

Digital Leadership in Digital Transformation: A Bibliometric Analysis of Current Trends and Future Directions

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Abstract

As digital performance continues to intensify, there is an increasing need for leadership capable of managing technological disruptions. This has contributed to the emergence of digital leadership as a fast-growing but theoretically diverse area of research. Despite the growing interest among researchers, the field remains dispersed across disciplinary borders. Limited studies have utilised quantitative bibliometric techniques to map its structure with reduced subjective bias. This study addresses this gap with two aims: first, using bibliographic coupling analysis to identify current trends in digital leadership and digital transformation research; second, it uses keyword co-occurrence (co-word) analysis to identify future thematic trends. This study used VOSviewer software to analyse and visualise the 496 documents obtained from the Web of Science database. 59 highly cited documents were then identified using bibliographic coupling analysis, revealing five distinct clusters representing the field's current empirical core: digital transformation implementation and organisational readiness, digital leadership conceptualisation, education and institutional applications, industry-specific applications, and leadership-driven innovation and sustainable performance. Subsequently, four thematic clusters emerged from the co-word analysis based on 2,006 terms: firm-level capabilities, leadership skills and workplace antecedents, the innovation–transformation nexus, and institutional or public-sector applications. Notwithstanding the role of digital leadership and digital transformation as a unifying conceptual foundation, the study remains fragmented across person, firm, and institutional levels of analysis when coupling and co-word analyses are considered together. The study highlights the need for integrative, multi-level frameworks connecting leadership competences to business capabilities and institutional outcomes. The study also provides theoretical, practical, and future research implications.

Introduction

Leaders now face unprecedented challenges in navigating technological disruption while maintaining organisational performance, driven by the rapidly accelerating pace of digital transformation. The evolution of technology has profoundly changed how firms compete, innovate, and create value. Consequently, digital leadership has emerged as a distinct and rapidly expanding field of study at the intersection of strategic management, information systems research, and leadership theory. Understanding how leadership skills translate into successful digital transformation outcomes has become both a theoretical priority and a practical necessity, as organisations across sectors, from private corporations to public institutions, grapple with the human dimension of digital change.

Despite the significant increase in scholarly work related to digital leadership during the last ten years, this field is characterised by fragmentation as a result of interdisciplinary nature of its evolution, involving such disciplines as organisational psychology, management, information systems, and education. This fragmentation leads to the existence of the extensive but dispersed body of knowledge, making it difficult for researchers as well as practitioners to identify existing trends in research and possible future direction. While many narrative and systematic reviews of literature can be found

focusing on certain aspects of digital leadership, there are not many empirical analyses using bibliographic methods (Donthu et al., 2021; Zupic & Čater, 2015).

The current study aims to address this gap in two ways. The first goal is to use bibliographic coupling analysis to identify the most prevalent current trends in digital leadership and digital transformation, and to determine which thematic clusters currently serve as the empirical and conceptual core of the literature. The second goal is to use co-word analysis to identify emerging terminological clusters and conceptual connections that indicate the likely future directions of the field's discourse by analysing keyword co-occurrence patterns. Together, these two goals provide a temporally layered understanding of the field that neither approach could provide on its own. This study seeks to offer a methodologically triangulated understanding of the current state and likely future trajectory of digital leadership research within digital transformation contexts by integrating the findings from both analyses. This will provide a solid foundation for future research and practice.

Methodology

The Bibliometric Method

It is a quantitative method that assesses bibliographic databases using a scientific mapping technique (Donthu et al., 2021). The method is intended to provide a comprehensive and transparent examination of a field (Zupic & Čater, 2015). Bibliometric analysis is well suited to examining large volumes of publications because it reduces subjectivity bias compared with systematic literature reviews and meta-analyses (Zupic & Čater, 2015; Donthu et al., 2021) and, unlike manual coding, does not require the exclusion of publications during the sampling process (Donthu et al., 2021). The two main approaches to bibliometric analysis are performance analysis and scientific mapping (Noyons et al., 1999). The former evaluates the contributions of research constituents in terms of publication and citation impact, whereas the latter focuses on the relationships between constituents by examining the knowledge structure of a particular subject (Donthu et al., 2021; Cucari et al., 2023).

This study uses bibliographic coupling and co-word analysis to achieve the two objectives of this study:

1. Bibliographic coupling is used to analyse recent and ongoing developments in a field of study (Donthu et al., 2021). It is based on the principle that two publications with comparable references (citing papers) address similar subjects (Rojas-Lamorenna et al., 2022). Bibliographic strength is the term used to describe this relationship, which provides an overview of the state of the field (Hasumi & Chiu, 2022).
2. Co-word analysis uses phrases from abstracts, keywords, and document titles to connect ideas that appear together (Zupic & Čater, 2015). It is based on the notion that a group of keywords represents an underlying topic and that co-occurrences indicate a similar underlying subject (Jafari Roodbandi et al., 2022). Frequently occurring keywords have a greater impact on a field than those that occur

less often. The links between the keywords help researchers identify emerging issues and future research directions (Donthu et al., 2021).

Research Design and Data Collection Procedure

The search string in Table 1 was used to identify publications employing relevant terms. These terms include digital leadership, digital transformation, and other related disciplines. The subject search (TS) was restricted to the Web of Science (WoS) database in order to obtain titles, abstracts, and keywords. For the past 40 years, WoS has been considered the most reliable and leading database for the scientific community, with over 21,100 peer-reviewed, high-quality scholarly articles spanning more than 250 fields (Pranckute, 2021). Included were articles, proceedings papers, early access publications, and review articles. The analysis and network visualisation of the science mapping were carried out using VOSviewer 1.6.18 software (van Eck & Waltman, 2010).

Table 1
Search String in WoS Database

No	Keywords	Justification
1	"digital leadership" OR "digital leader*" OR "e-leadership" OR "e-leadership" OR "electronic leadership" OR "technology-mediated leadership" OR "technology mediated leadership" OR "ICT-enabled leadership" OR "leadership in the digital age" OR "leadership in the digital era" OR "digital transformation leadership"	Identify literature related to digital leadership
2	"digital transformation" OR "digital business transformation" OR "digital organizational transformation" OR "digital organisational transformation" OR "digital transformation strateg*" OR digitali?ation	Identify literature related to digital transformation

Findings and Discussion

On 8 August 2026, a search was conducted in the WoS database. Following the initial search, a total of 496 documents were found, including articles, early-access items, proceedings papers and review articles, excluding book chapters. The total number of citations collected over this period was 4,930, while the number without self-citations was 4,601. The h-index was 43 and the average number of citations per publication was 14.92. The total number of publications and their associated citations are shown in Fig. 1. The first digital leadership study appeared in 2015. Over the first six years, the number of articles rose steadily until 2024. Since then, the number has increased sharply, reaching a peak of 2,400 publications in 2025. The number of papers in this research area is expected to rise in 2026 because of ongoing academic interest in this topic, which will support future growth in digital leadership and related activities.

Bibliographic Coupling

Determining the citation threshold to generate the most suitable and reliable network visualisation is the first stage in this investigation. Fifty-nine of the 496 documents met the requirement of 33 citations. Before establishing the network map, multiple trials were conducted to assess the citation threshold. The citation threshold defines the minimum number of citations a publication must have in order to be included in the network visualisation. The network map should be well formed, with sufficient and suitable clusters that reflect digital leadership research streams in digital transformation. The threshold must be precisely calibrated: if it is set too high, it results in over-filtering; if it is set too low, it results in under-filtering. While the latter generates numerous clusters, leading to redundancy, the former removes pertinent clusters from the network map (Fauzi et al., 2023; Geng et al., 2020). The top ten publications by number of citations are shown in Table 2. The number of studies on the map is represented by the number of nodes (dots), and the larger the node, the more citations it has received (van Eck and Waltman, 2010). The total link strength (TLS) is indicated by the thickness of the lines connecting the nodes. A publication with a higher TLS is more strongly linked to other publications in the network map. Cortellazzo et al. (2019) (392 citations), Trenerry et al. (2021) (312 citations), and El Sawy et al. (2016) (218 citations) are the three most cited documents. In the present research front on digital leadership in digital transformation, these 59 documents produced five distinct clusters.

Figure 2 presents a network visualisation of bibliographic coupling. Red, green, blue, yellow and purple are the five identifiable groupings. By re-examining representative articles within the clusters, the authors inductively interpreted and labelled the clusters, synthesising them based on shared themes and research streams. To minimise potential bias and misunderstanding, the authors cross-checked the cluster labels against the underlying themes. By modelling actual research streams on the subject, this procedure guarantees inter-rater reliability.

Table 2
Top 10 documents in bibliographic coupling analysis.

No	Author	Journal	Scope	Citation	TLS
1	Cortellazzo et al. (2019)	Frontiers in Psychology	Leadership	392	52
2	Trenerry et al. (2021)	Frontiers in Psychology	Digital Transformation in the Workplace	312	158
3	El Sawy et al. (2016)	MIS Quarterly Executive	Enterprise Capabilities for Digital Leadership	218	6
4	Zeike et al. (2019)	International Journal of Environmental the the Research and Public Health	Digital Leadership Skills	190	18
5	Guinan et al. (2022)	Business Horizons	Digital Transformation	173	3
6	Chatterjee et al. (2023)	Journal of Innovation & Knowledge	Digital leadership capability	168	65
7	Schiuma et al. (2022)	International Journal of Entrepreneurial Behavior & Research	The Competencies of Leadership for Digital Transformation	167	53
8	Erhan et al. (2022)	Management Research Review	Digital leadership behavior	152	104
9	Weber et al. (2022a)	Journal of Business Research	leadership behaviors in managing organizational change	139	108
10	Imran et al. (2021)	Journal of Change Management	Digital Transformation	137	107
Source: Researcher Findings					

Digital Transformation Implementation and Organizational Readiness

Cluster labeled in red colour, "Digital Transformation Implementation and Organisational Readiness," encompasses 18 publications. The main theme of the cluster is the planning, implementation, and performance consequences of digital transformation projects in corporations. Through a comprehensive review integrating several levels (personal, group, and organisational) that affect workplace readiness for digital transformation, Trenerry et al. (2021) make a fundamental contribution to the research area by presenting readiness as a necessary condition for implementing changes but not their consequence. Using the implementation approach, Imran et al. (2021) suggest an integrated model for industrial firms, according to which the implementation of a digital transformation project requires the alignment of

technology-related, structural, and leader-related enablers rather than the implementation of technologies independently.

Company size makes a major impact on the choice of the strategy and resource distribution. Peter et al. (2020) contribute to the discussion by providing a comparative empirical analysis of strategic action areas implemented by Swiss SMEs and large companies. Jardak and Ben Hamad (2022) add an empirical dimension to these processes through showing that digital transformation has a quantifiable impact on the financial performance of Swedish listed companies. Overall, the contribution of these studies proves that Cluster 1 is the most operationally oriented part of the digital leadership body of knowledge because it focuses on the implementation mechanisms of transformations such as readiness, strategic implementation, and performance evaluation but not its conceptual framework.

Digital Leadership Conceptualization and Theoretical Foundations

Cluster 2 represented by green colour contains 12 publications and is labelled as “Digital Leadership Conceptualization and Theoretical Foundation”. It serves as the theoretical and conceptual foundation for the digital leadership literature and consists of articles that define, map, and synthesise digital leadership as a distinct concept rather than assessing its effects empirically. Fundamental contribution made by Cortellazzo et al. (2019) becomes one of the most cited reviews in the field. They trace the evolution of leadership theory in response to the demands of digitalised organisational environments. The study also identifies digital leadership as a reaction to the disruption of traditional leadership models caused by technology. Built on this conceptual foundation, Karakose et al. (2022) use a bibliometric mapping approach to trace the developmental trajectory of digital leadership as a study area. As a result, they provide a meta-level view of the construct transitions over time and across disciplines.

Towards ensuring conceptuality and clarification in definition within the cluster, Eberl and Drews (2021) conduct a critical review on digital leadership with an attempt to understand if digital leadership can be considered a novel theoretical “mountain” or merely a relabelled “molehill” of already existing leadership concepts. To complete the cluster, Schiuma et al. (2022) come up with a six-competency “transformative leadership compass” aimed at digital transformation entrepreneurship. This cluster acts as the conceptual foundation for all other clusters as it defines, limits, and provides competency frameworks for other clusters.

Digital Leadership Frameworks in Education and Institutional Change

Cluster 3 (in blue), is categorised under digital leadership frameworks in education and institutional change, and it includes 11 scholarly publications. This cluster covers digital leadership models that explain how digital leadership approaches aid in making organisational changes. Furthermore, it also captures contextual specialisation of digital leadership theory in certain institutional settings, especially

those related to education and public-sector organisations. The authors Shin et al. (2023) explore this issue by providing evidence of how digital leadership approaches impact digital culture and digital competencies of employees in South Korean organisations and create a connection between the behaviour of the leaders, performance, and sustainability. Cheng and Wang (2023) highlight this topic in the field of basic education, where it has been revealed that Hong Kong school managers drive digital transformation by removing obstacles for applying AI technology by teachers.

Malik et al. (2025) extend the cluster into strategic organisational change by analysing how digital leadership facilitates business model innovation and positions the leader as the primary actor guiding companies through digital transformation processes. To broaden the cluster's geographic and economic reach beyond Western and high-income contexts, Magesa and Jonathan (2022) complement this institutional and strategic focus with a contextual study from Tanzania, conceptualising the distinctive digital leadership traits required for successful digital transformation in a developing-economy setting. Taken together, these papers show that Cluster 3 is unique in emphasising the application of digital leadership in public institutions, schools, and developing-economy businesses, extending the theoretical foundations of Cluster 2 into tangible, context-specific organisational change processes.

Industry-Specific Applications of Digital Leadership

This cluster, labelled "Industry-Specific Applications of Digital Leadership", consists of 10 publications. Cluster 4, shown in yellow, illustrates how the field has progressed towards evaluating boundary conditions and sector-specific generalisability by examining the adaptation of digital leadership constructs to particular industry sectors and entrepreneurial environments. To address a sector that has historically been slower to digitalise, Zulu and Khosrowshahi (2021) developed a taxonomy of digital leadership specifically for the construction industry. This taxonomy identifies the leadership behaviours required to promote technology adoption on-site and across project teams. Building on this sector-specific foundation, Gledson et al. (2024) extend Zulu and Khosrowshahi's taxonomy into a more practical, implementation-focused model by proposing a digital leadership framework designed to support firm-level digital transformations within the context of Construction 4.0. By demonstrating that digital leadership behaviours concurrently influence organisational innovation and sustainability outcomes, Niu et al. (2022) expand the cluster's scope by linking sector-specific leadership practices to broader sustainability agendas.

The cluster's concern with how leadership translates into specific strategic and sectoral action is reinforced by Tuerk's (2023) strategic lens, which examines how companies remain relevant in the face of digital transformation and how this is influenced by digital leadership. Considered collectively, these papers establish Cluster 4 as the field's testbed for contextual and industry-specific validity, transferring digital leadership theory from general organisational settings to entrepreneurial, industrial, and construction contexts, where sector-specific constraints impact leadership practices.

Leadership, Innovation, and Sustainable Organizational Performance

The most recent and closely linked stream in the network is represented by the final cluster (in purple), “Leadership, Innovation, and Sustainable Organisational Performance”, with seven publications. This marks a clear shift towards outcome-oriented research that connects digital leadership to competitive advantage, innovation capability, and sustainability-linked performance. This cluster is anchored by Chatterjee et al. (2023), who show that digital leadership capability moderates the relationship between digital workplace practices and organisational performance, positioning leadership as a contingency factor that either amplifies or constrains the performance of transformation. Chen et al. (2024) extend this performance focus by testing a moderated mediation model that demonstrates how market-driven business model innovation fosters sustainable company performance through digital transformation, with digital leadership competencies acting as a crucial enabling factor in that pathway.

Albannai et al. (2025) push the cluster towards capability building, explaining how digital leadership creates digital dynamic capabilities that businesses use to achieve successful digital transformation. This directly connects leadership to the literature on resource-based and dynamic capabilities. Furthermore, Zada et al. (2025) complete the cluster by linking digital leadership to sustainable development outcomes, demonstrating that top management innovativeness and green innovation are important ways in which digital leadership improves firm-level sustainability. Taken as a whole, these papers indicate that Cluster 5 represents the current empirical frontier of the field, where previous conceptual (Cluster 2) and contextual (Clusters 3 and 4) work converges into rigorously tested models linking digital leadership to innovation, dynamic capabilities, and sustainability-oriented firm performance

In conclusion, the bibliographic coupling analysis on digital leadership research in digital transformation has developed around a dominant empirical core (Clusters 1 and 5), anchored by high-impact studies such as Trenerry et al. (2021) and Chatterjee et al. (2023), which show that organisational readiness and digital leadership capability causally enhance digital transformation outcomes and firm performance. Three additional clusters extend this core into specialised but weakly integrated areas, including institutional and educational contexts (Cluster 3), sector-specific industrial applications (Cluster 4), and theoretical or conceptual frameworks defining the construct itself (Cluster 2). This indicates a clear research gap where integrative studies that combine institutional context, sector-specific constraints, and conceptual clarity with the core digital leadership–performance pathway are required to capture not only whether digital leadership drives successful transformation, but also for whom and under what circumstances. The field has convincingly demonstrated that digital leadership improves digital transformation outcomes, but it remains fragmented in explaining the boundary conditions under which this holds. A summary of the bibliographic coupling analysis is presented in Table 3.

Table 3
Summary of bibliographic coupling analysis.

Cluster no (Color)	Cluster Label	No. of Publications	Representative Publications
1 (Red)	Digital Transformation Implementation and Organizational Readiness	18	Imran et al. (2021), Jardak et al. (2022), Peter et al. (2020), Trenerry et al. (2021)
2 (Green)	Digital Leadership Conceptualization and Theoretical Foundations	12	Cortellazzo et al. (2019), Eberl & Drews (2021), Karakose et al. (2022), Schiuma et al. (2022).
3 (Blue)	Digital Leadership Frameworks in Education and Institutional Change	11	Cheng & Wang (2023), Magesa & Jonathan (2022), Malik et al. (2025), Shin et al. (2023)
4 (Yellow)	Industry-Specific Applications of Digital Leadership	10	Gledson et al. (2024), Niu et al. (2022), Tuerk, A. (2023), Zulu & Khosrowshahi (2021)
5 (Purple)	Leadership, Innovation, and Sustainable Organizational Performance	7	Albannai et al. (2025), Chatterjee et al. (2023), Chen et al. (2024), Zada et al. (2025)

Co-occurrence Analysis

Out of the 2,006 terms, the co-word analysis reveals four themes that met 56 thresholds, forming four clusters. The citation threshold was established by testing several lower thresholds until a reliable map was produced in the network visualisation, similar to bibliographic coupling. The authors' cross-checking process assessed the map's resilience to ensure inter-rater reliability and reduce bias and misinterpretation. The top 15 keywords from the co-word analysis are shown in Table 4. The most frequently occurring terms are "digital transformation" (215 occurrences), "digital leadership" (238 occurrences), and "innovation" (72 occurrences). Digital leadership and digital transformation are significantly correlated, as indicated by the grouped keywords performance, dynamic capabilities, leadership, impact, and transformation.

Table 4
Top 15 keywords

Rank	Keyword	Occurrences	TLS
1	Digital Transformation	215	666
2	Digital Leadership	238	647
3	Innovation	72	319
4	Performance	69	304
5	Dynamic Capabilities	53	239
6	Leadership	64	228
7	Impact	45	219
8	Transformation	50	210
9	Management	47	188
10	Technology	49	187
11	Capabilities	32	138
12	Model	29	125
13	E-leadership	38	120
14	Digitalization	42	117
15	Business	25	114

The network structure of the co-word analysis is shown in Fig. 3. It displays four clusters, each representing a distinct theme. Drawing on the authors' interpretation of the qualitative analysis of sample terms in the network map, the clusters are assigned appropriate labels.

Firm-Level Capabilities, Resources, and Competitive Advantage

"Firm-Level Capabilities, Resources, and Competitive Advantage" is the label for Cluster 1 (shown in red). Industry, resources, firm performance, mediating role, capabilities, digital culture, competitive advantage, firm, PLS-SEM, adoption, business, digital maturity, and impact are all included in this cluster. As can be seen from the "mediating role" and "PLS-SEM" nodes, this cluster represents the resource-based and empirically tested concept of digital leadership, and how it develops firm resources, capabilities, and competitive positioning, which is frequently examined using mediation models and the PLS-SEM technique. This cluster is exemplified by Memon and Ooi (2023), who show how responsible innovation creates competitive advantage through digital leadership, utilising a SEM–neural network technique.

Braojos et al. (2024) reaffirm the concepts of resources and capabilities by demonstrating how digital leadership and environments for continuous learning strengthen organisational commitment through digital transformation capabilities. To establish a link between firm performance, business, and impact, Chen et al. (2024) apply a moderated mediation model in which business model innovation and digital leadership competencies generate sustainable business performance. Meanwhile, Shin et al. (2023) connect adoption and digital culture by showing how digital leadership influences employees' adoption of digital capabilities and digital culture.

Digital Leadership Skills, Workplace, and Educational Antecedents

This cluster (in green) represents the skills-based aspect of digital leadership, including the behaviours, abilities, and educational antecedents that equip leaders for digitally intensive workplaces. It is anchored by Cortellazzo et al. (2019), who examine how leadership behaviour and the necessary abilities change as businesses undergo digital transformation. Jameson et al. (2022) extend the cluster to higher education, systematically reviewing the state of digital leadership research in academic institutions. Karakose et al. (2021) emphasise workplace challenges by considering how the COVID-19 pandemic tested school administrators' technological and digital leadership skills. Zeike et al. (2019) establish an empirical link between digital leadership skills and psychological well-being outcomes at work by connecting skills and behaviour to well-being.

Digital Transformation, Innovation, and Organizational Systems

This theme (in blue), which is the largest and most important cluster, encapsulates the fundamental theoretical connection between digital leadership and the process of digital transformation, namely how leadership promotes innovation and transforms organisational structures. Using a contingency-based framework of digital transformation leadership capabilities, Mueller et al. (2024) exemplify this fundamental linkage by directly connecting transformation, organisations, and systems. Malik et al. (2025) reaffirm innovation and transformation, demonstrating how organisational change and business model innovation are enabled by digital leadership during digital transformation. For technology-driven corporate environments, Weber et al. (2022) provide a conceptual and empirical framework of leadership roles that links organisations to systems. Through an integrated, multilevel analysis of workplace readiness factors for digital transformation, Trenerry et al. (2021) establish a connection between digital maturity and organisations.

Performance, Strategic Frameworks, and Public-Sector/Institutional Applications

The last cluster (yellow), represented by the e-government node, captures the application of digital leadership in public sector and institutional settings. This cluster is anchored by a literature review by McCarthy et al. (2022), which identifies leadership traits for digital transformation, specifically

addressing frameworks and performance. Niu et al. (2022) emphasise capability and performance, connecting ESG management and digital leadership to organisational innovation and sustainable outcomes. Qiao et al. (2024) examine how digital leadership strategically improves employee performance and organisational commitment by linking performance and perspective. By conceptualising the digital leadership traits required for successful digital transformation in a developing country government and enterprise environment (Tanzania), Magesa and Jonathan (2022) expand the cluster’s institutional and public sector applicability.

In conclusion, research on digital leadership in digital transformation is organised around a dense conceptual core – digital leadership and digital transformation – from which four distinct but overlapping topic clusters radiate, according to the keyword co-occurrence analysis. The co-word map as a whole shows that although digital leadership and digital transformation serve as the field’s unifying conceptual anchors, the surrounding thematic structure is only moderately integrated. The development of skills-based, capability-based, and institutional/performance-based research streams has been relatively independent, indicating a persistent need for studies that connect individual-level leadership competencies with firm-level capability outcomes and broader institutional or public sector applications. A summary of the co-word analysis, according to cluster labels and keywords, is presented in Table 5.

Table 5
Summary of co-word analysis

Cluster no (color)	Cluster Label	Number of Keywords	Representative Keywords
1 (red)	Firm-Level Capabilities, Resources, and Competitive Advantage	16	industry, resources, firm performance, mediating role, capabilities, digital culture, competitive advantage, firm, pls-sem, adoption, business, digital maturity, impact
2 (green)	Digital Leadership Skills, Workplace, and Educational Antecedents	16	higher education, work, skills, antecedents, industry 4.0, behavior, intelligence, workplace, digitalisation, e-leadership, technology, challenges, model
3 (blue)	Digital Transformation, Innovation, and Organizational Systems	13	digital leadership (core), digital transformation (core), innovation, transformation, information, organizations, systems, industry, digital maturity
4 (yellow)	Performance, Strategic Frameworks, and Public-Sector/Institutional Applications	11	performance, perspective, science, e-government, framework, capability, systems

Implications of the Study

The results of the keyword co-occurrence analysis and bibliographic coupling analysis provide convergent evidence, with theoretical and practical implications for the study and application of digital leadership.

Theoretical Implications

The two analyses reinforce and cross-validate one another in a way that strengthens confidence in the field's structure. The co-word map's central digital leadership node and its surrounding skills and behaviour cluster (Cluster 2, green) directly parallel the bibliographic coupling map's conceptual core (Cluster 2: Digital Leadership Conceptualization), indicating that theoretical underpinnings remain fundamental but have not yet fully developed into a cohesive paradigm. Similarly, the firm capability cluster in the co-word map (Cluster 1, red) and the performance- and innovation-oriented core found in the coupling analysis (Cluster 5) mirror each other, confirming that outcome-focused, empirically tested research using mediation-based designs such as PLS-SEM represents the most active and rapidly expanding frontier in the field.

Sector-specific and institutional applications (bibliographic clusters 3 and 4; co-word cluster 4) remain peripheral and loosely connected to the empirical core rather than integrated with it, even though both studies separately highlight the same structural flaw. The idea that digital leadership research is theoretically dispersed across levels of analysis – individual, company, and institutional – rather than grounded in a single coherent approach is reinforced by this twofold confirmation. This suggests that, instead of continuing to develop in isolated silos, the discipline would benefit from multi-level theoretical frameworks (such as a leader competency → firm capability → institutional outcome pathway) that formally unite what have so far been treated as distinct streams of research.

Practical/Managerial Implications

The findings indicate that organisations should approach digital leadership development as a two-way pipeline, in which individual competency-building programmes are explicitly designed and evaluated against firm-level capability and performance outcomes. It should close the gap between both levels of analysis rather than be treated as purely individual training (as Cluster 2 research might imply) or solely as a firm-capability investment (as Clusters 1 and 5 suggest). Additionally, leaders and policymakers in these sectors should be cautious about directly transplanting corporate digital leadership frameworks, because institutional and public-sector contexts (schools, government, developing economies) consistently emerge as peripheral in both maps rather than centrally connected to the empirical core. However, the adoption of competency models in the public sector is necessary.

Implications for Future Research

Both analyses converge on the same three under-integrated areas: individual competencies, firm capabilities, and institutional or public sector context. Future studies are best positioned to make a meaningful contribution by explicitly bridging these levels in a single design, for example through multi-

level or mixed-methods studies, rather than replicating single-level, single-context studies that further densify the already well-populated empirical core.

Conclusion

Using two complementary bibliometric methodologies, this study aimed to map the conceptual and intellectual architecture of digital leadership research within the framework of digital transformation. The bibliographic coupling analysis traced the evolution of the field's body of knowledge, beginning with foundational, definitional work that established digital leadership as a construct, moving through contextual applications in education and specific industries, and culminating in a developing empirical frontier that links leadership to innovation and long-term firm performance. The thematic vocabulary underpinning this evolution was then uncovered by the keyword co-occurrence analysis, which showed that scholarly attention revolves around four recurrent conversations: the innovation–transformation nexus, performance-oriented institutional frameworks, firm-level capability and competitive advantage, and leader-level skills and workplace readiness.

The two analyses present a coherent picture. Although digital leadership has established itself as a respectable and expanding field of study, knowledge generation is still divided by analytical level. Relatively little research has examined how these levels interact or reinforce one another within a single study, yet scholars have produced compelling, independent evidence that digital leadership matters for individuals, organisations, and institutions. This is a genuine characteristic of the literature itself, discernible from two distinct analytical perspectives, rather than a drawback of the techniques employed here.

Addressing this gap offers value beyond academic completeness. As organisations across sectors continue to navigate digital transformation amid technological uncertainty and resource constraints, a more integrated understanding of digital leadership – one that connects what a leader does, what a firm gains, and how that translates across different organisational contexts – would provide far greater explanatory and practical power than the fragmented picture currently available. Future research that pursues this integration could move the field from documenting that digital leadership works to explaining precisely how, for whom, and under what conditions it does.

Declarations

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Competing Interests

The authors have no relevant financial or non-financial interests to disclose.

Author contributions

All authors contributed to the study conception and design. Material preparation, data collection, and analysis were performed by Khalid Abdul Wahid, Mohd Nasir Ismail, and Pratsanee Na Keeree. The first draft of the manuscript was written by Siti Zulaikha Mustapha, and all authors commented on earlier versions. All authors read and approved the final manuscript. Conceptualization: Shamila Mohamed Shuhidan and Siti Zulaikha Mustapha; Methodology: Khalid Abdul Wahid; Formal analysis and investigation: Khalid Abdul Wahid, Mohd Nasir Ismail; Writing - original draft preparation: Siti Maziah Ab. Rahman, Pratsanee Na Keeree; Writing - review and editing: Siti Zulaikha Mustapha; Funding acquisition: Khalid Abdul Wahid, Pratsanee Na Keeree.

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Figures

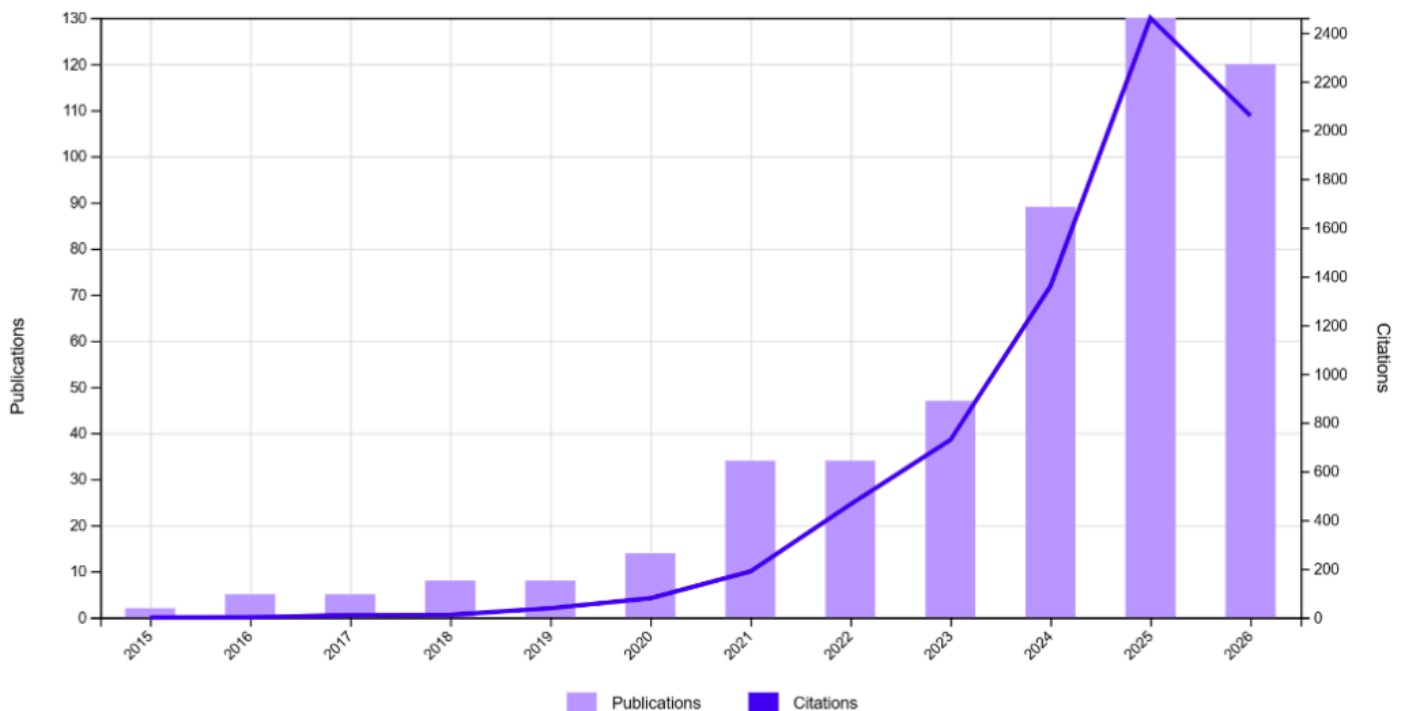


Figure 1

Number of publications and citations on AI in SME Resilience. Source: Web of Science

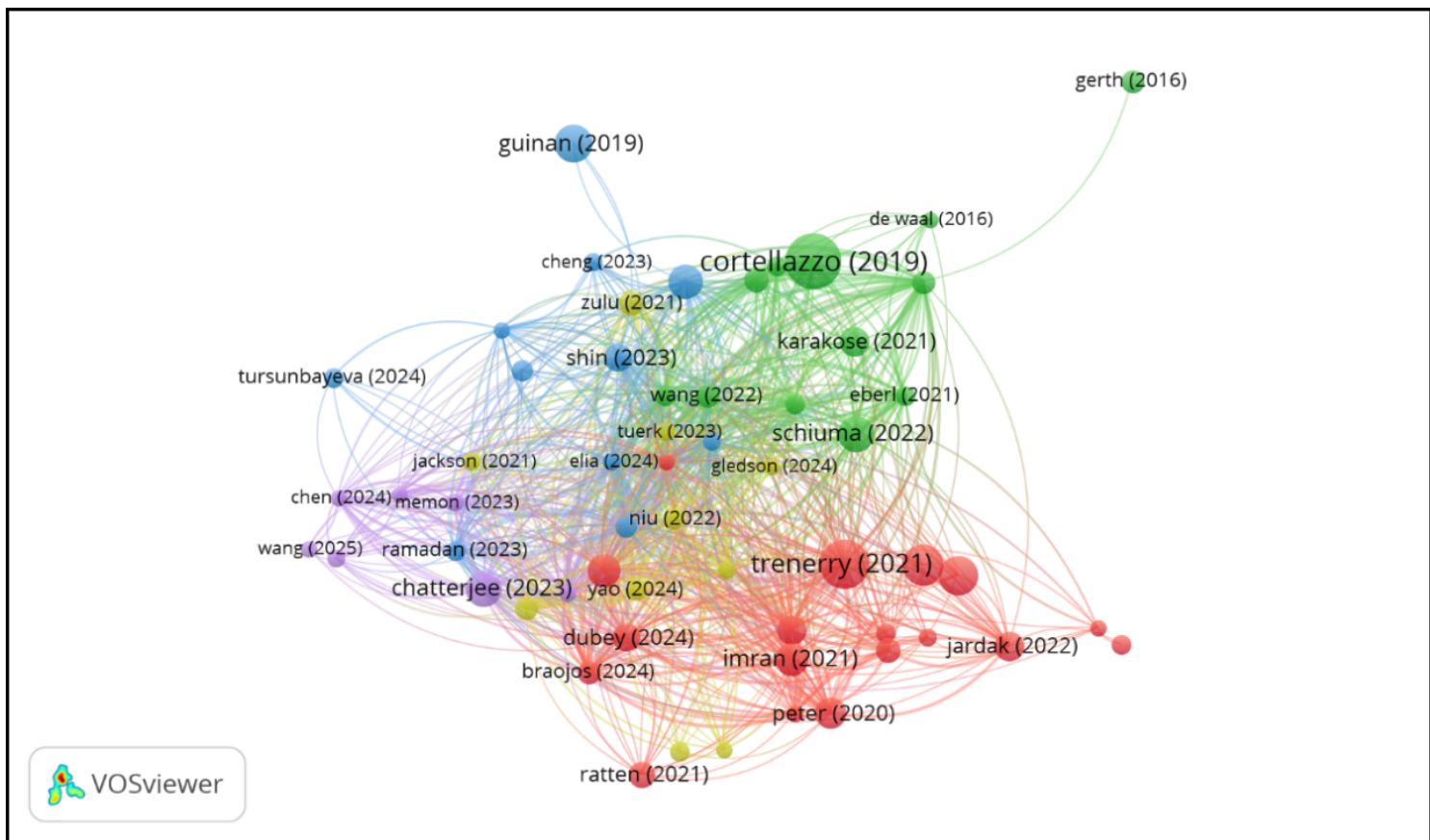


Figure 2

Network visualization of bibliographic coupling. Source: Researcher findings

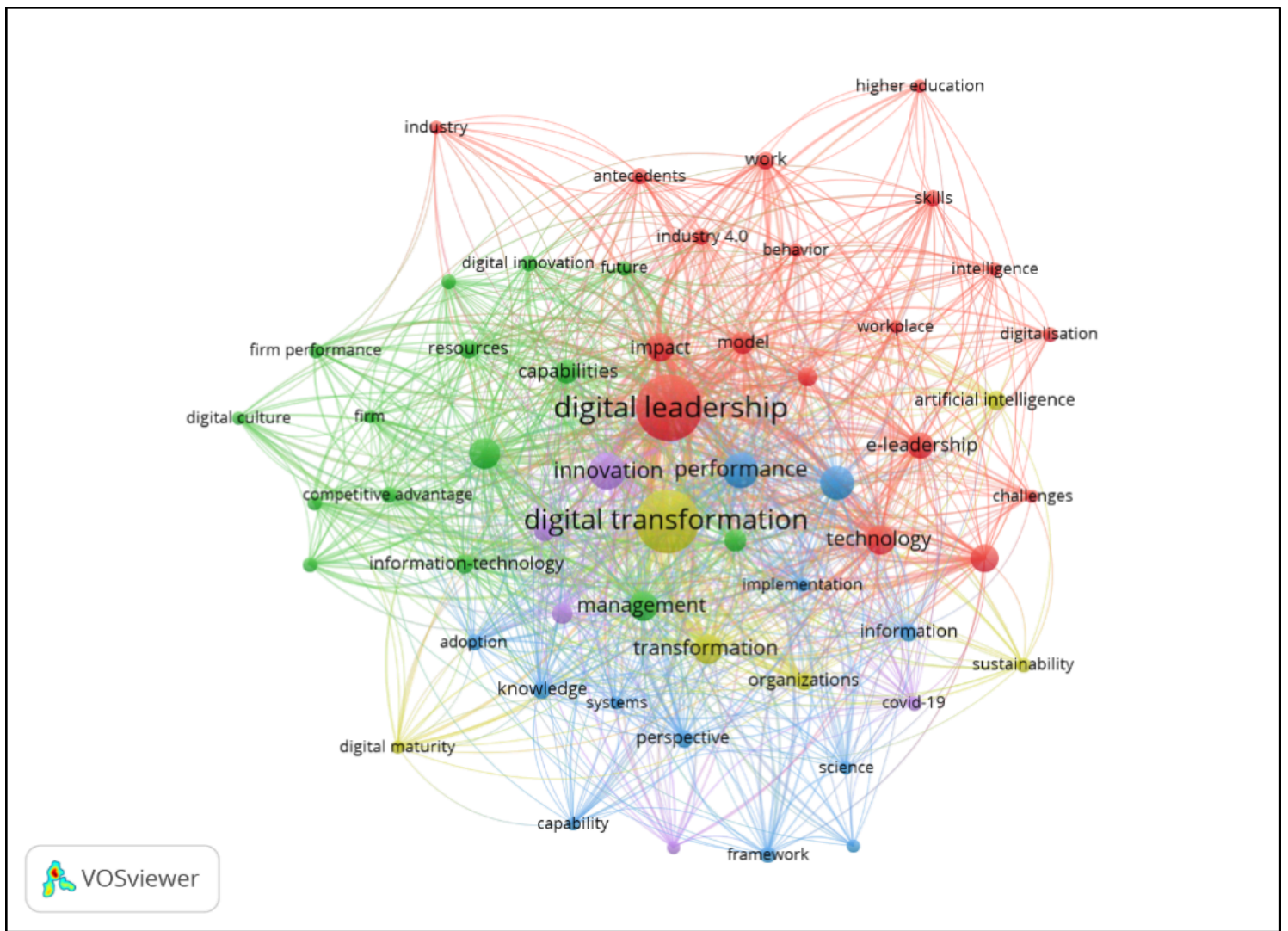


Figure 3

Network visualization of co-word analysis. Source: Researcher findings