

# Digital Transformation in Enterprise Risk Management: A Bibliometric Study and Research Trends

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## ABSTRACT

This study examines digital transformation research using bibliometric analysis, identifying key trends, collaborative networks, and thematic areas. Findings reveal that "digital transformation" is central, closely linked to "decision making," "artificial intelligence," and "risk assessment." Over time, research has shifted from broad technological advancements to domain-specific applications like healthcare and telemedicine. Co-authorship analysis highlights strong academic networks, particularly in the U.S., U.K., and China, though interdisciplinary collaboration remains a challenge. The study emphasizes the need for ethical AI governance, enhanced cybersecurity, and inclusive global research participation to ensure balanced technological progress.

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## 1. INTRODUCTION

In recent years, digital transformation has emerged as a critical driver of change across industries, reshaping traditional business models and organizational frameworks. With rapid advancements in technologies such as artificial intelligence (AI), big data analytics, blockchain, and cloud computing, enterprises are leveraging digital tools to optimize processes and enhance decision-making. Enterprise Risk Management (ERM), a strategic framework designed to identify, assess, and mitigate risks

across an organization, is no exception to this trend. Digital transformation in ERM facilitates more proactive, data-driven, and adaptive approaches to risk identification and response, ensuring resilience and sustainability in an increasingly volatile business environment [1]. As organizations face unprecedented disruptions, including cyber threats, regulatory changes, and economic uncertainties, the integration of digital technologies into ERM has become a necessity rather than an option.

Despite the increasing importance of digital transformation in risk management,

traditional ERM frameworks often rely on outdated methodologies that struggle to cope with modern complexities. Conventional risk assessment approaches, such as qualitative risk matrices and expert judgment, are limited in their ability to handle vast amounts of real-time data and evolving risk scenarios [2]. Digital technologies, on the other hand, provide organizations with predictive analytics, automated risk monitoring, and real-time reporting, enabling a more agile and responsive ERM framework. Companies that fail to embrace digital transformation in their ERM strategies risk falling behind competitors and exposing themselves to avoidable threats. Consequently, a growing body of literature is dedicated to exploring the role of digitalization in modern risk management practices, highlighting the need for further research into its implications, challenges, and best practices [3].

A bibliometric study provides a structured and quantitative approach to analyzing research trends, identifying key contributors, and mapping intellectual progress within a particular field. By applying bibliometric methods, researchers can assess the evolution of digital transformation in ERM, uncovering influential publications, prominent authors, and emerging research themes [4]. Given the fast-paced nature of technological advancements, it is crucial to understand how scholarly discourse has shaped and continues to influence the adoption of digital technologies in risk management. A comprehensive bibliometric analysis allows scholars and practitioners to identify knowledge gaps, evaluate the impact of existing studies, and forecast future research directions in this dynamic domain.

Moreover, organizations across various industries are increasingly recognizing the value of integrating digital tools into their risk management frameworks. Financial institutions, for example, leverage AI-powered fraud detection systems to mitigate cyber risks, while manufacturing firms employ IoT (Internet of Things) sensors to predict and prevent operational failures [5]. Digital risk management platforms enable

real-time threat detection, enhancing an organization's ability to anticipate and respond to risks effectively. The integration of machine learning algorithms into risk assessment models further enhances predictive capabilities, providing deeper insights into risk correlations and potential mitigations. As digital transformation accelerates, companies must align their risk management strategies with technological innovations to maintain competitive advantages and regulatory compliance [6].

The increasing complexity of global supply chains, cybersecurity threats, and regulatory requirements further underscores the necessity for digitized ERM frameworks. Digital transformation enables organizations to transition from reactive risk management approaches to proactive, predictive, and even prescriptive methodologies. Real-time data analytics, risk simulation models, and blockchain-enhanced compliance tracking provide organizations with unprecedented control over their risk landscapes. However, the successful implementation of digital transformation in ERM requires a thorough understanding of existing research trends, technological enablers, and industry best practices. A bibliometric study serves as a valuable tool to systematically assess the academic contributions in this field, offering insights that guide future research and practical applications.

Despite the growing adoption of digital technologies in ERM, there remains a lack of comprehensive studies that systematically analyze research trends in this area. While numerous studies explore individual aspects of digital transformation and risk management, there is limited bibliometric analysis that synthesizes existing knowledge to provide a holistic understanding of the field. The fragmented nature of research in digital ERM creates challenges for scholars and practitioners in identifying key themes, methodologies, and technological advancements. Without a structured analysis of existing literature, the field lacks a clear roadmap for future research directions and practical implementations.

Thus, there is a pressing need for a bibliometric study that examines the evolution of digital transformation in ERM, identifying key contributors, emerging trends, and areas requiring further exploration. This study aims to (1) analyze the growth and distribution of scholarly articles on digital ERM, (2) identify the most cited works and prominent researchers in the field, (3) map the evolution of research themes over time, and (4) highlight technological advancements that have shaped the discourse on digital ERM.

## 2. LITERATURE REVIEW

Digital transformation has revolutionized Enterprise Risk Management (ERM) by integrating advanced technologies to enhance risk identification, assessment, and mitigation processes [7]. Traditional ERM frameworks relied heavily on qualitative approaches and human expertise, often leading to inconsistencies and inefficiencies in risk management [8]. The rise of digital technologies, such as artificial intelligence (AI), big data analytics, blockchain, and cloud computing, has enabled organizations to shift towards data-driven, predictive, and real-time risk management models [8]. These technological advancements have significantly improved the agility and accuracy of ERM frameworks, allowing organizations to better anticipate and mitigate risks in a rapidly changing business environment.

Recent studies have highlighted the role of AI and machine learning in enhancing ERM processes. AI-driven risk assessment models can process vast amounts of structured and unstructured data, identifying patterns and correlations that human analysts might overlook [9]. Additionally, big data analytics allows organizations to leverage historical data and real-time insights to improve risk forecasting and decision-making [10]. Blockchain technology has also emerged as a crucial tool in ERM, providing immutable and transparent records for compliance tracking and fraud prevention [11]. These

advancements have collectively transformed ERM from a reactive function to a proactive, predictive, and prescriptive discipline.

Bibliometric studies have gained prominence as a systematic approach to analyzing research trends and intellectual structures in various domains, including digital transformation and risk management [4]. By examining citation networks, keyword co-occurrences, and author collaborations, bibliometric analysis provides valuable insights into the evolution of academic discourse in a given field. Several studies have employed bibliometric methodologies to map research trends in digital transformation, highlighting the increasing convergence of technology and management disciplines [12]. In the context of risk management, bibliometric studies have been used to assess the development of risk assessment methodologies, regulatory compliance frameworks, and emerging risk factors. However, there remains a gap in bibliometric research specifically focused on the intersection of digital transformation and ERM. While individual studies explore various aspects of digitalization in risk management, a comprehensive bibliometric analysis that synthesizes these contributions is lacking. This study aims to address this gap by systematically analyzing research trends, influential works, and emerging themes in digital ERM.

## 3. METHODS

This study employs a bibliometric analysis to systematically examine research trends in digital transformation within Enterprise Risk Management (ERM). Bibliometric analysis is a quantitative research method used to assess the development and impact of academic literature through citation analysis, co-authorship networks, and keyword mapping. Data for this study is collected exclusively from the Scopus database using a predefined set of keywords related to digital transformation and ERM. The collected dataset is processed and analyzed using VOSviewer, a widely used

bibliometric tool that facilitates the visualization of research trends, citation networks, and thematic evolution. Descriptive statistics, co-citation analysis, and

keyword co-occurrence analysis are applied to identify influential publications, prominent researchers, and emerging research themes.

## 4. RESULTS AND DISCUSSION

Table 1. Top Cited Research

Citations	Authors and year	Title
1186	[13]	The impact of digital technology and Industry 4.0 on the ripple effect and supply chain risk analytics
636	[14]	Roles of artificial intelligence in construction engineering and management: A critical review and future trends
315	[15]	Data Security and Privacy Protection for Cloud Storage: A Survey
312	[16]	Development of a risk framework for Industry 4.0 in the context of sustainability for established manufacturers
184	[17]	The dark side of generative artificial intelligence: A critical analysis of controversies and risks of ChatGPT
175	[18]	Impact of artificial intelligence on employees working in industry 4.0 led organizations
171	[19]	Digital work and organisational transformation: Emergent Digital/Human work configurations in modern organisations
167	[20]	Digital Supply Chain Twins: Managing the Ripple Effect, Resilience, and Disruption Risks by Data-Driven Optimization, Simulation, and Visibility
146	[21]	Digital systems and new challenges of financial management – fintech, XBRL, blockchain and cryptocurrencies
140	[22]	Contact tracing apps and values dilemmas: A privacy paradox in a neo-liberal world

Source: Scopus, 2025

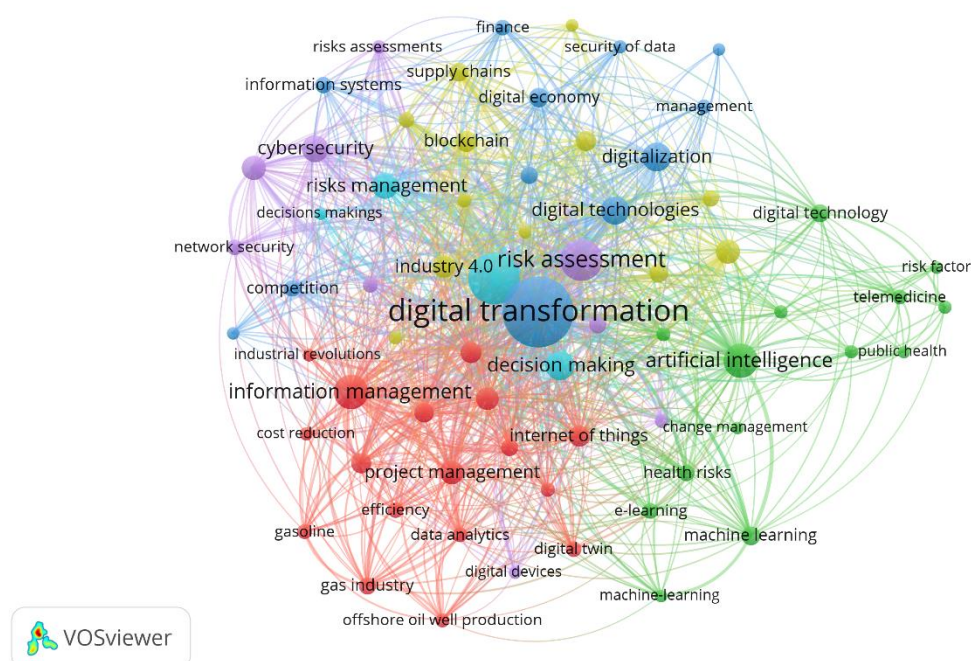


Figure 1. Network Visualization

*Source: Data Analysis Result, 2025*

The VOSviewer visualization illustrates a bibliometric network analysis of keywords related to digital transformation, financial technology, and related research domains. The size of each node represents the frequency of occurrence of a keyword, while the links between nodes indicate co-occurrence relationships. The colors denote different clusters, which suggest thematic groupings within the research landscape. The dominant keyword in the network is "digital transformation," indicating that it is a central theme around which other concepts revolve.

The red cluster in the lower-left part of the network appears to focus on themes related to project management, data analytics, and industrial applications. Keywords such as "information management," "internet of things," "digital twin," and "efficiency" suggest that this cluster is related to the practical implementation of digital transformation in industrial and corporate settings. The presence of terms like "gasoline" and "gas industry" also hints at the role of digital technologies in optimizing resource management and energy sector operations. In contrast, the blue cluster in the upper-left portion of the network is centered on cybersecurity and risk management. Keywords such as "cybersecurity," "network security," and "risk assessment" suggest a strong focus on digital security concerns, particularly in relation to digital

transformation initiatives. The presence of "finance" and "blockchain" indicates that financial technology (fintech) is also an integral part of this cluster, highlighting the increasing role of security and trust in digital financial ecosystems.

The green cluster on the right side of the visualization appears to focus on health-related applications of digital transformation. Keywords such as "artificial intelligence," "machine learning," "telemedicine," and "public health" suggest that this cluster is linked to the adoption of digital technologies in healthcare. The presence of "risk factor" and "health risks" further implies that this area of research addresses the challenges and potential dangers associated with digitalization in healthcare services. The yellow cluster, positioned toward the upper-middle section, seems to emphasize digitalization and the broader economic implications of digital transformation. Keywords like "digital economy," "digital technologies," "security of data," and "supply chains" suggest an interest in how digital innovation affects economic structures, business operations, and data security. This cluster represents the macroeconomic and strategic dimensions of digital transformation, showing the interconnectedness of technological advancements across different industries.

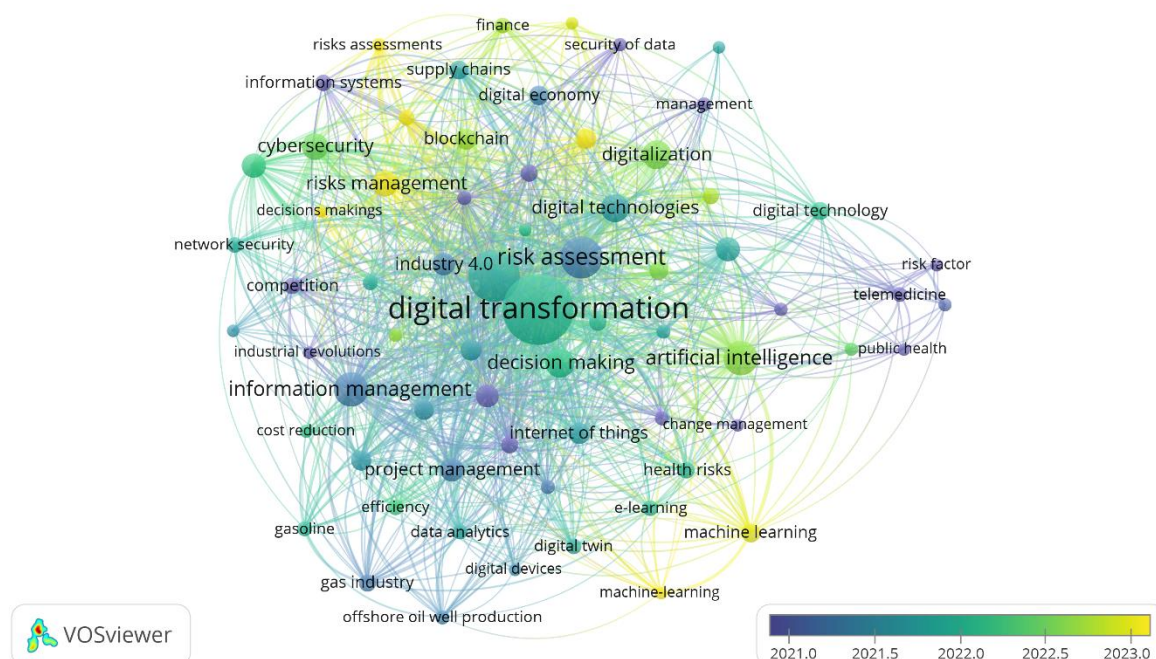


Figure 2. Overlay Visualization

Source: Data Analysis Result, 2025

The VOSviewer visualization presents a bibliometric network analysis of research keywords related to digital transformation over time. The nodes in the network represent keywords, with their size indicating frequency, while the links show co-occurrence relationships. The color gradient from dark blue (2021) to yellow (2023) represents the timeline of keyword emergence. The central and most dominant theme in the network is "digital transformation," which is interconnected with key topics such as "artificial intelligence," "decision making," "risk assessment," and "information management." This suggests that digital transformation research is evolving around these core concepts.

Clusters of keywords reveal different research domains within digital transformation. On the left, the green and blue nodes indicate topics related to cybersecurity, information systems, and risk management, which have been active since 2021. Keywords like "network security," "competition," and "industrial revolutions" suggest an early focus on securing digital ecosystems and

addressing challenges in industrial and business applications. In contrast, the yellow nodes on the right, such as "machine learning," "telemedicine," and "public health," indicate more recent research trends emerging around 2023. This highlights a shift in focus towards AI-driven healthcare applications and the increasing role of digital technology in public health.

The timeline visualization also reveals an evolution in research priorities. Earlier studies (2021-2022) were more concentrated on broad technological advancements and cybersecurity risks, as seen in keywords like "blockchain," "digital economy," and "supply chains." More recent research (2022-2023) has shifted towards specialized applications such as "machine learning," "e-learning," and "health risks," reflecting growing interest in AI integration, education, and healthcare applications. This progression suggests that digital transformation is moving from foundational technological developments to sector-specific implementations, particularly in healthcare and education.



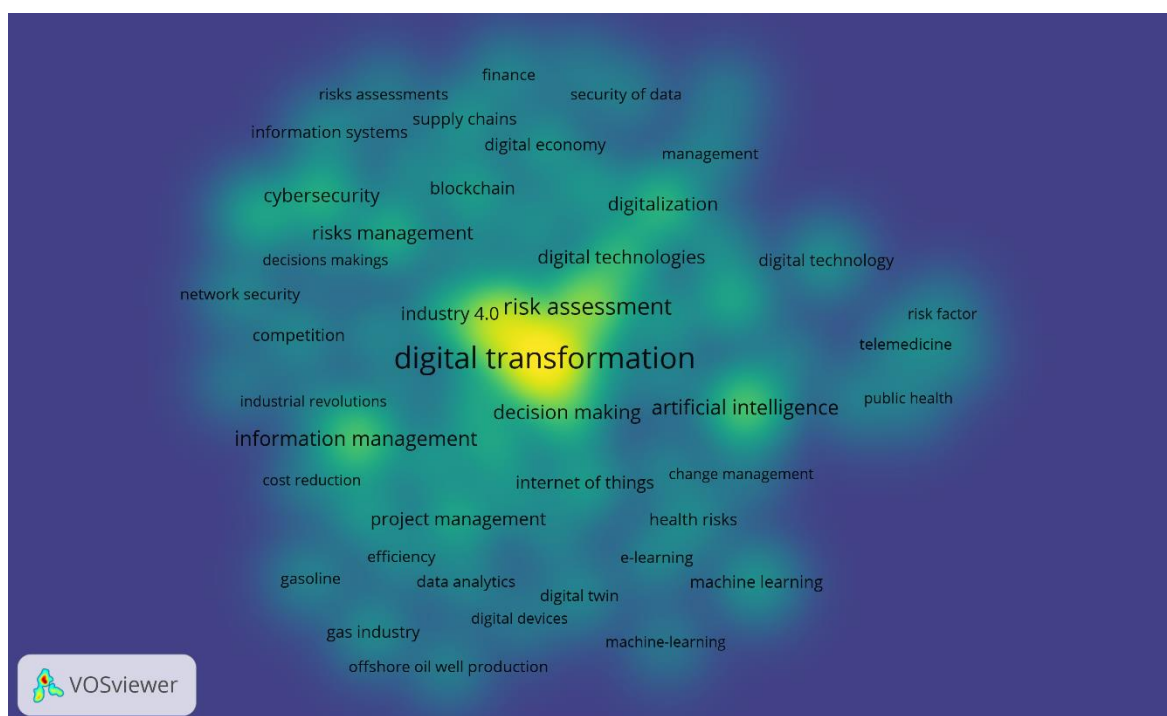


Figure 3. Density Visualization

Source: Data Analysis, 2025

The heatmap visualization from VOSviewer highlights the most frequently occurring keywords in digital transformation research. The intensity of the color represents the frequency of keyword occurrences, with bright yellow indicating the most frequently studied topics and dark blue representing less frequently mentioned ones. The central and most prominent keyword is "digital transformation," which is closely associated with "risk assessment," "decision making," and "artificial intelligence." These terms suggest that research in this field heavily focuses on assessing risks and leveraging AI for decision-making processes. Additionally, keywords such as "information management," "project management," and "internet of things" indicate significant research interest in

the technological and managerial aspects of digital transformation.

Beyond the central cluster, the heatmap reveals secondary areas of interest in cybersecurity, blockchain, and finance, which appear in the upper-left quadrant. This suggests a strong research emphasis on security measures and financial applications within digital transformation. On the right side, emerging research topics include "telemedicine," "public health," and "health risks," signifying an increasing interest in applying digital technologies in healthcare. The distribution of heat across different areas of the map indicates a well-balanced research landscape, with a strong foundation in core digital transformation themes and growing attention to specialized applications such as AI-driven healthcare and cybersecurity.

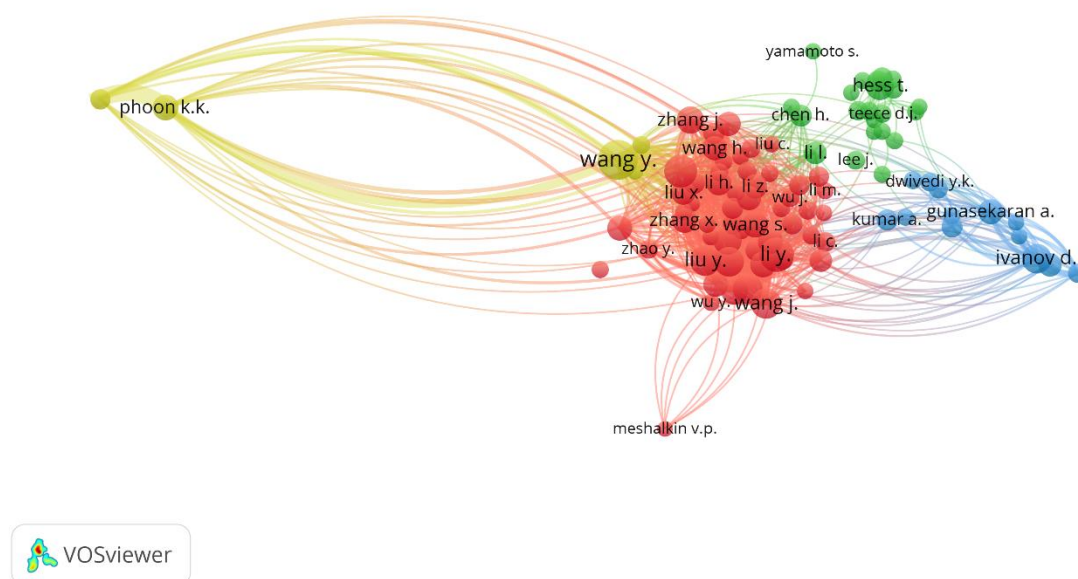


Figure 4. Author Collaboration Visualization

Source: Data Analysis, 2025

The VOSviewer visualization represents a co-authorship network, where nodes signify authors, and links indicate collaboration between them. The different colors correspond to clusters of researchers who frequently collaborate. The central red cluster contains highly interconnected authors, with "Wang Y.," "Liu Y.," and "Li Y." appearing as key contributors with multiple co-authorship connections. This suggests a strong collaboration network among these researchers. The yellow cluster, led by "Phoon K.K.," is less connected to the central cluster

but still maintains ties, indicating a semi-independent research stream. The green and blue clusters, including authors like "Hess T.," "Teece D.J.," and "Ivanov D.," represent distinct research groups that are somewhat connected to the main body but operate in specialized subfields. The distribution of authors suggests that while certain researchers dominate collaborations in this field, there are also smaller, specialized research groups contributing to the broader academic discourse.



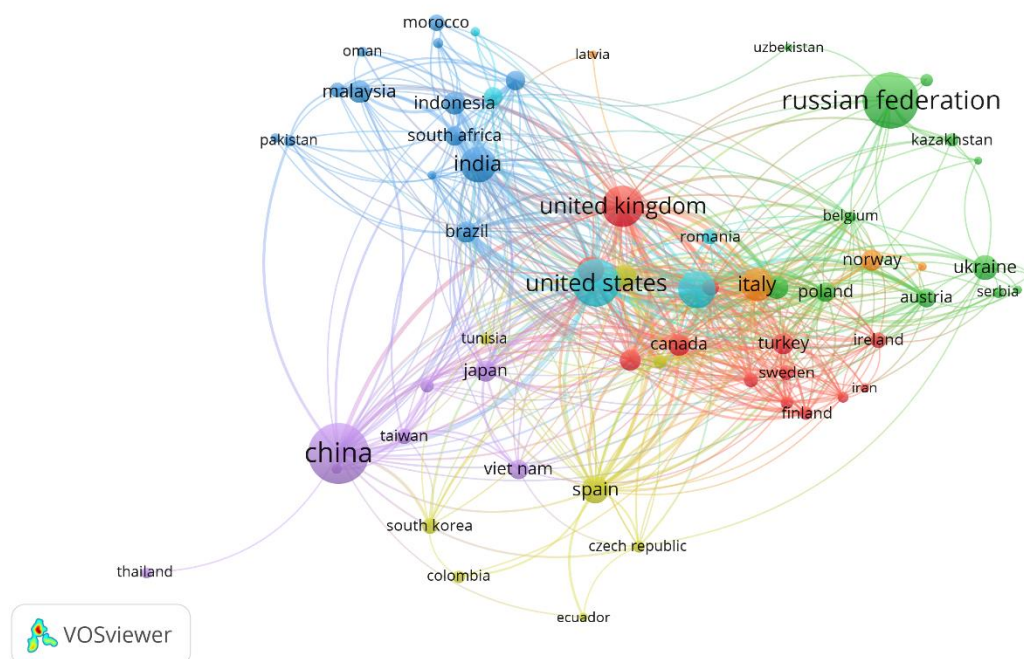


Figure 5. Country Collaboration Visualization

Source: Data Analysis, 2025

The VOSviewer visualization represents a co-authorship network between countries, where nodes signify nations, and the links indicate collaborative research efforts. The size of the nodes reflects the volume of research output, while the colors denote different clusters of countries that frequently collaborate. The United States, United Kingdom, and China appear as dominant research hubs, connecting with multiple countries across different regions. The Russian Federation also forms a distinct cluster with collaborations extending to Eastern European and Central Asian countries such as Ukraine, Kazakhstan, and Poland. Similarly, India, Indonesia, and Malaysia form another highly interconnected group, indicating strong regional academic cooperation. Spain and Italy act as important bridges between European and Latin American research networks.

## Discussion

### 1. Thematic Trends in Digital Transformation Research

The bibliometric analysis highlights the growing scholarly interest in digital

transformation, with significant research clustering around themes such as artificial intelligence (AI), risk assessment, cybersecurity, and financial applications. The keyword co-occurrence network suggests that "digital transformation" is the central concept, surrounded by related terms such as "decision making," "information management," and "artificial intelligence." This indicates that researchers have increasingly focused on integrating digital technologies into decision-making processes across various industries. The presence of terms like "blockchain," "cybersecurity," and "risk management" reflects the increasing awareness of digital security challenges and the need for robust risk assessment mechanisms in digital transformation initiatives.

The temporal analysis of research keywords further reveals a shift in scholarly focus over time. While earlier research emphasized broad topics like "blockchain," "digital economy," and "supply chains," more recent studies have explored applications in specific domains such as "telemedicine," "public health," and "machine learning." This trend signifies a maturation of digital

transformation research, moving from theoretical explorations to practical implementations in healthcare, education, and industrial automation. The increasing prominence of AI-driven solutions, as indicated by the frequent occurrence of "machine learning" and "artificial intelligence," suggests that automation and predictive analytics are becoming key components of digital transformation strategies.

## 2. Collaboration Networks Among Researchers

The co-authorship network analysis demonstrates that digital transformation research is characterized by clusters of highly interconnected scholars. The largest cluster, dominated by authors such as "Wang Y.," "Liu Y.," and "Li Y.," indicates a strong research community centered on digital innovation. These scholars have formed extensive collaboration networks, contributing significantly to knowledge production in this field. The presence of smaller, yet distinct, research groups—such as the one led by "Phoon K.K."—suggests that while certain researchers dominate the discourse, smaller specialized teams are also making notable contributions.

Interestingly, the visualization shows that some research groups are less connected to the main academic network. This could indicate the existence of regional or disciplinary silos, where scholars work within their specific domains without significant interdisciplinary collaboration. Future research efforts should aim to bridge these gaps by encouraging cross-disciplinary partnerships between cybersecurity experts, financial analysts, healthcare researchers, and AI specialists. Such interdisciplinary collaborations could lead to more comprehensive digital transformation frameworks that address the multifaceted challenges associated with technological advancements.

## 3. Global Research Collaboration Patterns

The country-level co-authorship network highlights the dominance of a few key nations in digital transformation research. The United States, the United Kingdom, and China emerge as central nodes, facilitating extensive international collaborations. This suggests that these countries not only contribute a significant volume of research but also act as global hubs for academic partnerships. The presence of well-connected countries like Spain, Italy, and India further indicates that digital transformation research is not confined to a single region but has gained traction worldwide.

The distinct clusters in the visualization also reveal regional research alliances. For instance, the Russian Federation has strong ties with Eastern European and Central Asian countries, while India, Indonesia, and Malaysia form another closely-knit research group. Such regional clustering suggests that geographical proximity and shared economic interests influence research collaborations. However, the relatively lower connectivity of African and South American countries indicates that these regions may have less participation in digital transformation research. Encouraging greater international cooperation, particularly with emerging economies, could foster a more inclusive global research landscape.

## 4. Implications for Future Research and Policy

The bibliometric findings provide valuable insights into future research directions and policy considerations for digital transformation. First, the increasing focus on AI and machine learning suggests that future studies should explore the ethical and regulatory implications of these technologies. Issues such as bias in AI decision-making, data privacy, and algorithmic transparency must be addressed to ensure responsible digital transformation. Second, the strong emphasis on cybersecurity and risk management highlights the need for enhanced digital security frameworks. Given

the rising threats of cyberattacks and data breaches, researchers and policymakers must collaborate to develop robust security protocols. This is particularly relevant for financial institutions, healthcare providers, and government agencies that handle sensitive digital information. Third, the emergence of healthcare-related keywords like "telemedicine" and "public health" underscores the transformative potential of digital technologies in medical services. Future research should focus on evaluating the effectiveness of digital health interventions, identifying barriers to adoption, and proposing strategies for integrating AI-driven diagnostics into mainstream healthcare systems. Finally, the disparities in global research collaboration call for increased efforts to integrate underrepresented regions into the digital transformation discourse. Initiatives such as international funding programs, joint research projects, and academic exchange programs could facilitate knowledge sharing and enhance the participation of developing countries in digital transformation research.

## 5. CONCLUSION

The result of bibliometric analysis illustrates the evolving landscape of digital transformation research, highlighting key thematic trends, collaboration networks, and global research patterns. The centrality of AI, risk assessment, and cybersecurity in digital transformation studies underscores the importance of these topics in shaping future technological advancements. Furthermore, the strong co-authorship networks among leading scholars and countries suggest that digital transformation is a highly collaborative and interdisciplinary field. Despite significant progress, challenges remain, particularly in terms of ensuring equitable global participation in research and addressing emerging ethical concerns related to AI and data security. By fostering greater collaboration, encouraging cross-disciplinary research, and prioritizing ethical considerations, the field of digital transformation can continue to drive meaningful innovations that benefit both industry and society.

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