Exploring the Intersection of Innovation and Digital Transformation: A Bibliometric Analysis of Agile Leadership

Aini Mas Idha[1*], Sumartono[2], Firda Hidayati[3], Ainul Hayat[4]
[*]aincyl73@gmail.com

Faculty of Administrative Science, Brawijaya University, Malang, Indonesia[1,2,3,4]

Abstract. This research aims to examine the relationship between innovation and digital transformation, which has given rise to the current structure of agile leadership. The study uses a comprehensive dataset from the Scopus scientific database. A total of 282 articles published between 2014 and 2024 were analyzed using bibliometric meta-analysis with R-Bibliometrix software and VOSviewer, an open-source bibliometric analysis program. The main results show an increasing trend in the number of publications and citations, impact factors, author-country networks, and the formation of six related thematic clusters. The intersection between innovation and digital transformation is agile leadership, which has emerged due to increased agility and leadership. The novelty of this research is the absence of studies that critically examine the literature on agile leadership. This research provides guidance on how organizations implement innovation and digital transformation to build agile leadership, and provides valuable insights for scholars, researchers, and stakeholders.

Keywords: agile, agility, digital transformation, innovation, leadership

1. Introduction

Innovation is very important for organizations to remain competitive and relevant. Traditional organizational structures often become obstacles, limiting the ability to respond to dynamic conditions effectively [1]. Conditions of Volatility, Uncertainty, Complexity, and Ambiguity (VUCA) demand that organizations, including governments, be more responsive, flexible, and adaptable in managing crises and meeting evolving needs effectively. Innovation is closely related to digital transformation because both involve the use of new technologies to improve processes, products, and services.

Innovation often becomes a catalyst for digital transformation. Companies that foster a culture of innovation are more likely to identify and implement the digital solutions needed to improve their operations and customer engagement. Digital transformation is an organization-wide initiative aimed at adopting digital technologies to improve processes and stakeholder experiences [2]. The basis of digital transformation includes external and internal factors. Externally, organizations seek outside resources to digitize and gain a competitive edge, while internally, they concentrate on effectively integrating innovation into their organizational frameworks [3]. This transformation is driven by core technologies such as AI, machine learning, big data, cloud computing, and social media, which enable the digitization of existing components and optimize performance. In addition, digital transformation can drive innovation by creating new opportunities for businesses to develop a competitive advantage. This encourages companies to rethink their strategies and operations, fostering a culture that supports

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continuous improvement and adaptation [4]. Agile originated in 2001 as a strategy for managing software development projects [5]. The core principles of agile leadership include (a) dividing tasks into small teams, (b) fostering a network-oriented approach with partners, and (c) focusing on customers [6].

Although extensive literature exists on innovation, digital transformation, and agile leadership individually, there is a significant gap in understanding how these concepts are interconnected. Analyzing the intersection of these areas can offer a holistic view of how organizations can leverage agile leadership to drive innovation and digital transformation. Organizations can adopt various approaches to agile leadership, innovation, and digital transformation, leading to inconsistencies in outcomes [7]. Bibliometric analysis can help identify trends, methodologies, and frameworks that have proven effective, allowing practitioners to learn from existing research. A systematic review through bibliometric analysis will help capture the most relevant and impactful research themes, methodologies, and contributions in this interdisciplinary arena [8]. There is a need for empirical studies that explore the mechanisms by which agile leadership influences these elements to help organizations implement strategic initiatives effectively. This leads to the research questions:

1. What are the publication trends?
2. Who are the most influential authors and publications?
3. Which journals are the most influential?
4. Which countries are the most influential?
5. What are the distribution trends of innovation and digital transformation related to agile leadership?

This paper is structured as follows: Section 2 explains our literature review. Section 3 describes our methodology, including the research design, data collection, and data cleaning from Scopus for bibliometric analysis. Section 4 presents the results of our analysis, offering insights into the intersection of innovation and digital transformation, which results in the currently structured agility and leadership. In Section 5, we engage in a comprehensive general discussion, exploring the implications of our findings on the important roles of agility and innovation in driving Agile Leadership and the limitations of our research; we also outline potential avenues for future research. Finally, in Section 6, we summarize our main findings and their broader significance in the evolving landscape of Agile Leadership.

2. Literature Review

2.1. Review of Innovation and Digital Transformation

Innovation encompasses various frameworks and perspectives that seek to explain how new ideas, products, and processes are developed and implemented within organizations and society [9]. One of the main aspects of innovation theory is understanding how innovation can generate competitive advantage and organizational change. This involves examining the processes by which innovation is generated, disseminated, and adopted [10]. Innovation often highlights the role of creativity, knowledge, and resources in driving innovation. It also explores the impact of external factors, such as market demand and technological advancements, on the innovation process. In addition, innovation theory considers the organizational structures and cultures that support or hinder innovation, emphasizing the importance of leadership and strategic alignment in driving successful innovation initiatives. Innovation is the process of creating new ideas, products, services, or processes that bring value or improvement to existing systems. It involves applying creativity and new thinking to solve problems, meet new requirements, or address unarticulated needs. Innovation can occur gradually, through

incremental improvements, or radically, through disruptive changes that significantly alter industries or markets.

The theory of digital transformation explores how organizations integrate digital technology to fundamentally transform their operations, culture, and customer interactions [11]. This theory emphasizes the dual nature of digital transformation as both an exogenous and endogenous phenomenon. Exogenously, companies leverage external technological advancements to gain a competitive edge. Endogenously, they focus on incorporating these innovations into their organizational structures to increase efficiency and responsiveness [3]. Core technologies driving digital transformation include AI, machine learning, big data, cloud computing, IoT, and social media. These technologies enable the digitization of existing components, optimize performance, and transform processes into data-driven operations. Successful digital transformation requires aligning these technologies with the external environment and internal organizational needs, driving a multi-level organizational revolution [12]. In the context of digital transformation, innovation plays a vital role as organizations seek to leverage new technologies to improve their operations, enhance customer experiences, and gain a competitive advantage. This often requires rethinking traditional business models and adopting new strategies that align with technological advancements. Innovation is not limited to technology but also includes changes in organizational culture, processes, and leadership approaches to foster an environment that supports continuous improvement and adaptation.

2.2. Review of Agile Leadership Theory

The evolution of leadership theory has progressed through various stages, reflecting changes in organizational needs and social values. Initially, leadership theories focused on traits and behaviors, such as the Great Man Theory [13] and Trait Theory [14], which emphasized the inherent qualities of leaders. As understanding evolved, behavioral theories emerged, highlighting the importance of leaders' actions and styles, such as autocratic, democratic, and laissez-faire leadership. Various leadership styles have evolved over the past few decades, and this process continues today. As we move rapidly towards the future, we must realize that many of our beliefs and strategies regarding business activities and operations are around 50 years old, making them obsolete.

The evolution of leadership styles has been influenced by the need to adapt to complex business environments and the demands of digital transformation. Traditional leadership styles, such as autocratic and transactional, have given way to more participatory and empowering approaches such as democratic, servant, and transformational leadership [3, 15]. These modern styles emphasize high engagement, collaboration, and alignment of goals between leaders and employees. In the context of digital transformation, the concept of digital leadership has emerged. This style combines technological capabilities with the traits of building trust and self-sacrifice found in transformational leaders. Digital leaders are expected to follow technological trends, determine the direction of digital change, and effectively communicate the necessary changes to their teams [10]. Agile leadership, in particular, has been highlighted for its ability to prevent employee frustration and disconnection during digital transformation by emphasizing agile values, principles, and employee empowerment.

3. Methodology

Bibliometric analysis is a quantitative research method used to evaluate and analyze academic literature and publications in a particular field or on a specific topic [16, 17]. It uses statistical tools to assess various aspects of published works, such as publication volume,

citation patterns, authorship trends, journal impact, and the relationships between various research outputs. In recent years, bibliometrics has gained significant popularity due to its ability to categorize bibliographies and create representative summaries of key findings [8]. The first stage was marked by the theoretical foundation to better understand the aspects and concepts of innovation and digital transformation. We read several articles to understand the terms that could be used in more detailed research. We chose to compile the following keywords: (("innovation" OR "digital transformation") AND ("agility" OR "leadership") OR ("agile leadership")), and we used these in the Scopus database. We chose the Scopus scientific database because it is a comprehensive database that presents articles published by relevant journals worldwide. In the first collection, without filtering, we selected 433 results.

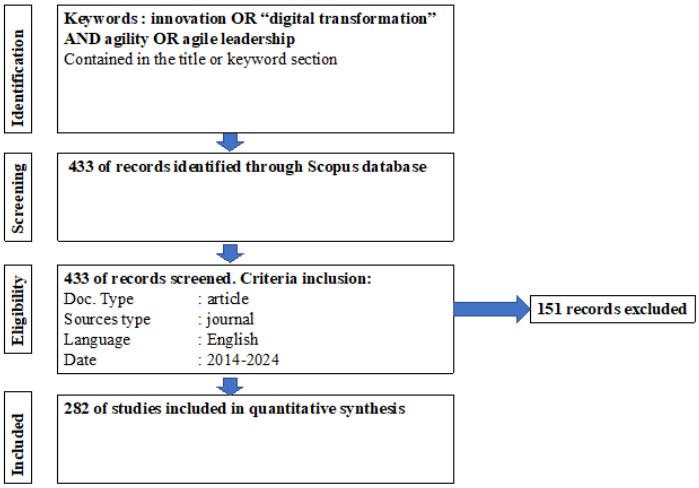

Figure 1. Preferred reporting items for systematic review and meta-analysis (PRISMA)
Source: Author's own creation.

For these 433 documents, a more specific verification process was carried out regarding the scope of each article, especially by reading the title, keywords, and abstract. In cases of doubt, we conducted a full reading to ensure that the research scope aligned with what we wanted to study. After this verification, 282 articles remained, and these were considered as the sample to be exported for analysis in R and Vosviewer software. VOSviewer is a software tool used to visualize and analyze bibliometric networks. VOSviewer, an extension of VOS, was introduced by van Eck and Waltman (2007) as a new method for mapping and visualizing similarities between objects [18]. We used the VOSviewer tool to analyze metadata, a process that primarily identifies words/phrases relevant to the frequency of occurrence, co-occurrence, relevance, and dominance. In addition, R and VOS Viewer were used given their functions in creating data visualizations in the form of maps of publications, countries, citations, and keywords [8, 19, 20]. In addition, R and VOS Viewer are software that can help researchers in data mining, database mapping, authorship, and article grouping [16]. VOSviewer identifies words/phrases from metadata and displays them as items or nodes in a two-dimensional space.

The VOSviewer map file is used to generate visualizations of bibliometric data/metadata extracted from the database. We used the VOSviewer visualization map file for analysis. Generally, it consists of three stages: database selection, data collection and cleaning, and data analysis. In the data collection and cleaning step, we used the PRISMA (Preferred Reporting

Items for Systematic Reviews and Meta-Analyses) method. PRISMA, as shown by previous bibliometric studies such as [21, 22], plays an important role in ensuring data validity and reliability. The screening and eligibility stages, for example, guarantee data validity by examining their compliance with exclusion and inclusion criteria. The research process is presented in Figure 1.

4. Results

4.1. Publication Trends

The publication trends related to agile leadership show a clear upward trajectory from 2014 to 2023, indicating an increasing interest in and recognition of the importance of agile methodologies in leadership practices. This reflects the fact that a decade ago, publications related to innovation, digital transformation, and agile leadership were still rare and have increased rapidly since 2020. The initial scarcity of publications related to innovation, digital transformation, and agile leadership can be attributed to several factors.

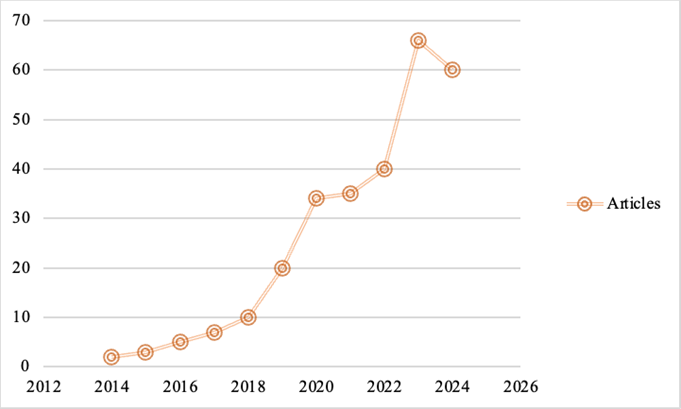

Figure 2. Publication trends
Source: Author's own creation.

These concepts were still emerging in the early years within academic and organizational frameworks. Many traditional management practices dominated the discourse, leading to slower adoption of new methodologies and frameworks that emphasized agility and innovation [23]. In addition, early research may have focused more on basic theories, leaving less room for contemporary concepts that combine technology with leadership practices.

The number of articles continued to increase over time, with a significant jump, especially between 2018 and 2019, when publications jumped from 10 to 20. This trend continued sharply until 2020 and 2021. However, in 2023, interest in agile leadership peaked, with 66 significant articles published, underscoring the growing importance of this topic among scholars and practitioners. In 2024, a slight decrease to 60 articles indicates a potential stabilization in publication rates, signaling a maturation phase in the exploration of agile leadership. The sustained interest over the past decade is likely driven by the increasing complexity of modern organizations and the urgent need for adaptive leadership. This need underscores the importance of the topic. As more organizations adopt agile practices, the body of knowledge surrounding agile leadership will continue to grow, with implications for both theoretical frameworks and practical applications in leadership development [24].

However, since 2020, the rapid acceleration of digital transformation triggered by the COVID-19 pandemic has fundamentally changed the way organizations operate [25]. As businesses were forced to adapt to remote work, changing consumer behavior, and economic uncertainty, there was an urgent need for more innovative and agile leadership and management approaches [26]. This environment drove a surge in research and publications as academics and practitioners sought to understand and document successful strategies and frameworks. The increased visibility and relevance of these topics, along with a significant increase in scientific contributions, signals a promising future for the evolution of innovation, digital transformation, and agile leadership in today's fast-paced world.

4.2. Most Cited Documents

The most cited publication during the research period was "Building Dynamic Capabilities for Digital Transformation: An Ongoing Process of Strategic Renewal" by Warner & Wager (2019). This research explores the strategies and capabilities necessary for organizations to successfully navigate the digital transformation and innovation ecosystem, emphasizing strategic agility, the importance of digital ecosystems, and the need to redesign organizational structures to enhance agility and innovation [27]. The text also highlights the importance of digital maturity, the impact of disruptive technologies, and the need for business model innovation. Through various case studies, the document illustrates how traditional companies develop dynamic capabilities to adapt to the digital landscape, focusing on cultural transformation, strategic renewal, and balancing traditional values with new digital initiatives. Incumbent companies in traditional industries use several key strategies to adapt to digital transformation: (1) Strategic Renewal of Business Models: Companies refresh their established product-based business models by integrating the logic of digitization, (2) Building Dynamic Capabilities: Companies focus on building dynamic capabilities that enable them to leverage digital technologies for innovation and rapid responsiveness. This involves balancing innovation capabilities with existing practices and ensuring flexibility in governance structures, (3) Collaborative Approaches: Digital transformation often involves adopting new collaborative approaches.

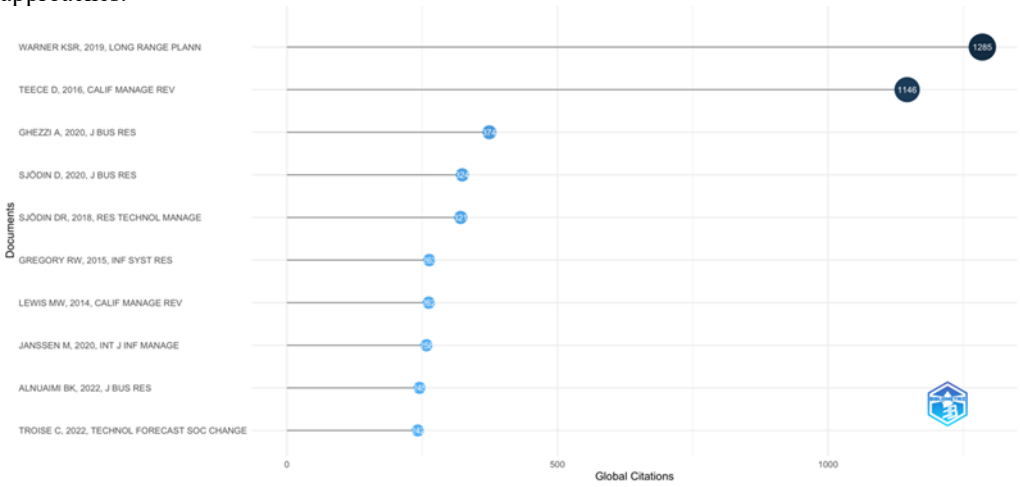

Figure 3. Most influential cited documents
Source: Author's own creation, with R-Bibliometrix

This can mean replacing traditional operations with more collaborative models, which can lead to changes in organizational culture, (4) Experimentation and Reinvention: Digitization provides a platform for experimentation, allowing companies to reinvent their business models. This can involve rethinking value propositions, reconfiguring value delivery models, and creating new digital businesses, (5) Agility as a Core Mechanism: Agility is recognized as a core mechanism for strategic renewal of business models, collaborative approaches, and organizational culture. This continuous process uses new digital technologies to enhance customer experiences and streamline operations. These strategies collectively help incumbent companies navigate the complexities and uncertainties introduced by digital transformation. There are several other highly cited studies in Warner & Wager (2019) that can be analyzed in more detail in other research. There are several other cited studies that discuss innovation, digital transformation, and agile leadership [7, 9, 11, 28-32].

4.3. Most Influential Journals

H-Index and G-Index, as bibliometric measures, play a unique role in measuring the productivity and citation impact of a researcher or journal [33]. The H-Index, by identifying the highest number (h) such that (h) publications have at least (h) citations each, effectively balances quantity with citation quality. In contrast, the G-Index, by giving more weight to highly cited articles, provides a broader view of a researcher's or journal's impact. It does this by identifying the highest number (g) such that the top (g) articles receive at least (g^2) citations in total, thus highlighting cases where several publications have a very high number of citations [33]. The data presented displays several journals and their total citations, H-index, and G-index, providing insight into their academic influence and research productivity. For example, the Journal of Business Research leads the list with 1,801 citations and an H-index and G-index of 11, indicating consistent and impactful research articles.

Table 1. Most influential journals

Journal Name	Total Citations	H_Index	G_Index
1. Journal of Business Research	1801	11	11
2. IEEE Transactions on Engineering Management	299	7	11
3. Journal of Product Innovation Management	383	6	8
4. California Management Review	1568	5	8
5. International Journal of Production Economics	482	5	5
6. Technological Forecasting and Social Change	345	5	6
7. Administrative Sciences	27	3	5
8. Global Journal of Flexible Systems Management	94	3	3

9. Gruppe. Interaktion. Organisation. Zeitschrift Fur Angewandte Organisationspsychologie	21	3	4
10. International Journal of Information Management	327	3	3

Source: Author's own creation.

This shows that many articles published in this journal are well-received and widely cited in academic literature. In contrast, IEEE Transactions on Engineering Management, with fewer total citations at 299, presents a noteworthy G-index of 11, indicating that its most cited articles receive substantial recognition, enhancing its perceived impact in the field. On the other hand, journals such as Administrative Sciences and Global Journal of Flexible Systems Management, with lower H-index and G-index values, reflect a more moderate level of citation impact and research productivity. However, these values also indicate potential for future growth and impact, suggesting that they may be emerging journals or focused on specific topics [33]. Overall, this data enables a comparative analysis of the effectiveness and influence of these journals, providing insight into their contributions within the broader context of business and management research.

4.4. Visualization of Country Scientific Production Publications

The United Kingdom (UK) emerges as the most influential region; this excellence can be attributed to the UK's strong academic infrastructure, substantial funding for research initiatives, and a dynamic collaborative ecosystem between universities, industry, and government that drives innovative studies. Other significant contributors include Brazil and Italy, which show publications alongside the US. The presence of these countries at the top level of scientific production indicates a growing global interest in how agile leadership is influenced by innovation and digital transformation, showing that scholars in various contexts are actively contributing to this evolving dialogue. The reasons for the scientific production figures from these countries can be attributed to several interconnected factors.

For example, the UK's well-established research institutions, such as universities renowned for their contributions to management and technology studies, have positioned it at the forefront of scientific discourse. In developing countries like Indonesia and India, there is a noticeable increase in focus on digital innovation and agile methodologies as these countries seek to enhance their competitiveness in an increasingly globalized global economy [34].

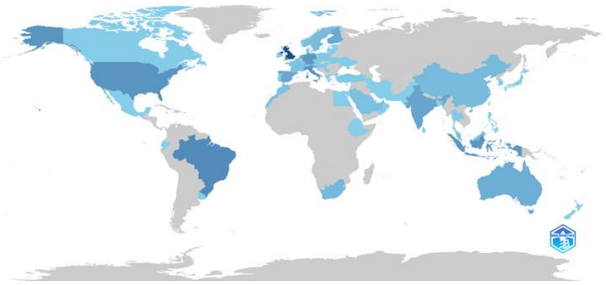

Figure 4. Visualization of country scientific production publications
Source: Author's own creation, with R-Bibliometrix

In addition, countries such as Germany, the Netherlands, and Finland also map this discussion, as they are known for their forward-thinking approach to digital transformation and innovation leadership [35]. Collectively, the representation in this data illustrates how countries at various stages of economic and technological development interact with the themes of agile leadership, reflecting local challenges and priorities as they adapt to the demands of the digital era [1].

Table 2. Mapping of publication frequency with themes of innovation, digital transformation, and agile leadership by country

Region	Frequency Production
UK	128
Brazil	64
Italy	55
USA	55
Indonesia	52
Germany	51
India	38
Netherlands	37
Spain	37
Finland	35

Source: Author's own creation.

This bibliometric analysis, which focuses on the intersection of innovation and digital transformation that produces the currently structured agile leadership, shows various contributions from various countries related to scientific production [16]. The UK stands out as a leading contributor with 128 publications, indicating a strong research environment and significant investment in understanding the dynamics of innovation and digital transformation of agile leadership. Following the UK, Brazil, Italy, and the US show significant production with 64, 55, and 55 publications respectively (see Figure 4 and Table 1). This distribution of scientific output illustrates the increasing interest in these themes across various geographical regions, highlighting the global relevance of agile leadership as organizations increasingly adapt to rapid technological changes and the need for innovation.

The reasons behind the influence of certain countries in this scientific production can be attributed to several factors. First, well-established academic institutions and research funding in the UK foster an environment conducive to high-quality research output [36]. Similarly, countries like Brazil and Italy, which are very active in innovation and digital transformation, reflect regional priorities and collaborative efforts that enhance their visibility in international research [35]. In addition, the involvement of developing countries like Indonesia and India, which have a notable number of publications, indicates their increased engagement in the global discussion surrounding agile leadership and transformation in the digital landscape. As digital transformation continues to permeate various sectors worldwide, the contributions of these countries signify a collective movement towards understanding and implementing effective leadership practices that align with agile methodologies, ultimately influencing the broader scientific discourse in this field [27].

4.5. Distribution Trends of Innovation and Digital Transformation Related to Agile Leadership

Cluster 1 (Green). Concepts related to agile methodology and leadership, including "agile organization", "agile leadership", and "digital transformation" [37, 38]. This cluster is centrally connected to the keyword "innovation", indicating a strong emphasis on understanding how agile approaches contribute to and are driven by innovation. These findings highlight the growing interest in researching the intersection of agile practices with innovative thinking and how these concepts shape the future of leadership in organizations.

Cluster 2 (Yellow). Focuses on digital technology and its implementation, such as "artificial intelligence", "digital storage", and "agility". It is connected to "digital transformation" and "innovation." The yellow cluster in the bibliometric analysis highlights the important role of digital technology and its implementation in driving innovation and digital transformation. Keywords such as "artificial intelligence", "digital storage", and "agility" are connected to "digital transformation" and "innovation", indicating that these technologies are seen as essential to facilitate the adoption of new digital practices and the creation of new ideas and solutions [37]. This cluster underscores the important relationship between technological advancements and the broader pursuit of innovation in the field of study.

Cluster 3 (Blue). Shows concepts related to strategy, including "strategy", "competitive advantage", and "information technology". They are more connected to "digital transformation" and the green cluster. The blue cluster in the bibliometric analysis focuses on strategic considerations related to digital transformation, emphasizing the importance of "strategy", "competitive advantage", and "information technology". This cluster is more strongly related to "digital transformation" and the green cluster representing agile methodologies and leadership, indicating that strategic thinking is increasingly related to the adoption of agile practices and the implementation of digital technologies [24]. This suggests that successful digital transformation requires a strategic approach that leverages agile methodologies and harnesses the power of information technology to gain a competitive advantage.

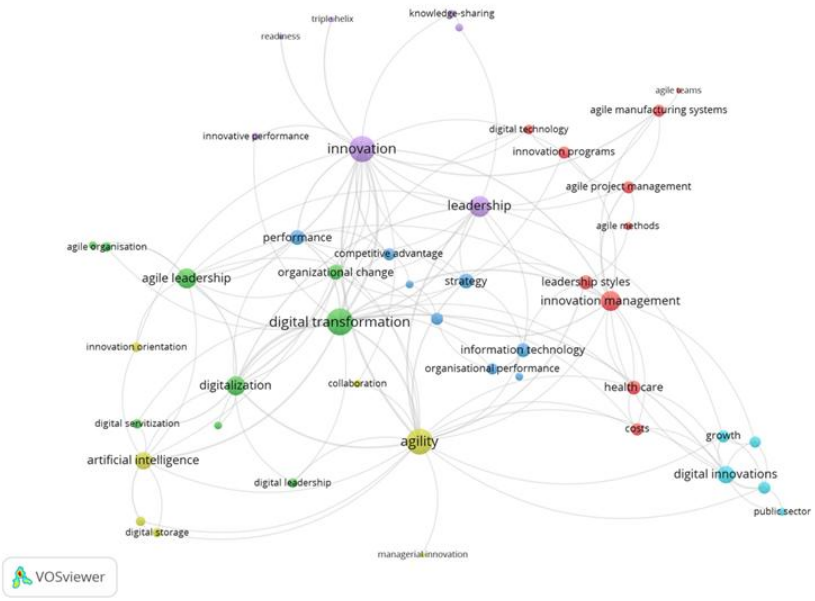

Figure 5. Network visualization of the co-occurrence of keywords
Source: Author's own creation, with VOSWier.

Cluster 4 (Purple). Represents knowledge sharing and leadership, with "knowledge sharing" and "leadership". They are connected to "innovation". The purple cluster in the bibliometric analysis highlights the role of leadership and knowledge sharing as key drivers of innovation. Keywords such as "knowledge sharing" and "leadership" are connected to "innovation", indicating that the ability of leaders to effectively share knowledge and foster a collaborative environment is crucial for driving new ideas and solutions [1, 5]. This cluster underscores the importance of leadership in creating a culture that values knowledge sharing and collaboration, which is essential for driving innovation within organizations.

Cluster 5 (Red). Centers on the impact and application of agile methodologies, with "cost," "healthcare," and "innovation management." They are connected to "leadership" and "innovation." This cluster's relationship with "leadership" and "innovation" indicates that agile practices are increasingly recognized as a way to manage costs, improve healthcare outcomes, and drive innovation, especially when implemented under effective leadership [1]. This highlights the growing interest in exploring the practical applications of agile principles in various fields and understanding how leadership plays a crucial role in facilitating their successful implementation.

Cluster 6 (Light Blue). Shows the results and aspects of digital innovation, including "growth," "digital innovation," and "public sector." It is primarily connected to "innovation" and "leadership." This cluster's relationship with "innovation" and "leadership" suggests that digital innovation is seen as a driving force for growth, with leaders playing a crucial role in shaping its direction and impact across various sectors, including the public sector [38]. This cluster emphasizes the transformative potential of digital innovation and highlights the importance of leadership in harnessing this potential for positive results.

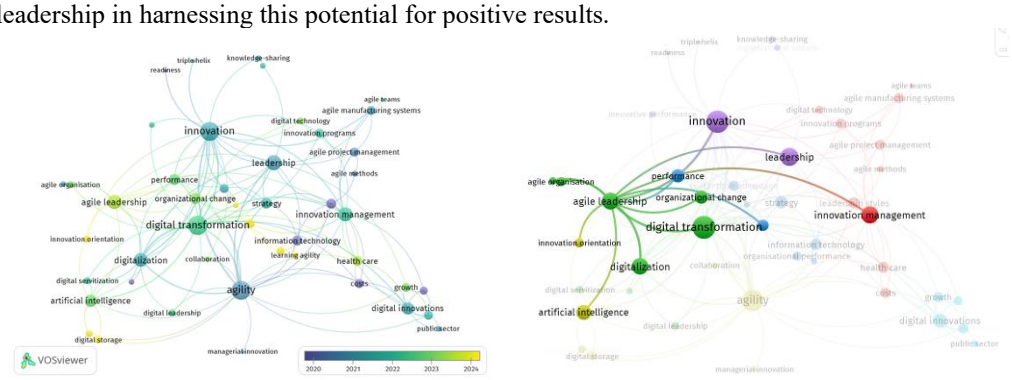

Figure 6. Overlay visualization by publication and connection
Source: Author's own creation, with VOSviewer.

Figure 6 shows that the color gradient indicates the temporal aspect, showing the evolution and increasing interest in these topics from 2020 to 2024. The map shows clusters of related terms and their frequency in research, represented by the proximity and thickness of the connecting lines. Central Themes are "Digital Transformation" and "Innovation" are central, indicating a strong relationship with other concepts [24]. Agile and agile leadership are closely related, emphasizing their importance in facilitating digital transformation and innovation. Emerging Trends are terms such as "artificial intelligence," "digital technology," and "digital innovation" indicate emerging trends and areas of focus. Collaborative and Strategic Elements: Concepts such as "knowledge sharing," "organizational change," and "strategy" highlight the

strategic and collaborative nature of digital transformation efforts [39]. Innovation Clusters are related to "leadership" and "performance," highlighting the influence of leadership in driving innovation and improving organizational performance. Digital Transformation Clusters are connected to "agile leadership," showing how agile practices are essential for successful digital transformation. "Artificial intelligence" and "digitalization" are closely related, reflecting their role in facilitating innovation and transformation [6]. Terms such as "organizational change" and "strategy" indicate a focus on strategic planning and change management as important components. Overall, the visualization underscores the multi-faceted relationships and collaborative nature of these themes in effectively enabling organizational growth and adaptation.

5. Discussion

Innovation and digital transformation are closely related to agile leadership because both require flexibility, rapid adaptation, and continuous improvement. Overall, innovation and digital transformation are mutually reinforcing processes. Innovation facilitates digital transformation by providing new solutions and approaches, while digital transformation creates an environment that encourages and supports sustainable innovation. To effectively respond to the demands of digital transformation and drive innovation, organizations may need to re-evaluate and restructure their traditional frameworks. Incorporating agile principles into organizational culture can result in increased collaboration, faster decision-making, and a more rapid response to market changes. Digital Transformation: Positioned in the center, indicating its strong relationship with other concepts such as innovation, digitization, and agile leadership. Innovation: This is not just a concept, but a key player closely related to digital transformation and agile leadership, highlighting its important role in this process. Agile Leadership: Connected to agile teams, performance, and strategy, emphasizing its importance in facilitating organizational and digital change.

Various clusters connect agile methods, digital tools, and strategic initiatives, illustrating the multi-faceted nature of digital transformation efforts. Emerging concepts are Agility, which is related to innovation management and organizational change. This reflects its significance in adapting to rapid market changes and Artificial Intelligence and Digital Innovation, which show its influence on the landscape of transformation and innovation. The exponential growth in publications since 2020, especially the surge in 2023, signifies increased awareness and interest in these topics, likely driven by the rapid digitization triggered by the COVID-19 pandemic. The shift towards remote work, changing consumer behavior, and economic uncertainty have forced organizations to embrace agile methodologies and innovative thinking to navigate these complexities.

The UK's excellence in driving scientific discourse not only underscores the critical role of strong academic infrastructure and dedicated research funding but also highlights the global impact of this research. The active participation of developing countries like Indonesia and India in understanding and implementing agile leadership principles further strengthens this global academic community, enhancing competitiveness in an increasingly digital global market. The clusters identified further illuminate the interconnected nature of these themes. Agile methodologies, as shown by this research, are not just trends but are increasingly important for the success of digital transformation. They have strong links with innovation, strategic planning, leadership, and knowledge sharing, emphasizing the need for an organizational culture that values collaboration, adaptability, and continuous learning.

The findings from this bibliometric analysis confirm the crucial role of agile leadership in the context of digital implementation and transformation. The significant increase in publications since 2020, which peaked in 2023, reflects the growing recognition of the importance of agile approaches in guiding organizations through the complexities of digital change. Digital transformation, characterized by the adoption of technologies such as artificial intelligence, cloud computing, and big data, is not merely the implementation of new tools; it requires a fundamental shift in organizational culture, structure, and processes.

Agile leadership emerges as a framework that is very suitable for managing these transformative changes. Unlike traditional leadership styles that may emphasize hierarchy and control, agile leadership emphasizes empowerment, collaboration, and adaptability. These principles are very important in a digital environment that is dynamic and often unpredictable, where organizations must be able to pivot quickly in response to market changes, new technologies, and evolving customer needs.

Our keyword network analysis further highlights the symbiotic relationship between agile leadership and digital transformation. Keywords such as 'agile organization,' 'agile leadership,' and 'digital transformation' frequently appear together, indicating that researchers and practitioners increasingly understand that agile leadership is not a stand-alone concept, but an integral component of successful digital transformation. In addition, the strong relationship between 'digital transformation' and keywords such as 'artificial intelligence' and 'digital technologies' emphasizes the crucial role of agile leaders in guiding organizations through a complex technological landscape and ensuring that technology is applied effectively to drive innovation and create value.

The implication is that organizations that wish to succeed in their digital transformation efforts must prioritize the development of agile leadership. This requires investment in leadership training programs that equip leaders with the skills and mindset needed to lead agile teams, encourage cross-functional collaboration, and create a culture of continuous learning and experimentation. In addition, organizations need to create structures and processes that support agile practices, such as self-organized teams, decentralized decision-making, and rapid feedback cycles. In short, this research provides further evidence that agile leadership is not just a passing management trend, but an essential capability for organizations that wish to thrive in the digital age. By embracing agile principles, organizations can improve their ability to innovate, adapt, and deliver value in an increasingly digital world.

6. Conclusion

Bibliometric analysis is very valuable for systematically examining existing literature, uncovering trends, and informing future research and practices in this important field. This research underscores the important role of agile leadership in navigating the complexities of innovation and digital transformation. As organizations around the world grapple with rapid technological advances, evolving market dynamics, and unstable global landscapes, the ability to adapt, innovate, and respond effectively is paramount. Agile leadership, emphasizing flexibility, collaboration, and customer focus, emerges as a critical factor in enabling organizations to thrive in this dynamic environment.

This research provides valuable insights for academics, practitioners, and policymakers. It identifies critical research gaps and emerging trends in the academic field. It offers practical guidance for practitioners on implementing agile leadership practices to drive innovation and navigate digital transformation, empowering them with actionable strategies. Finally, for

policymakers, it highlights the importance of fostering an environment conducive to digital innovation and the development of agile leadership.

This study primarily focuses on publications indexed in the Scopus database, potentially overlooking relevant research published in other databases or gray literature. In addition, this analysis primarily focuses on the co-occurrence of keywords, which may not capture the full complexity of the relationships between these multi-faceted concepts. Future research can benefit from a deeper qualitative analysis of highly cited publications to provide a richer understanding of the nuances in these themes. Future research can delve deeper into exploring the practical implementation of agile leadership in various organizational contexts and cultural settings. Investigating the specific challenges and opportunities faced by organizations in different sectors and regions, as well as the impact of cultural factors on the adoption of agile leadership, will provide valuable insights for practitioners and scholars. In addition, testing the long-term impact of agile leadership on organizational performance, employee well-being, and innovation outcomes will contribute significantly to the growing body of knowledge in this field.

References

[1] Kurnia, T., I.D.A. Nurhaeni, and R.E. Putera, *Leveraging Agile Transformation: Redesigning Local Government Governance.* KnE Social Sciences, 2022: p. 720–733-720–733.

[2] Feliciano-Cestero, M.M., et al., *Is digital transformation threatened? A systematic literature review of the factors influencing firms' digital transformation and internationalization.* Journal of Business Research, 2023. 157: p. 113546.

[3] Porfírio, J.A., et al., *Leadership Characteristics And Digital Transformation.* Journal of Business Research, 2021. 124: p. 610-619.

[4] Kraus, S., et al., *Digital Transformation: An Overview Of The Current State Of The Art Of Research.* Sage Open, 2021. 11(3): p. 21582440211047576.

[5] Bianchi, M., G. Marzi, and M. Guerini, *Agile, Stage-Gate And Their Combination: Exploring How They Relate To Performance In Software Development.* Journal of business research, 2020. 110: p. 538-553.

[6] Denning, S., *Understanding The Three Laws Of Agile.* Strategy & Leadership, 2016. 44(6): p. 3-8.

[7] Janssen, M. and H. Van der Voort, *Agile And Adaptive Governance In Crisis Response: Lessons From The COVID-19 Pandemic.* International journal of information management, 2020. 55: p. 102180.

[8] Kurnia, L., M. Saifi, and C.R. Damayanti, *Trends And Future Research In Corporate Governance: A Bibliometric Analysis (2014-2024).* Khizanah al-Hikmah: Jurnal Ilmu Perpustakaan, Informasi, dan Kearsipan, 2024. 12(1).

[9] Teece, D., M. Peteraf, and S. Leih, *Dynamic Capabilities And Organizational Agility: Risk, Uncertainty, And Strategy In The Innovation Economy.* California Management Review, 2016. 58(4): p. 13-35.

[10] AlNuaimi, B.K., S.K. Singh, and B. Harney, *Unpacking The Role Of Innovation Capability: Exploring The Impact Of Leadership Style On Green Procurement Via A Natural Resource-Based Perspective.* Journal of business research, 2021. 134: p. 78-88.

[11] Troise, C., et al., *How Can Smes Successfully Navigate VUCA Environment: The Role Of Agility In The Digital Transformation Era.* Technological Forecasting and Social Change, 2022. 174: p. 121227.

[12] Chowdhury, S., et al., *AI-Employee Collaboration And Business Performance: Integrating Knowledge-Based View, Socio-Technical Systems And Organisational Socialisation Framework.* Journal of Business Research, 2022. 144: p. 31-49.
[13] Afrianty, T.W., *Are Leaders Born Or Made?: A Point Of View.* Jurnal Penelitian IPTEKS, 2020. 5(1): p. 17-23.
[14] Jayawickreme, E., C.E. Zachry, and W. Fleeson, *Whole Trait Theory: An Integrative Approach To Examining Personality Structure And Process.* Personality and individual differences, 2019. 136: p. 2-11.
[15] Guinan, P.J., S. Parise, and N. Langowitz, *Creating An Innovative Digital Project Team: Levers To Enable Digital Transformation.* Business Horizons, 2019. 62(6): p. 717-727.
[16] Zupic, I. and T. Čater, *Bibliometric Methods In Management And Organization.* Organizational research methods, 2015. 18(3): p. 429-472.
[17] Wang, Q. and E.W. Ngai, *Event Study Methodology In Business Research: A Bibliometric Analysis.* 2020.
[18] Karismariyanti, M., et al. *A Systematic Literature Review And Bibliometric Analysis Of IT Governance Disclosure In Scopus Database*. In *Fifth Annual International Conference On Business And Public Administration (AICoBPA 2022)*. 2023. Atlantis Press.
[19] Donthu, N., et al., *How To Conduct A Bibliometric Analysis: An Overview And Guidelines.* Journal of Business Research, 2021. 133: p. 285-296.
[20] Budianto, R. *Bibliometric Analysis Of Audit Delay In The Dimensions Database During 2013-2022*. In *International Students Conference On Accounting And Business (ISCOAB)*. 2023.
[21] Moher, D., et al., *Preferred Reporting Items For Systematic Review And Meta-Analysis Protocols (PRISMA-P) 2015 statement.* Systematic reviews, 2015. 4: p. 1-9.
[22] Malapane, O.L., et al., *Bibliometric Analysis And Systematic Review Of Indigenous Knowledge From A Comparative African Perspective: 1990–2020.* Land, 2022. 11(8): p. 1167.
[23] Appio, F.P., et al., *Digital Transformation And Innovation Management: A Synthesis Of Existing Research And An Agenda For Future Studies.* Journal of Product Innovation Management, 2021. 38(1): p. 4-20.
[24] Parker, D.W., M. Holesgrove, and R. Pathak, *Improving Productivity With Self-Organised Teams And Agile Leadership.* International Journal of Productivity and Performance Management, 2015. 64(1): p. 112-128.
[25] Tregua, M., et al. *Digital Transformation In The Era Of Covid-19*. In *International Conference On Applied Human Factors And Ergonomics*. 2021. Springer.
[26] Deroncele-Acosta, A., M.L. Palacios-Núñez, and A. Toribio-López, *Digital Transformation And Technological Innovation On Higher Education Post-COVID-19.* Sustainability, 2023. 15(3): p. 2466.
[27] Warner, K.S. and M. Wäger, *Building Dynamic Capabilities For Digital Transformation: An Ongoing Process Of Strategic Renewal.* Long range planning, 2019. 52(3): p. 326-349.
[28] Ghezzi, A. and A. Cavallo, *Agile Business Model Innovation In Digital Entrepreneurship: Lean Startup Approaches.* Journal of Business Research, 2020. 110: p. 519-537.
[29] Sjödin, D.R., et al., *Smart Factory Implementation And Process Innovation: A Preliminary Maturity Model For Leveraging Digitalization In Manufacturing Moving To Smart Factories Presents Specific Challenges That Can Be Addressed Through A*

Structured Approach Focused On People, Processes, And Technologies. Research-technology management, 2018. 61(5): p. 22-31.
[30] Gregory, R.W., et al., *Paradoxes And The Nature Of Ambidexterity In IT Transformation Programs.* Information Systems Research, 2015. 26(1): p. 57-80.
[31] Lewis, M.W., C. Andriopoulos, and W.K. Smith, *Paradoxical Leadership To Enable Strategic Agility.* California Management Review, 2014. 56(3): p. 58-77.
[32] AlNuaimi, B.K., et al., *Mastering Digital Transformation: The Nexus Between Leadership, Agility, And Digital Strategy*. Journal of Business Research, 2022. 145: p. 636-648.
[33] Ali, M.J. *Understanding The 'G-Index'and The 'E-Index'*. in *Seminars in Ophthalmology*. 2021. Taylor & Francis.
[34] Fletcher, G. and M. Griffiths, *Digital Transformation During A Lockdown.* International journal of information management, 2020. 55: p. 102185.
[35] Hunady, J., et al., *Digital Transformation In European Union: North Is Leading, And South Is Lagging Behind.* International Journal of Information Systems and Project Management, 2022. 10(4): p. 58-81.
[36] Velte, P., *Environmental Performance, Carbon Performance And Earnings Management: Empirical Evidence For The European Capital Market.* Corporate Social Responsibility and Environmental Management, 2021. 28(1): p. 42-53.
[37] Rialti, R. and R. Filieri, *Leaders, Let's Get Agile! Observing Agile Leadership In Successful Digital Transformation Projects*. Business Horizons, 2024.
[38] Mohagheghi, P. and C. Lassenius, *Organizational Implications Of Agile Adoption: A Case Study From The Public Sector*, in *Proceedings of the 29th ACM Joint Meeting on European Software Engineering Conference and Symposium on the Foundations of Software Engineering*. 2021, Association for Computing Machinery: Athens, Greece. p. 1444–1454.
[39] Attar, M. and A. Abdul-Kareem, *The Role Of Agile Leadership In Organisational Agility*, In *Agile Business Leadership Methods For Industry 4.0*. 2020, Emerald Publishing Limited. p. 171-191.