

Research Questions:

RQ1: What are the key trends, most productive authors, most cited articles, and major subject areas in flexibility management literature based on bibliometric analysis?

RQ2: How has the focus of flexibility management research evolved, and what emerging areas warrant further investigation?

METHOD

A quantitative, systematic bibliometric analysis was conducted to address the gap in the flexibility management literature. Scopus, known for its extensive coverage of scientific journals, was used for a systematic search on March 27, 2025. A comprehensive search of the flexibility management literature was performed using the primary search query: TITLE-ABS-KEY ("flexibilit* management*" OR "adapt* management*" OR "agility* management*" OR "dynamic* management*" OR "resilient* planning*" OR "organization* adaptabilit*"). This initial search yielded 24,550 documents, reflecting significant research activity in this domain.

To ensure relevance and focus, only articles in the final publication stage were included, while conference papers and reviews were excluded. Additionally, only English-language documents were considered. The refined search query applied was: TITLE-ABS-KEY ("flexibility* managemen*" OR "Adapti* Managemen*" OR "Agility* Managemen*" OR "Dynami*Managemen*" OR

"Resilient* Planning*" OR "Organizationa*Adaptabilit*") AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (SRCTYPE , "j")) AND (LIMIT-TO (PUBSTAGE , "final")). Applying these criteria reduced the final dataset to 19,384 entries.

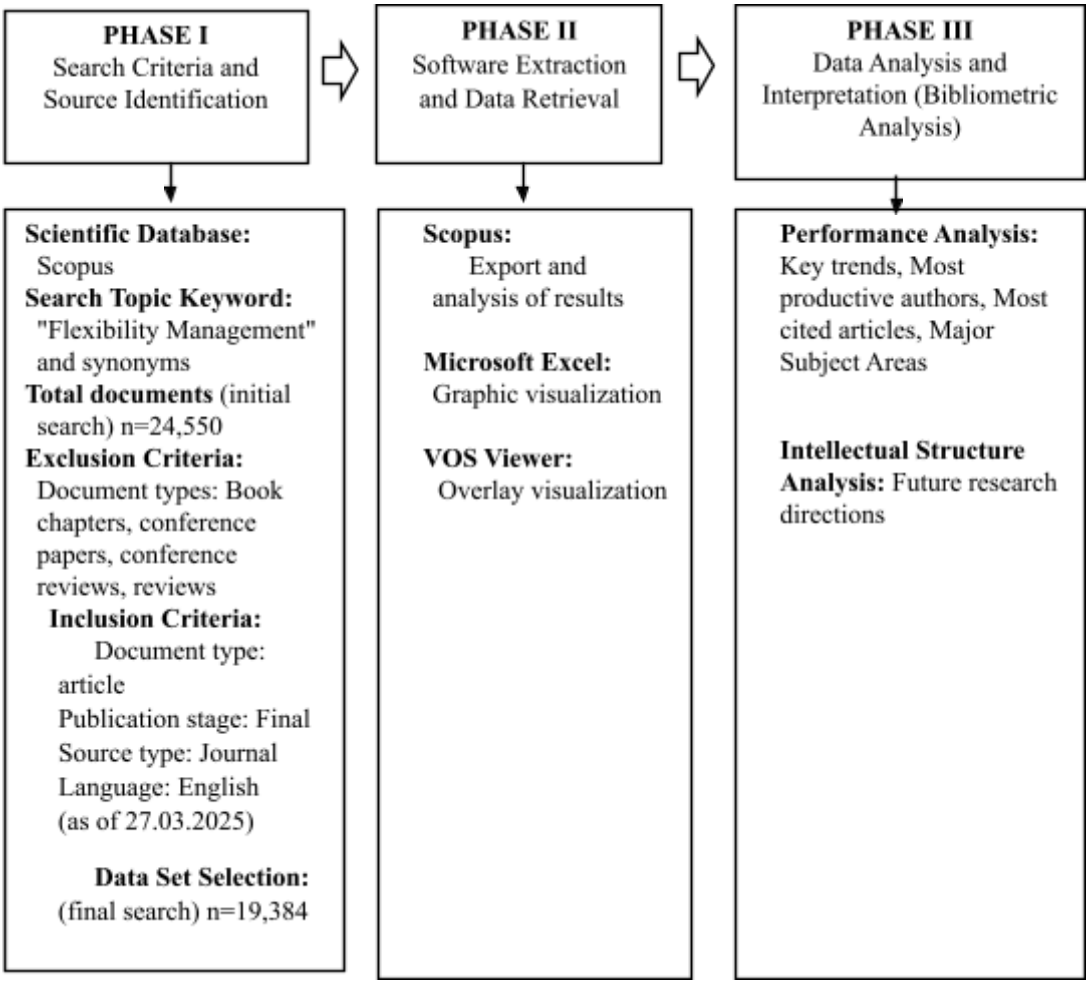

Figure 1 Design of Bibliometric Analysis Methodology
Source: (Sulistyowati, 2024; Sulistyowati et al., 2025)

RESULTS AND DISCUSSION

RQ1: What are the key trends, most productive authors, most cited articles, and major subject areas in flexibility management literature based on bibliometric analysis?

Key Trends

The bibliometric analysis of flexibility management literature from 1971 to 2025 reveals key trends in the evolution of this research domain. From 1988 to the early 2000s, publication activity remained relatively low, indicating that

flexibility management was either an emerging concept or not yet widely recognized in academic discourse. However, a significant shift occurred around 2005, marked by a sharp increase in the number of published documents. This surge suggests that flexibility management gained prominence due to technological advancements, the growing complexity of business environments, and an increasing need for adaptive strategies in various industries. The peak in research output occurred between 2018 and 2022, reflecting heightened interest and widespread exploration of the topic across multiple disciplines. Following this peak, the dataset shows a decline in publications from 2022 onwards, which may be attributed to incomplete indexing of recent works, a shift in focus towards more specialized areas within flexibility management, or the maturation of the field. Despite this potential decline, the overall trajectory highlights the increasing importance of flexibility management in addressing organizational, technological, and environmental challenges. Future research should explore emerging trends, such as AI-driven adaptability, resilience in supply chains, and sustainability-driven flexibility, to understand how the field continues to evolve in response to dynamic global challenges.

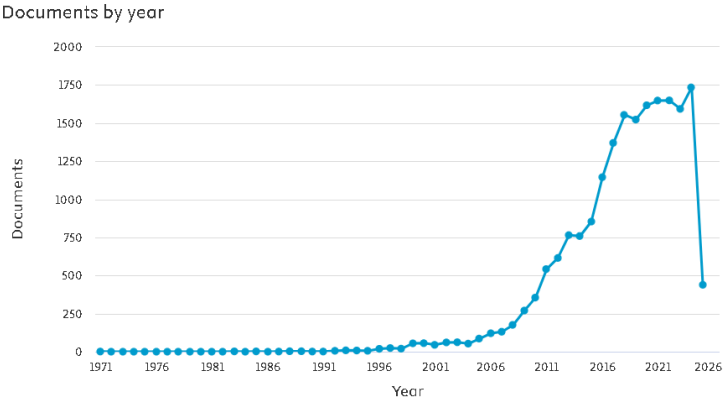

Figure 2. Key Trends in Flexibility Management (1971-2025)
Source: Scopus Database as of March 27, 2025

Most Productive Authors

Figure 3 provides insights into the most prolific researchers in flexibility management literature from 1971 to 2025. It highlights the top 10 authors based on the number of publications, showcasing their contributions to the field. Ford, J.D. leads with the highest document count, indicating a strong research presence and significant influence. Following closely is Johnson, F.A., the second most prolific author. Other notable contributors include Hobday, A.J., Runge, M.C., Pahl-Wostl, C., Williams, B.K., Nicholls, R.J., Smith, T.F., Aerts, J.C.J.H., and Derner, J.D., each demonstrating a considerable research footprint.

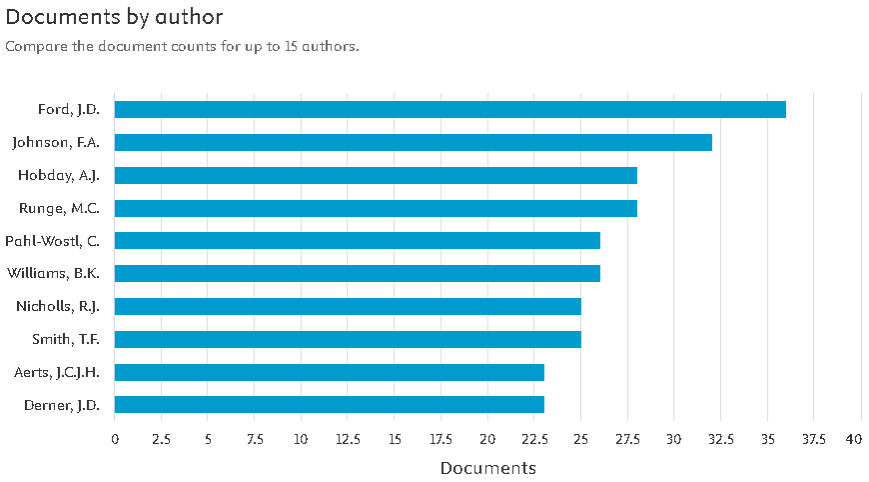

Figure 3. Ten Most Productive Authors in Flexibility Management (1971-2025)
Source: Scopus Database as of March 27, 2025

Most Cited Articles

The ten most cited articles in flexibility management from 2000 to 2025 highlight key research contributions that have shaped the field. These highly cited works focus on resilience, adaptive capacity, and risk management in response to environmental and social uncertainties. The most cited article, "Resilience: The Emergence of a Perspective for Social-Ecological Systems Analyses" (Folke, 2006), has an impressive 5,261 citations (24.20%), reflecting its foundational influence on the study of resilience in complex systems. Following this, "Influence of Extreme Weather Disasters on Global Crop Production" (Lesk et al., 2016) (2,510 citations, 11.54%) and "Global Flood Risk Under Climate Change" (Hirabayashi et al., 2013)(2,013 citations, 9.26%) underscore the growing concern over climate-related risks and their management.

Other highly cited works, such as "Ecological Resilience - In Theory, and Application" (Gunderson, 2000)(1,980 citations, 9.11%) and "Linkages Between Vulnerability, Resilience, and Adaptive Capacity" (Gallopín, 2006) (1,941 citations, 8.93%), emphasize the theoretical and practical aspects of resilience in environmental and resource management. Additionally, studies like "Future Flood Losses In Major Coastal Cities" (Hallegatte et al., 2013)(1,716 citations, 7.89%) and "Climate Change and Forests of The Future: Managing in The Face of Uncertainty" (Millar et al., 2007) (1,524 citations, 7.01%) highlight the application of flexibility management principles in urban and natural ecosystems. The inclusion of "A Conceptual Framework for Analysing Adaptive Capacity and Multi-Level Learning Processes in Resource Governance Regimes" (Pahl-Wostl, 2009) (1,549 citations, 7.12%) and "Adaptive Co-Management for Building Resilience in Social-Ecological Systems" (Olsson et al., 2004) (1,378 citations, 6.34%) further showcases the importance of governance and learning processes in enhancing adaptability.

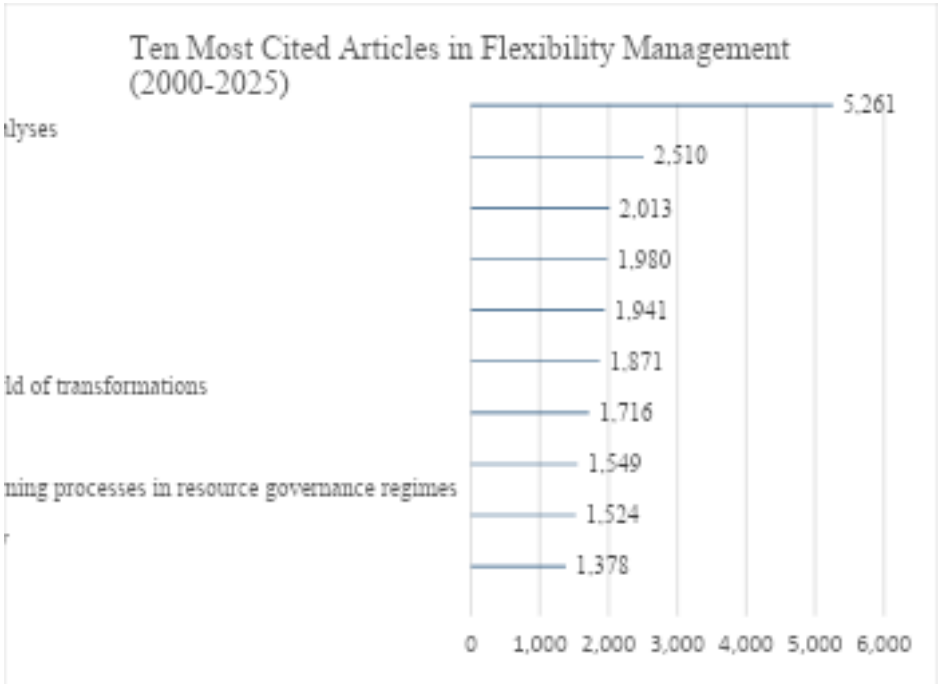

Figure 4. Ten Most Cited Articles in Flexibility Management (2000-2025)
Source: Data processed from Scopus Database as of March 27, 2025.

Overall, these articles demonstrate that flexibility management research is deeply rooted in environmental and climate-related challenges, with a strong focus on resilience, adaptation, and governance. The high citation counts of these studies indicate their significant impact on both academic research and practical applications, reinforcing the importance of flexible approaches in managing uncertainty across ecological, social, and economic systems.

Major Subject Area

Figure 5 provides insights into the distribution of flexibility management research across various academic disciplines. It highlights the interdisciplinary nature of the field, with Environmental Science (35.2%) being the most significant contributor, reflecting the importance of managing natural resources and ecosystems amid changing environmental conditions. Social Sciences (18.4%) form the second-largest segment, emphasizing the role of human behaviour, governance, and policy in managing complex, dynamic challenges. Agricultural and Biological Sciences (11.6%) also play a crucial role, particularly in ensuring sustainable agricultural practices and ecological resilience. Earth and Planetary Sciences (8.7%) contribute through research on climate systems, natural hazards, and geological processes, which are integral to developing flexible management strategies.

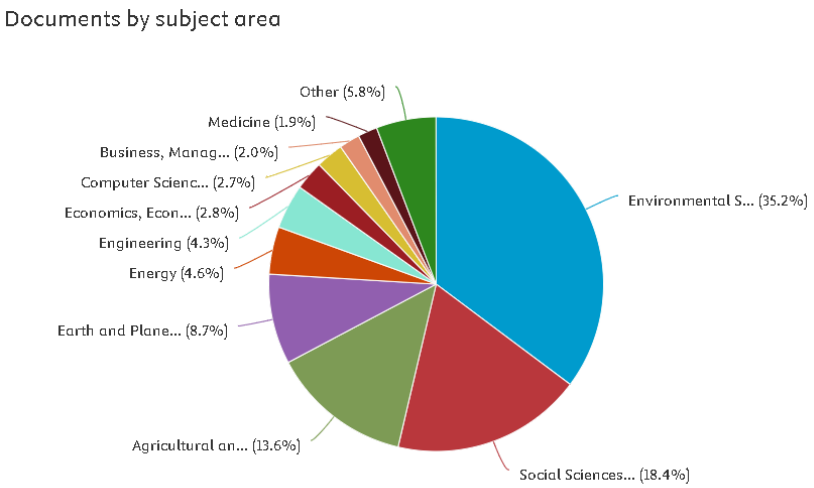

Figure 5. Documents by Subject Area
Source: Scopus Database as of March 27, 2025

The chart underscores that flexibility management is a highly interdisciplinary field, primarily driven by environmental and social science perspectives. This trend suggests that adaptability is essential in addressing global challenges such as climate change, resource management, and socio-political complexities. As the need for flexibility increases, contributions from diverse academic fields will likely continue to grow, further enriching the literature. Future research could delve into specific methodologies employed within each discipline, explore interdisciplinary collaborations, and track the evolution of subject-area contributions over time.

RQ2: How has the focus of flexibility management research evolved, and what emerging areas warrant further investigation?

The overlay visualization created using VOSviewer highlights how the focus of flexibility management research has evolved and identifies emerging areas for further investigation. Early research, represented by blue and purple nodes, primarily focused on foundational concepts such as ecosystem management, institutional frameworks, and resilience strategies, laying the groundwork for understanding flexibility in various systems. As research progressed, the mid-phase studies, indicated by green-coloured nodes, incorporated more applied concepts such as supply chain flexibility, smart grids, and automation, reflecting the increasing role of technology and strategic planning in managing dynamic environments. More recent studies, represented by yellow-coloured nodes, show a shift toward contemporary challenges, with increasing emphasis on climate change adaptation, digital transformation, artificial intelligence, and real-time decision-making. This suggests a growing recognition of the need for flexibility in addressing technological disruptions, environmental changes, and global uncertainties.

Based on these evolving trends, several emerging areas warrant further research. The integration of AI-driven flexibility management can enhance

adaptive strategies through predictive modelling and real-time system optimization. Similarly, the role of resilience in digital transformation is becoming critical, as organizations must adapt to cyber threats, technological advancements, and data-driven economies. The increasing prominence of climate change in recent research suggests the need for more studies on adaptive energy systems, sustainable infrastructure, and resilient urban planning. Additionally, interdisciplinary approaches that merge flexibility management with behavioural economics, cognitive decision-making, and social-ecological systems present new research opportunities. Moreover, as industries become more interconnected, real-time decision support systems, leveraging analytics, blockchain, and IoT, can further enhance flexibility management.

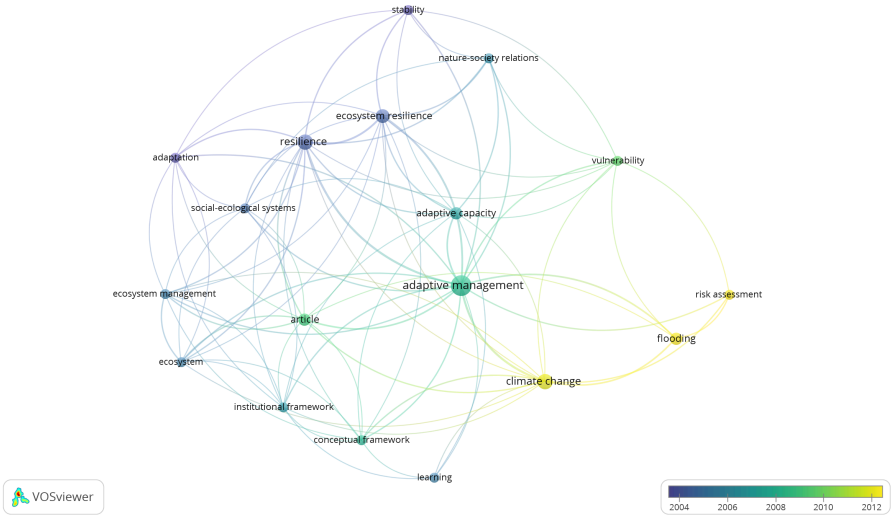

Figure 6. VOSviewer Overlay Visualization Output
Source: Data processed from Scopus Database as of March 27, 2025.

Overall, the evolution of flexibility management research reflects a transition from traditional strategic planning to more technology-driven, real-time adaptive approaches. The visualization underscores the importance of addressing emerging research gaps and providing organizations, policymakers, and industries with the necessary tools to navigate an increasingly complex and uncertain world.

CONCLUSION

The bibliometric analysis of flexibility management literature from 1971 to 2025 provides valuable insights into the field's key trends, influential authors, and major subject areas. The research trajectory highlights an initial period of low publication activity, followed by a surge in scholarly interest around 2005, driven by technological advancements and increasing organizational complexity. The peak in research output between 2018 and 2022 underscores the growing significance of flexibility management, particularly in response to climate change, supply chain disruptions, and adaptive governance. The most productive authors, led by Ford, J.D., and Johnson, F.A., have made significant contributions to the

field, further shaping its theoretical and practical applications. Highly cited articles primarily focus on resilience, adaptive capacity, and risk management, reinforcing the interdisciplinary nature of flexibility management. Environmental Science and Social Sciences emerge as dominant subject areas, reflecting the importance of managing environmental uncertainty and socio-political challenges. Additionally, the evolution of research themes, as visualized through bibliometric tools, suggests a shift toward AI-driven adaptability, digital transformation, and real-time decision-making. Future research should explore these emerging areas, emphasizing interdisciplinary collaboration and innovative methodologies to enhance flexibility management strategies in an increasingly dynamic global landscape.

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