

Mapping the Intellectual Structure of Digital Leadership (2015–2025): A Bibliometric Analysis and Research Agenda

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Systematic Review

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Abstract

Digital transformation has expanded leadership research beyond technology-mediated influence to questions of strategic renewal, organizational capability, and human-centered governance. Yet the literature on digital leadership remains fragmented, with blurred boundaries between digital leadership and adjacent constructs such as e-leadership, making it difficult to identify the field's intellectual structure and emerging directions. To address this gap, this study maps the digital leadership research domain from 2015 to mid-2025 through a bibliometric knowledge mapping approach. A dataset of 435 English-language journal articles indexed in Web of Science and Scopus was analyzed using CiteSpace. The analysis combined keyword co-occurrence, burst detection, cluster mapping, and temporal visualization to identify core themes, thematic evolution, and emerging research frontiers. The findings show that digital leadership research has developed rapidly, particularly since 2023. The bibliometric patterns can be interpreted as clustering around three broad and interconnected dimensions: a strategic-capability dimension centered on digital transformation, agility, and capability renewal; a human-centered dimension focused on empowerment, well-being, emotional intelligence, and professional development; and a technology-driven dimension highlighting big data, analytics, and human-AI collaboration. The results also indicate that digital leadership is conceptually broader than e-leadership because it emphasizes organization-wide transformation, governance, and capability building rather than only technology-mediated influence. These findings help delineate the knowledge contours of explicitly labeled digital leadership research and support an interpretive framework for understanding its development across organizational, technological, and human domains. The study contributes a structured evidence base for future theory development and offers a research agenda for examining trust, ethics, governance, and sustainable human outcomes in digitally transforming organizations.

1. Introduction

Digital technologies have expanded the leadership agenda from leading people and processes to orchestrating innovation and leading an organizational digital transformation (Vial, 2019; Hanelt et al., 2021). In this context, digital leadership is defined as leadership that strategically employs digital tools and data-driven insights to influence, coordinate, and drive innovation within technology-mediated contexts (Benitez et al., 2022; Cortellazzo et al., 2019).

Over the past decade, research on digital leadership has expanded rapidly, reflecting its relevance to innovation, organizational performance, employee-related outcomes, and adaptability under accelerating technological change. Yet, though it has grown, the literature is not well-integrated. Existing reviews and bibliometric studies suggest that the field has a diffuse intellectual structure and blurred boundaries with adjacent concepts such as e-leadership and virtual leadership (Avolio et al., 2000; Tigre et al., 2023; Lin, 2025). Such fragmentation constrains cumulative knowledge development and complicates efforts to trace how the field has evolved, where consensus has formed, and which themes are emerging.

To address this gap, this study employs a bibliometric approach utilizing keyword-based scientific knowledge mapping to systematically identify and visualize the intellectual structure of digital leadership research. Using CiteSpace (version 6.4.R1), we conduct keyword co-occurrence analysis, burst detection, cluster mapping, and temporal visualization to examine digital leadership research published between 2015 and mid-2025 (Chen, 2006; Donthu et al., 2021). To enhance construct clarity, this study provides a focused mapping of digital leadership as a construct separate from adjacent constructs like e-leadership and electronic leadership, as these are conceptually distinct as per the literature (Cortellazzo et al., 2019). Thus, this study aims for three related goals: (1) mapping the intellectual structure of digital leadership research from 2015 through mid-2025, (2) identifying key research clusters, emerging topics, and shifting emphases over time, and (3) integrating these insights within an interpretive framework to clarify strategic-capability, human-centered, and technology-driven aspects of digital leadership and guide future research.

Guided by these aims, the study addresses the following research questions:

1. What are the structural and thematic characteristics of the digital leadership research domain from 2015 to mid-2025?
2. How have the key topics and theoretical emphases evolved over time, and which emerging areas signal new conceptual directions?
3. In what ways can digital leadership be distinguished from adjacent leadership constructs, and how do its thematic trends relate to broader organizational transformations?

2. Literature Review

2.1 Digital Transformation and the Leadership Imperative

The quickening pace of digital transformation is reshaping organizations' operating logic, established ways of working, and networks of external relationships, making it difficult for leaders to keep up with rapidly changing technologies and markets. Digital transformation is a process that brings significant changes to an entity's core elements through the use of information and communication technologies (Vial, 2019). Recent syntheses indicate that digital transformation reshapes business models and organizational structures, being an ongoing process of strategic renewal and capability building, rather than a one-time technical project (Warner & Wäger, 2019; Hanelt et al., 2021).

In such a world, the key to leadership is no longer supervising stable daily operations, but enabling and driving change under conditions of volatility, uncertainty, complexity, and ambiguity (VUCA). Digital transformation's effects on work design and leadership are shown in studies with a rise in demand for collaboration, adaptability, and ongoing learning, as companies redesign processes and roles using digital technologies (Schwarzmueller et al., 2018). Therefore, it is expected that leaders align digital initiatives with strategy and support innovation, agility, and responsible governance (Cortellazzo et al., 2019; Nadkarni & Prugl, 2021).

Digital leadership thus emerges as a capability distinct from both traditional leadership and the narrower concept of e-leadership, which focuses solely on technology-mediated leadership. Whereas e-leadership mainly stresses electronically mediated interaction and influence processes (Avolio et al., 2014), digital leadership highlights steering the whole organization to transform, orchestrating digital resources and enabling innovation at scale (Cortellazzo et al., 2019; Benitez et al., 2022). Digital leadership also requires technical and data literacy, as well as leadership of cultural change, coordination across functions, and building enterprise-level governance and capabilities for transformation (Bharadwaj et al., 2013; Larjovuori et al., 2018).

2.2 Conceptual Evolution of Digital Leadership

Scholarly discourse around digital leadership can be found in discussions surrounding the closely related term e-leadership. Earlier studies defined e-leadership as a process of social influence mediated through ICT, emphasizing remote team management, virtual communication, and coordination (Avolio et al., 2014). This view highlights technology's mediating role in leadership but largely extends traditional leadership theories without addressing the internal organizational changes driven by digitalization.

As digital technologies became more pervasive, organizations also became increasingly digitized. As such, researchers began to see that e-leadership alone could not fully convey the significant changes needed in a digital world. Some studies clarify that digital leadership builds on e-leadership, broadening its scope from digital media use to tools for organizational renewal, capability development, and cultural transformation (Parviainen et al., 2017). This transition also reflects a shift in research attention, from the use of digital technologies as leadership media towards strategy, organizational renewal, and transformation.

During this process, the definition of digital leadership is constantly being enriched. For example, Horlacher and Hess (2016) defined it as being able to lead organizational change, manage resources, and generate innovations in a digital context, and digital leaders have to know not just technology trends but also strategic thinking for cross-functional coordination and value creation. Following up on this, Nuryadin et al. (2023) present a systematic literature review demonstrating that the scope of digital leadership moves from focusing on technical skills and tools to creating organizational culture, enabling data-driven decision making, and supporting multi-stakeholder governance, in line with public value and ethical considerations.

In short, the evolution of the concept of digital leadership will be a shift from the concept of leadership through technology as the mediator of digital leadership to a more complete concept of the leader, which encompasses an understanding of the organization's strategic direction, the ability to build the organization itself, organizational cultural change, and a sense of governance. This evolution reflects a growing recognition of digital leadership as a comprehensive framework for leadership in the context of technological transformation.

2.3 Core Competencies and Measurement Progress in Digital Leadership

Digital leadership requires not only technical expertise but also strategic thinking, cultural awareness, and the ability to empower the workforce. Based on 46 interviews, Larjovuori et al. (2018) identified four focal areas of leadership in the context of digital transformation: vision and action, leading cultural change, empowerment and network leadership, providing an empirical basis for the classification of capability domains. At the review level, Cortellazzo et al. (2019) systematically reviewed research on "leadership × digitalization" across disciplines, contending that digital leaders must craft a web of multi-stakeholder relationships, engender collaborative processes, and tackle matters of ethics and data governance, thereby incorporating governance and ethical elements into the competency framework. The organizational change literature also points out, through a large-scale review of digitalization, that it is not just the introduction of technical innovations; rather, digitalization triggers greater organizational plasticity and continuous adaptation, thereby making leadership competence context-specific and time-sensitive (Hanelt et al., 2021).

Recently, some key competency modules of digital leadership have been further confirmed by empirical research. Digital leaders must align technology with business goals, adapting the company vision and making rapid adjustments. Tagscherer and Carbon (2023) summarize the leadership profile as "vision-customer centric-embrace change," which was also confirmed by the interview and case study. Leaders boost organizational agility by lessening dependence on their personal authority and nurturing empowerment, open communication, and cross-level collaboration. These results align with the qualitative evidence from Larjovuori et al. (2018) and other multi-source studies. Zeike et al. (2019) measured digital leadership skills and found a strong link between executives' well-being and the balance between technological literacy and human-centered care. Measurement tools like the DigiFuehr scale and the human-centered digital leadership scale (DLS) assess digital leadership competencies, focusing on areas such as support orientation, organizational coordination, ethical AI use, and participatory leadership. These scales have been tested for structural validity and reliability, addressing governance and responsible leadership issues in digital transformation (Claassen et al., 2021; Claassen et al., 2023; Abbu et al., 2025). Moreover, another article put forth four types of competency portfolio archetypes: challengers, craftsmen, organizers, and competitors. According to the competing value framework, it highlighted that different competency configurations emerged due to the different drivers and purposes of digital transformation. It has a context-sensitive decision-making tool for the preparation and development of leadership competence (Müller et al., 2024). Also, a number of empirical studies show that digital leadership improves employee creativity and exploratory innovation through mediating job crafting, digital entrepreneurial orientation, and digital culture, respectively. The results provide empirical evidence for the theoretical chain of competencies, mechanisms, and performance (Zhu et al., 2022; Wang et al., 2022). These recent studies suggest a stable consensus set of digital leadership elements: strategic vision and value orientation; cultural change and empowerment;

technological and data literacy; ethical governance and transparency; and cross-boundary collaboration and networked leadership.

3. Methodology

To examine the intellectual structure and evolutionary trajectory of digital leadership research, this study integrates bibliometric analysis with scientific knowledge mapping. Bibliometric analysis enables the systematic identification of key domain characteristics, including frequently used keywords, influential authors, and institutional and national contributions, thereby supporting the detection of research patterns and potential future directions (Mayr & Scharnhorst, 2015; Donthu et al., 2021). Scientific knowledge mapping complements this approach by visualizing relational structures within the literature, such as co-citation relationships, thematic clusters, and temporal evolution patterns, which help clarify the knowledge base and developmental pathways of a research field (Abramo et al., 2011; Shafique, 2013; Hou & Hu, 2013). Compared with traditional narrative reviews or systematic syntheses, knowledge mapping offers a balance of breadth and structural depth and has been increasingly applied in education, management, and information science to synthesize large bodies of literature and anticipate emerging trends (Hérubel, 1999; Wang & Lu, 2020).

Bibliographic records were retrieved from two databases: WoS and Scopus. There is conceptual ambiguity and boundary debates between digital leadership and adjacent constructs (for example, e-leadership), which can lead to thematic overlap in evidence synthesis (Eberl & Drews, 2021; Jameson et al., 2022; Lin, 2025). To enhance construct clarity, this study adopted a construct-purification strategy by focusing on publications that explicitly address digital leadership while excluding records associated with adjacent labels. The search was conducted in Web of Science Core Collection using the exact phrase "digital leadership" in the Topic field, and not "e-leadership" or "electronic leadership" in the Topic field. In Scopus, the search was conducted using the exact phrase "digital leadership" in the Title-Abstract-Keywords field, and not "e-leadership" or "electronic leadership" in the Title-Abstract-Keywords field. The retrieval timeframe was set from January 1, 2015, to June 20, 2025, with 2025 treated as a partial year. Only English-language, peer-reviewed journal articles were included, whereas conference proceedings, editorials, book chapters, and non-English documents were excluded. The search was completed on June 20, 2025, yielding 275 records from WoS and 409 records from Scopus. Duplicates were removed via DOI and title matching. For records without DOIs, titles were manually checked to identify duplicates. This process resulted in a final dataset of 435 unique records for subsequent analysis (see Fig. 1).

Based on the retrieved records from Web of Science and Scopus, 435 digital leadership articles were published from 2015 to June 20, 2025. As shown in Fig. 2, annual output saw a large rise with a steep increase in 2024 ($n = 150$, 34.5%). Since 2025 is a partial year, with $n = 109$ as of June 20, publication counts for 2025 should be interpreted with caution. Taken together, the data indicate a rapid increase in scholarly attention to digital leadership, particularly from 2023 onwards.

Analyses were performed in CiteSpace (version 6.4.R1), a software program for visualizing and analyzing citation data that can detect clusters, bursts, and temporal patterns in scientific literature (Chen, 2006). We conducted four types of analysis:

1. Keyword co-occurrence analysis to identify core topics and conceptual foci
2. Burst detection to capture emerging terms and shifting attention over time
3. Keyword clustering to reveal thematic subfields and their knowledge structure
4. Timeline and time zone visualizations to trace the evolution and diffusion of major themes during 2015 to mid-2025

4. Results

4.1 Keyword Structure and Core Themes

CiteSpace was used for keyword analysis to identify the structural features and research emphases of digital leadership studies from 2015 to mid-2025. Node type: keyword, time slice: 1 year, top_k: 50. To increase the readability of the network, we used the Pathfinder algorithm (Chen et al., 2015).

Figure 3 is the keyword co-occurrence network generated by the dataset. The network contains 344 nodes and 729 links, which represent the main topics and their co-occurrence. Digital leadership is in the middle, often paired with digital transformation, innovation, capability, technology, and performance. These terms form the structure of the field, which is tightly interconnected across the organizational, strategic, and technical aspects.

To find out the most important terms, keywords were ranked by their frequency of occurrence and by betweenness centrality. The first ten results are presented in Table I. Digital transformation was the most frequent keyword (98), followed by impact (40), performance (36), dynamic capability (33), and innovation (29). Other frequent terms included were technology (28), management (26), and transformational leadership (26). Regarding its centrality, digital transformation (0.34) still has the highest connectivity, after which come skills (0.27), future (0.23), ethical leadership (0.23), and article (0.21).

In Fig. 3, the temporal color coding demonstrates how the appearance of new keywords such as artificial intelligence and ethical leadership emerged in the past few years (2022–2025). These terms indicate a shift in research attention towards the technological and ethical dimensions of leadership. The co-occurrence and centrality analysis jointly suggest that the core ideas in digital leadership studies are shaped by transformation, capability building, and innovation, while there is a growing interest in technology-oriented and human-centered topics.

Table Top Ten Keywords in Terms of Frequency and Centrality for Digital Leadership

Ranking	Counts	Keyword	Ranking	Centrality	Keyword
1	98	digital transformation	1	0.34	digital transformation
2	40	impact	2	0.27	skills
3	36	performance	3	0.23	future
4	33	dynamic capability	4	0.23	ethical leadership
5	29	innovation	5	0.21	article
6	28	technology	6	0.20	antecedents
7	28	transformation	7	0.19	technology
8	26	management	8	0.19	artificial intelligence
9	26	transformational leadership	9	0.19	integration
10	20	artificial intelligence	10	0.18	framework

4.2 Research Hotspots Identified by Burst Detection

Keyword burst detection was used to identify terms that attracted sudden and concentrated scholarly attention over specific periods. Utilizing CiteSpace to recognize the most prominent fifteen keywords exhibiting the highest burst strength during the years 2015–2025, as shown in Table II.

The timing of these bursts shows how the research focus has been developing over time. In the early phase (2015–2018), the bursts were framed by more general terms like age, article, and innovation management. In the second phase (2019–2020), keywords focused on capabilities and contexts such as human, leadership, and higher education. Third phase (2020–2022): A higher level of interest in the leadership mechanisms related to organizational transformation can be seen, as indicated by the bursts for transformational leadership, digital strategy, and behavioral data. In the most recent phase (2021–2025), the focus has widened to organization-wide outcomes, and there are strong bursts of business, trust, and IT.

Table ☐ Top 15 Keywords with the Strongest Bursts

4.3 Clustering of Research Themes

4.3.1 Thematic Clusters and Mountain View

Using CiteSpace to identify the 15 main clusters via LLR label (see Fig. 4). To add to the cluster network, we generated a mountain view (see Fig. 5) of each theme's relative activity span and within-cluster cohesion.

At the field level, the largest and most persistent clusters suggest that digital leadership research has been grounded in organization-level digitalization and transformation. Cluster #0 "Digital management" has shown consistent interest in what managers can learn from data, and the results from their data (Benitez et al., 2022; Zam et al., 2024). Cluster #11 "Digital transformation" centers on leadership for transformation, agility, and business renewal (Philip et al., 2023; Malik et al., 2025).

Along with these foundations, there are also technology-intensive themes that are appearing. Cluster #7 "Big Data and Real-Time Analysis" foregrounds data literacy and real-time analysis as a managerial concern, and is sometimes related to competitive advantage (Aftab et al., 2025). Cluster #9 "Human-AI collaboration" reflects growing interest in AI-assisted decision environments and the practical difficulty of combining human judgment with algorithmic suggestions (Jaboob et al., 2025).

Employee-focused themes are also highly visible in the cluster landscape. Clusters #6 "Well-Being" and #14 "ICT Hassles" show growing interest in technostress, psychological sustainability, and the conditions that make digital work healthy and supportive (Khan et al., 2025; Zhou et al., 2024). Cluster #8 "Employee professional development" points to learning, training, and culture-building as recurrent topics in the studies of leadership-enabled capability development (Fakhfakh et al., 2025). Several other clusters, such as digital space, fourth industrial revolution, and educational leadership, mainly work as an application context for where these themes are applied (Avolio et al., 2000; Diniz et al., 2024; Sheninger, 2014).

Taken together, the cluster and mountain visualize continuous transformation-related foundations with an expansion into analytics and AI decision contexts and employee sustainability concerns. These patterns form the empirically based description of the subsequent three-dimensional synthesis.

4.3.2 Temporal Evolution and Knowledge Diffusion

Figures 6 and 7 illustrate the evolution and spread of digital leadership research over time. Initially, from 2015 to 2018, the research was mainly focused on fundamental topics like digital transformation, technology, and knowledge, with an emphasis on digital infrastructure and organizational change. Starting in 2019, the research structure became more scattered, with clusters such as digital management, dynamic capability, and digital transformation maintaining continuity throughout the timeline. From 2021 onward, new clusters like emotional intelligence, well-being, and employee professional development gained importance, reflecting the increasing focus on leader behaviors and employee experience. These shifts show that the research has gradually expanded from a focus on technology and organizational transformation to more emphasis on organizational capabilities, leadership culture, and human resources. The timeline suggests a shift from an early emphasis on technology and organizational transformation toward a broader focus that increasingly includes capability development, leadership culture, and employee-related themes.

5. Conceptual Framework: An Interpretive Framework of Digital Leadership

Building on the bibliometric patterns identified above and interpreted in light of the reviewed literature, this section proposes an integrated interpretive framework of digital leadership. This framework does not offer a static classification of topics, but presents a dynamic view that links key contextual drivers, leadership dimensions, core competencies, and multi-level outcomes. It also highlights the need to balance organizational effectiveness with human-centered adaptation under conditions of rapid technological change. The clustering results indicate that, due to the acceleration of technological disruption and the widespread digitization, digital leaders are increasingly operating in a broader external environment. In this situation, the identified clusters suggest three broad and interrelated dimensions through which digital leadership can be understood (see Fig. 8):

1. Strategic-Capability Dimension.

Represented by clusters like #10 Dynamic Capability and #11 Digital Transformation, focusing on the leader's role in developing the organization's capacity for strategic renewal. It focuses on sensing the opportunities, reconfiguring resources, and innovating the business model.

2. Human-Centered Dimension.

Comprising clusters like #2 Emotional Intelligence, #5 Servant Leadership, #6 Well-being, #8 Employee Professional Development, and #14 ICT Hassles. This dimension captures the psychosocial and relational aspects of digital leadership, including empowerment, trust, psychological safety, supportive digital culture, and leaders' responses to technology-related stress experienced by employees.

3. Technology-Driven Dimension.

Including clusters like #7 Big Data and Real-Time Analysis and #9 Human-AI Collaboration, which foreground leaders' responsibilities in understanding, deploying, and governing digital technologies. This emphasizes data literacy, the ability to leverage analytics for decision-making, and the capability to orchestrate effective human-AI collaboration while addressing associated governance and ethical concerns.

Across these dimensions, several capabilities recur in the literature, including strategic orientation, change facilitation, relational sensitivity, and data-related competence. At the organizational level and in transformation-oriented and performance-oriented clusters, digital leadership is associated with enhanced innovation, agility, and performance (such as clusters #0 and #4). At the human level and within the well-being and development clusters, the outcomes include increased employee well-being, enhanced work motivation, and promotion of career development (as in clusters #6 and #8). Beyond those, broader societal and governance implications may be relevant, but they require further empirical investigation beyond the scope of the present bibliometric analysis.

To achieve effective digital transformation, leaders need to simultaneously coordinate the use of technology, formulate strategic directions, and lead and care for organizational members, so as to address both the needs of efficient operations and human-centered innovation. Taken together, the mapped literature suggests that digital leadership is discussed less as a matter of isolated tool use and more as a composite organizational capability.

6. Discussion

Interpreted through the integrated framework in Section 5, the bibliometric map suggests that digital leadership has evolved from a tool-use view to a multidimensional capability spanning strategy, technology, and people. The field's core clusters align with a strategic-capability stream (digital transformation, digital management, dynamic capabilities), alongside a human-centered stream (emotional intelligence, servant leadership, well-being, professional development, and ICT-related stressors reflected in ICT hassles) and a technology-driven stream (big data, real-time analytics, human-AI collaboration). These findings, interpreted through our framework, reinforce the view of digital transformation as an organization-wide, multidimensional change process, while aligning with prior work on strategic capability renewal, digital culture and employee well-being, and analytics-enabled performance through socio-technical alignment (Vial, 2019; Cortellazzo et al., 2019; Mikalef et al., 2019). Digital leadership scholarship appears to be moving beyond an early ICT-mediated influence perspective (Avolio et al., 2000) toward a more integrative understanding that links strategy, technology governance, and human-centered leadership.

Prior work notes a movement from "technology leadership" in the 1990s to e-leadership in the early 2000s and, more recently, digital leadership since the mid-2010s (Liu et al., 2025). This development reflects a shift from technology-centered leadership to a more integrated, transformation-oriented approach that requires coordination across strategy, technology, and human resources. The coexistence of strategic and human-oriented themes suggests that digital leadership involves balancing transformation-oriented capabilities with employee-related outcomes such as learning, well-being, and psychological safety. Leaders must simultaneously develop the dynamic ability for change and maintain human outcomes such as learning, well-being, and psychological safety.

The emergence of themes related to well-being and those related to ICT hassle and technical pressures indicates that the effectiveness of digital leadership not only depends on technical coordination but also on the leader's ability to alleviate stress and support healthy digital work. This interpretation is consistent with the evidence that analysis and digital planning can only generate value in organizations that support such conditions and cultures (Zeike et al., 2019; Mikalef et al., 2019). The same perspective also explains why digital leaders should be distinguished from electronic leaders in their approach to analysis. Although e-leadership is mainly described as the influence facilitated by technology in an environment mediated by information and communication technologies (Avolio et al., 2000), digital leadership more often associated with making strategic and coordinated arrangements for transformation, capability building, and governance (including ethical supervision) in the face of the increasing complexity of digitalization (Vial, 2019; Hanelt et al., 2021). This distinction is in line with the academic perspective on digital transformation. Digital transformation as an ongoing and systemic process shaped by continuous interactions between organizations and their broader digital environment, rather than a discrete adoption of technologies (Vial, 2019).

To ensure construct clarity, we focused on publications explicitly labeled as digital leadership, excluding those that discussed e-leadership or electronic leadership. This choice may omit relevant studies using adjacent labels, and future research could assess the robustness of cluster structures under different construct-boundary definitions. Burst detection reveals a late-stage shift toward governance and reliability concerns in digital leadership research, with recent bursts indicating a focus on trust and information technology. These trends show that the next wave of scholarship may focus on how digital leaders build trustworthy, data- and AI-enabled work systems through transparency, accountability, and ethical oversight. The mapped literature also suggests that digital leadership is often discussed as a bundle of interrelated capabilities rather than a narrow set of technology-use behaviors. Future research may further examine how such capabilities are enacted through routines related to experimentation, strategic alignment, and organizational redesign. Such routines are central to successful capability renewal in digital transformation contexts (Warner & Wäger, 2019), and they are not simply a collection of tools. At the people-management level, the recurring combination of emotional intelligence, well-being, employee development, and ICT hassle themes appears repeatedly. This indicates that in highly digitalized work settings, sustaining performance requires continuous investment in digital competency development, workflow redesign, and employee well-being policies. Leaders play a critical role in shaping digital culture and ethical boundaries (Cortellazzo et al., 2019). In the public sector and the field of education, the growing emphasis on governance and ethics, as well as the prominence of the theme of stakeholder coordination, indicate that leaders must combine data governance and artificial intelligence supervision with cultural building and stakeholder participation.

As limitations, the dataset was restricted to English-language journal articles indexed in Web of Science and Scopus, which may underrepresent relevant scholarship published in other languages, databases, or document types. Second, the search strategy deliberately focused on publications explicitly labeled as “digital leadership” and excluded adjacent labels “e-leadership” and “electronic leadership”. While this construct-purification strategy improved boundary clarity, it may also have omitted conceptually related studies. Third, 2025 was treated as a partial year, so recent publication trends should be interpreted cautiously. Finally, bibliometric mapping is effective for identifying thematic structures, relationships, and temporal shifts. However it cannot by itself establish causal mechanisms, validate construct boundaries empirically, or determine leadership effectiveness in practice. In addition, the interpretive framework proposed in this study reflects analytical synthesis and should therefore be understood as a bibliometrically informed interpretation rather than a definitive model.

7. Conclusion

This study maps the digital leadership research domain from 2015 to mid-2025 through bibliometric knowledge mapping based on 435 publications retrieved from Web of Science and Scopus. Using keyword co-occurrence analysis, burst term detection, clustering, and temporal visualization, the study identifies the field’s structural composition and its evolving thematic emphases. Digital leadership is increasingly seen as a multidimensional capability linking strategic capacity building with human-oriented governance and ethical digital culture.

The literature reveals three dominant streams: strategic capability, human-centered leadership, and technology-driven innovation. Synthesized together, these streams suggest that digital leadership could be understood as an ambidextrous construct that simultaneously orchestrates digital technologies and enables sustainable human functioning in technology-mediated work systems. Theoretically, this research is helpful in consolidating scattered academic studies and clarifying the boundaries between digital leadership and adjacent structures. Within the boundary conditions of this review, digital leadership appears broader than e-leadership in that it is more strongly associated with transformation-oriented orchestration, capability renewal, and governance than with technology-mediated influence alone. The findings suggest that digital leadership appears to encompass elements of organizational strategy, digital capabilities, and psychosocial sustainability. In fact, the overall picture indicates that digital leadership is discussed less as a set of isolated tools and more as a configuration of interrelated capabilities. Recurrent topics in the literature include strategic orientation, change facilitation, data-related competence, and employee-related concerns such as trust, well-being, and psychological safety.

The limitation of using only English-language articles may underrepresent scholarship from regions undergoing rapid digital transformation. Future studies could adopt multilingual bibliometric strategies and incorporate regional databases to capture a broader global picture. Moreover, although keyword-based mapping is effective for revealing structural patterns and thematic evolution, it cannot directly explain why shifts occur or how causal mechanisms operate at the micro level. Future research should triangulate bibliometric mapping with full-text topic modeling, qualitative synthesis, or mixed-method designs to connect macro-level thematic structures with underlying mechanisms and outcomes.

Based on the identified clusters and burst terms, several key research questions are proposed:

1. From the burst keyword "trust."

What particular leadership behaviors promote trust within data-driven and AI-driven work environments, and how does this trust influence employees' willingness to use algorithmic tools?

2. From Cluster #9 (Human-AI collaboration)

Digital leaders can reconcile the algorithms' choices with people's intuitions by mediating between them. How do they reconcile it, and what are the results on teams' efficiency, psychological safety, and cross-functional collaboration?

3. From strategic-capability cluster #10 and #11

What combinations of digital capabilities allow leaders to reconfigure resources during high-velocity digital transformation, and how do such capabilities interact with organizational learning processes?

4. From human-centered clusters (#2, #5, #6, #8, #14)

How leaders balance accelerated technology with employees' well-being, and which leadership processes cushion ICT-related stressors in hybrid and platform-based organizations?

Together, these research questions go beyond the usual generic recommendations and provide a domain-specific, evidence-driven agenda within the field's own conceptual framework. Looking ahead, organizations undergoing rapid technological change, adopting AI-assisted decision-making, and seeking ethically grounded digital transformation are likely to require more integrative forms of digital leadership. This study offers a bibliometrically informed basis for future theory development and may also inform leadership development and policy discussion in digitally transforming contexts.

Declarations

Ethical Approval

This article does not contain any studies with human participants performed by any of the authors.

Informed Consent

This article does not contain any studies with human participants performed by any of the authors.

Author Contribution

Author Contributions
Conceptualization: Midya Yousefi
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Writing, Review & Editing: Jun Zhang & Midya Yousefi
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All authors have read and approved the final version of the manuscript.

Data Availability

The materials supporting this study have been provided to the editors and reviewers for the purposes of peer review. These materials include the PRISMA checklist and flow diagram, database search strategies, extracted records, screening and deduplication logs, inclusion and exclusion criteria, and data extraction and synthesis tables. These materials are available in the supplementary files submitted with the manuscript.

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Table

Table II is available in the Supplementary Files section.

Figures

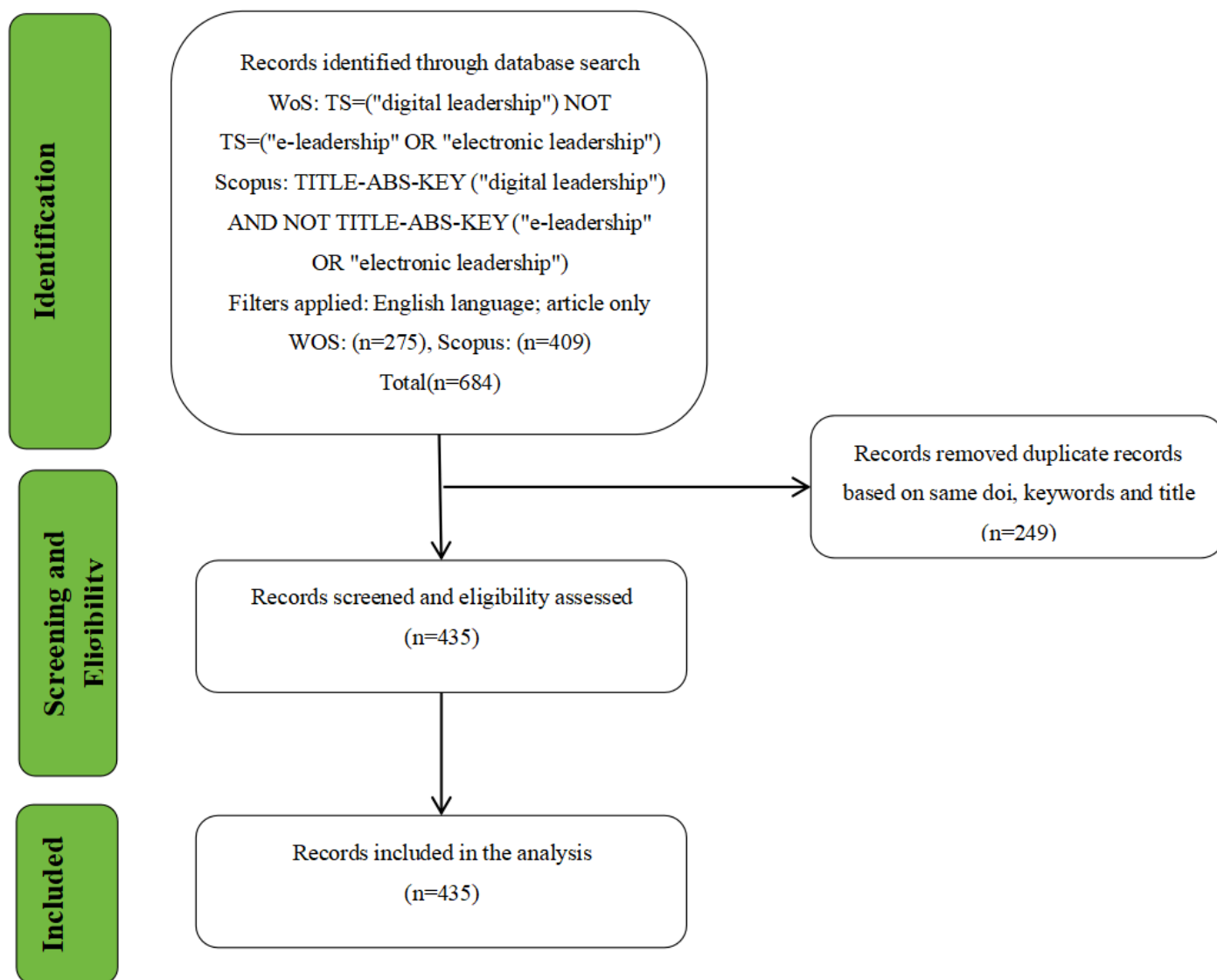


Figure 1

PRISMA Flow Diagram

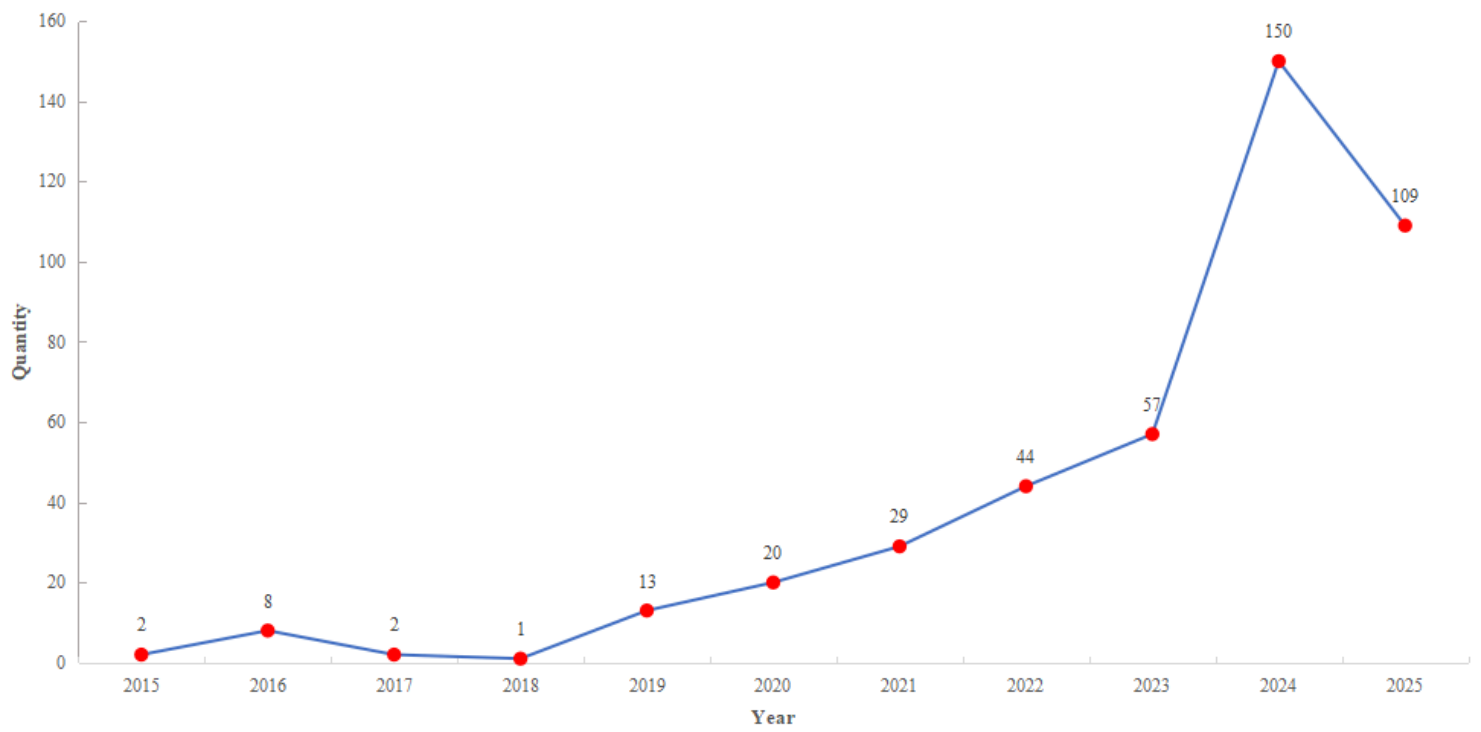


Figure 2

Annual Number of Publications on Digital Leadership from 2015 to June 2025

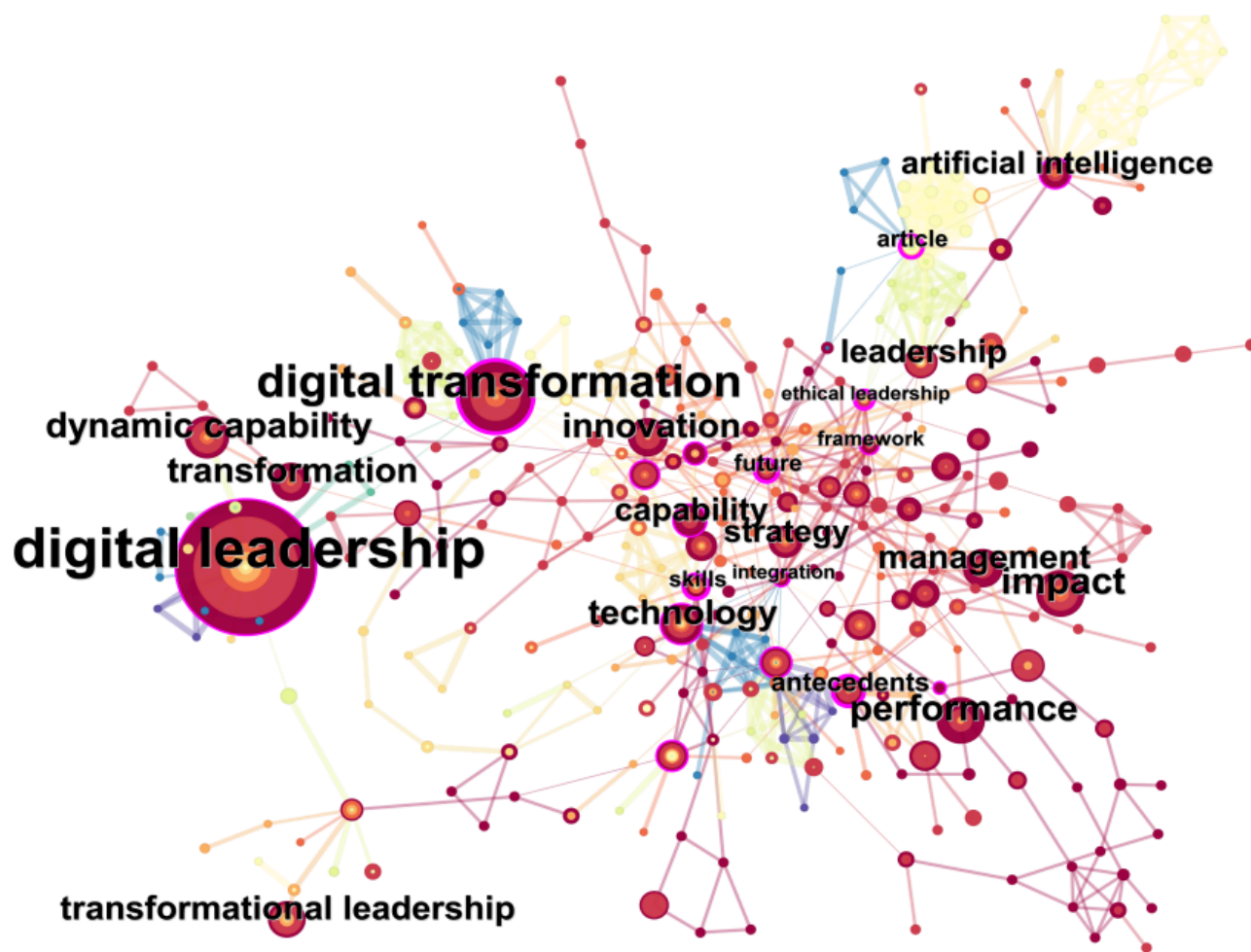


Figure 3
 Keyword Co-occurrence Network of Digital Leadership

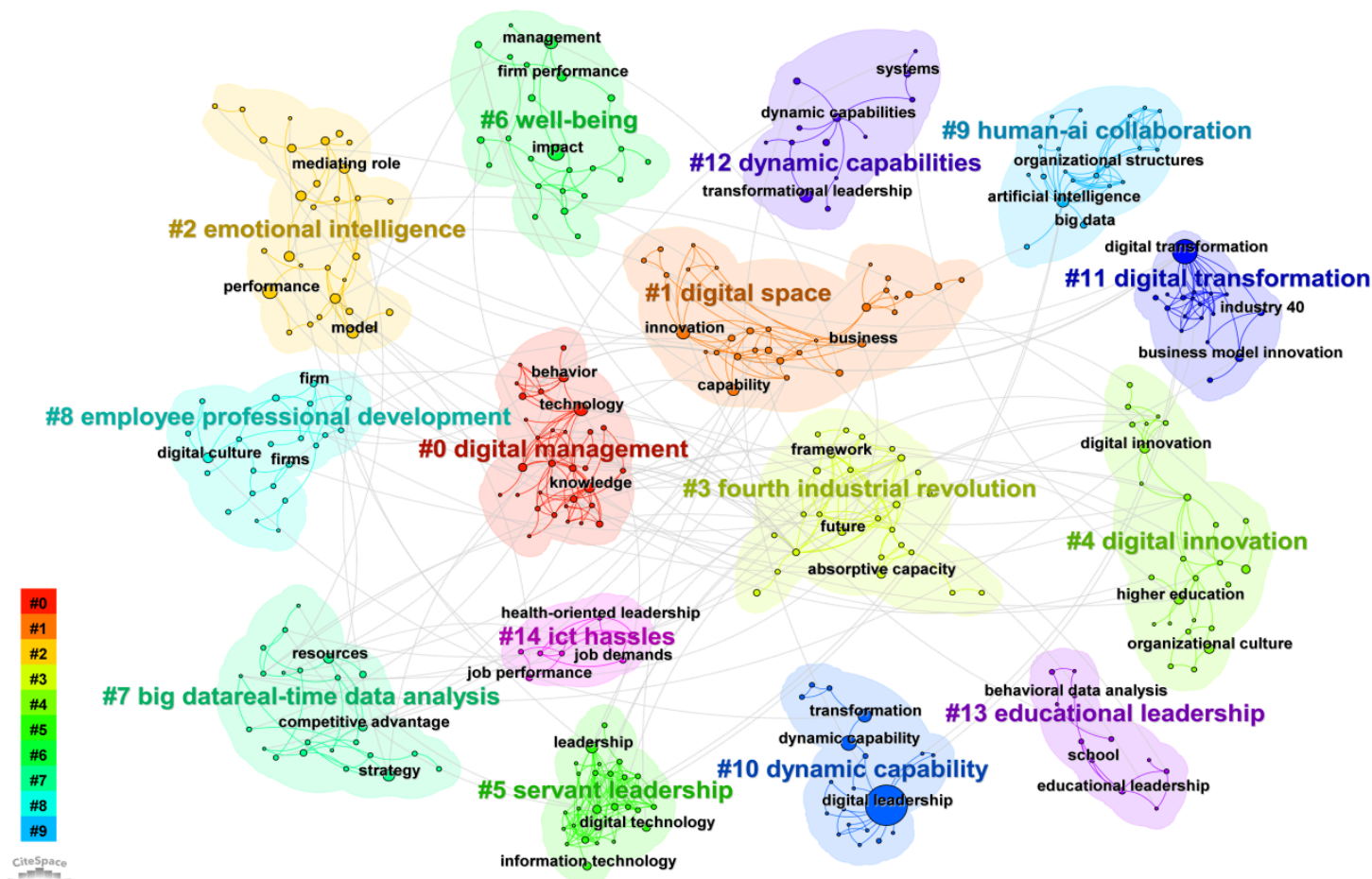


Figure 4
 Keyword Co-occurrence Clustering Network of Digital Leadership Research

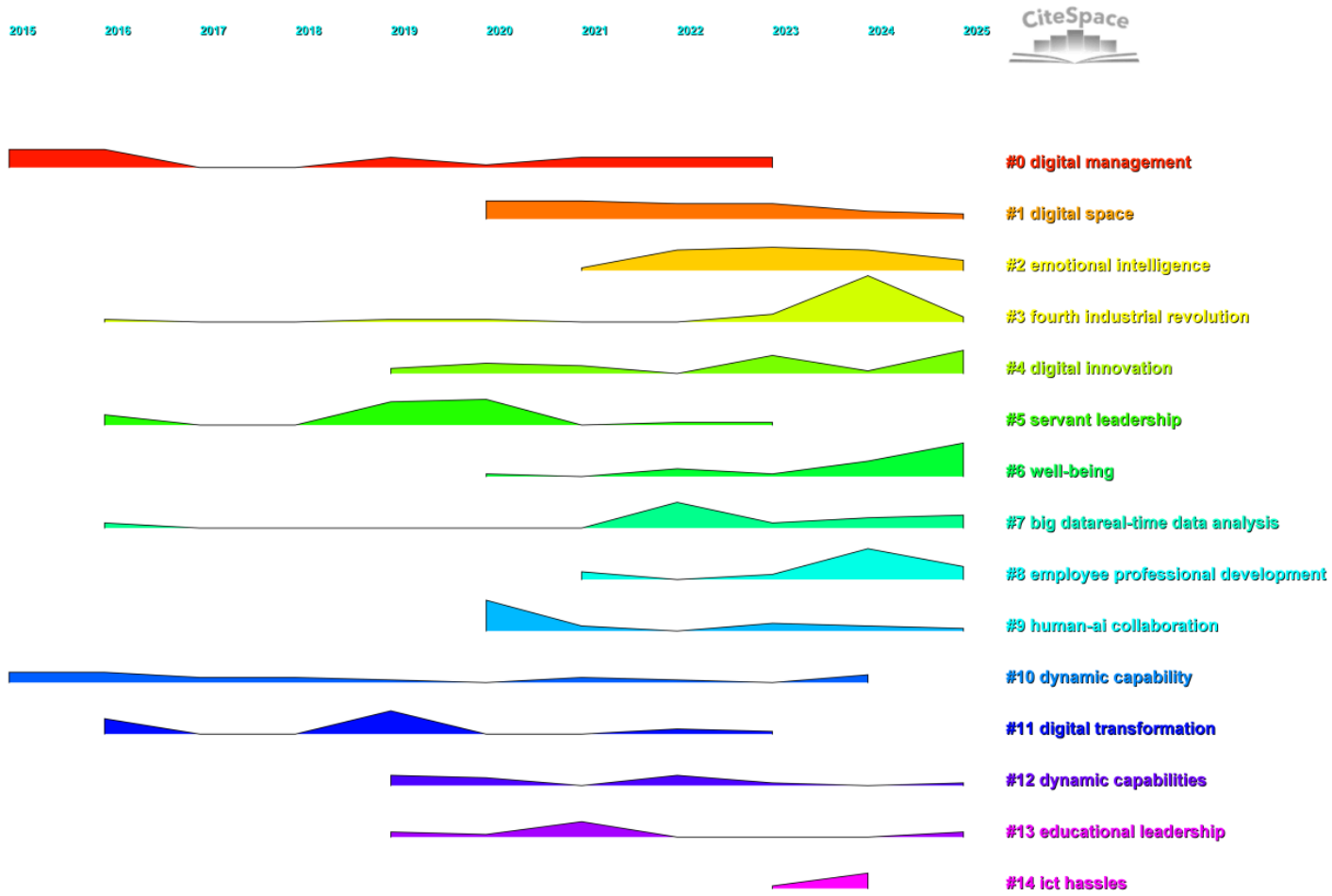


Figure 5

Mountain View of Thematic Clusters

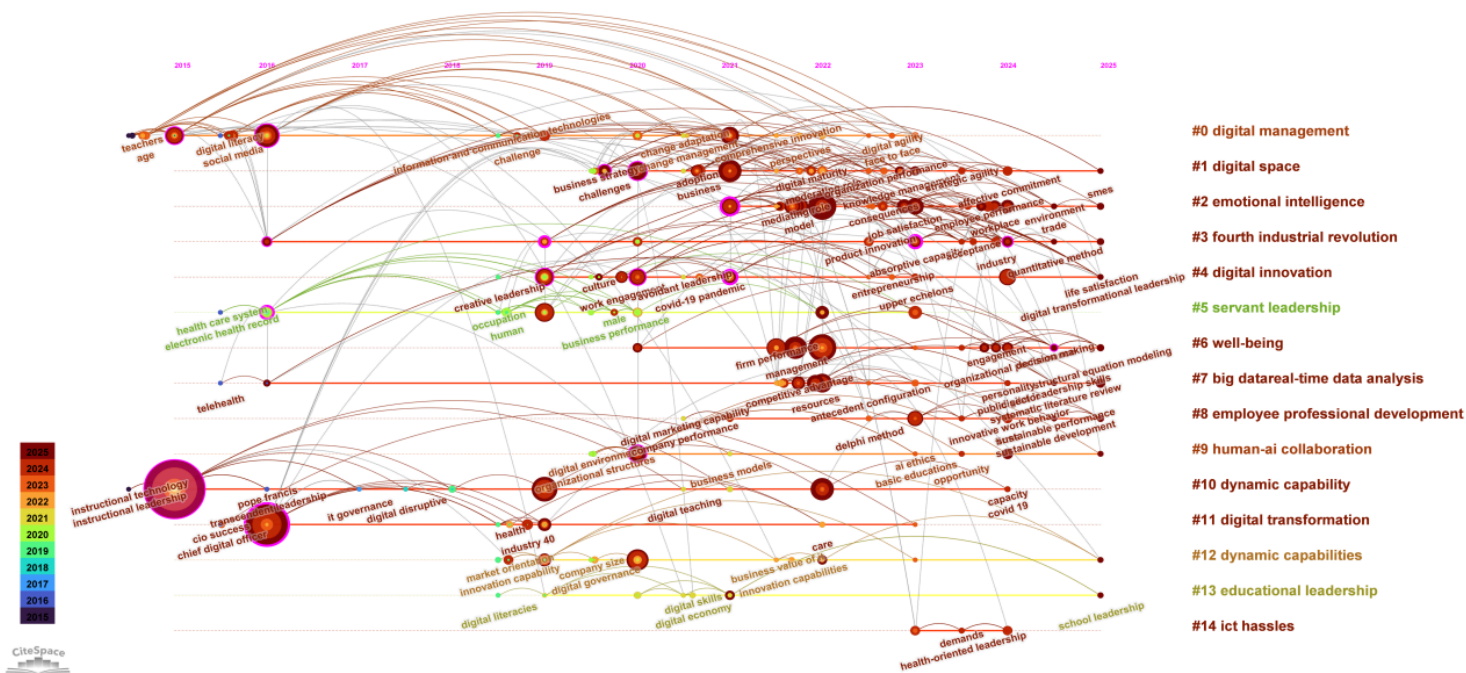


Figure 6
 Timeline Visualization of Keyword Clusters (#0-#14)

CiteSpace, v. 6.4.R1 (64-bit) Advanced
 August 29, 2025, 7:49:21 PM CST
 WoS: C:\Users\jzx\Desktop\digital leadership and e-leadership\data
 Timespan: 2015-2025 (Slice Length=1)
 Selection Criteria: g-index (k=25), LRF=2.5, L/N=10, LBY=-1, e=1.0
 Network: N=344, E=729 (Density=0.0124)
 Largest 1 CCs: 326 (94%)
 Nodes Labeled: 1.0%
 Pruning: Pathfinder
 Modularity Q=0.788
 Weighted Mean Silhouette S=0.9064
 Harmonic Mean(Q, S)=0.8431
 Excluded:

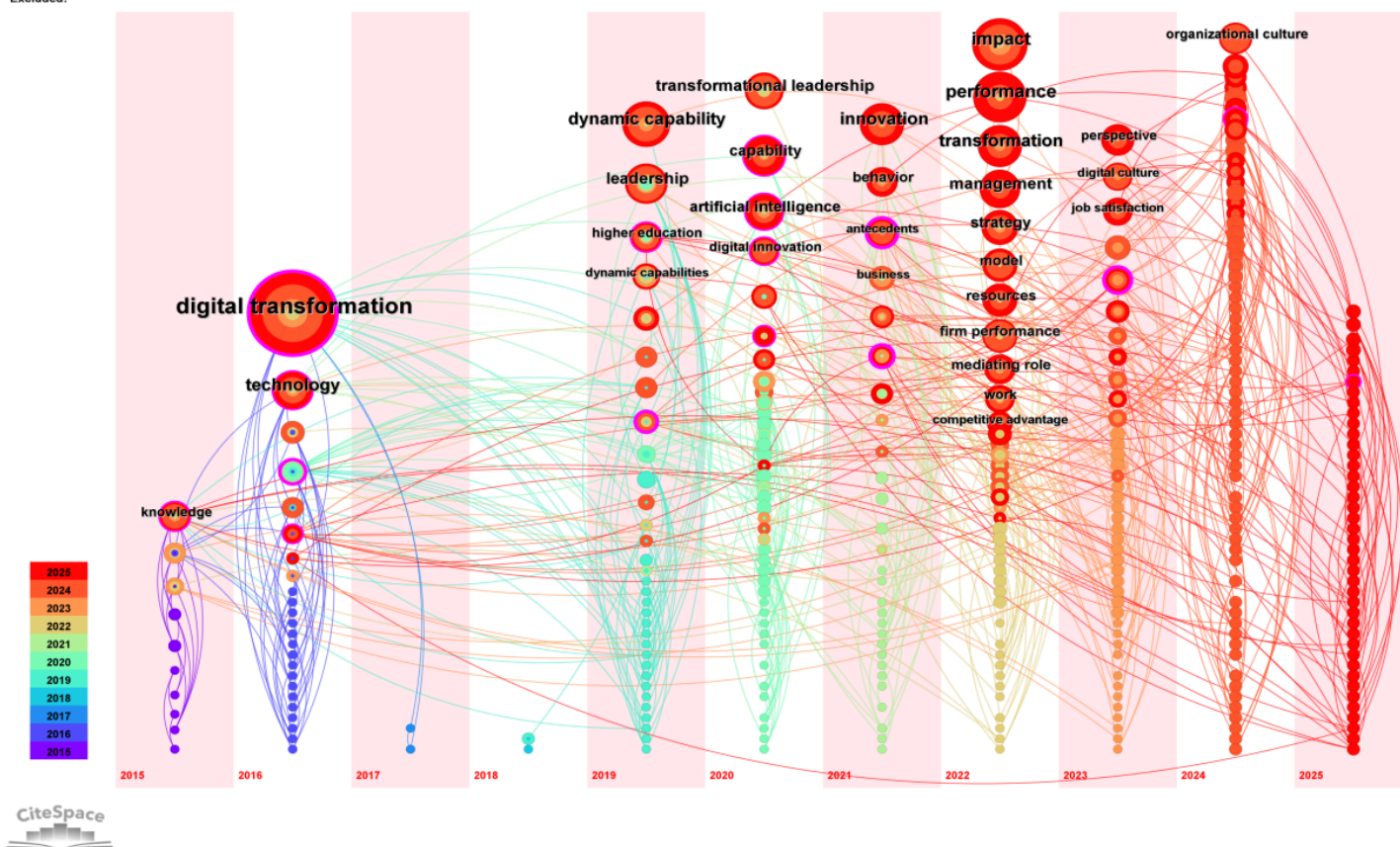


Figure 7

Timezone Visualization of Keyword Clusters (#0-#14)

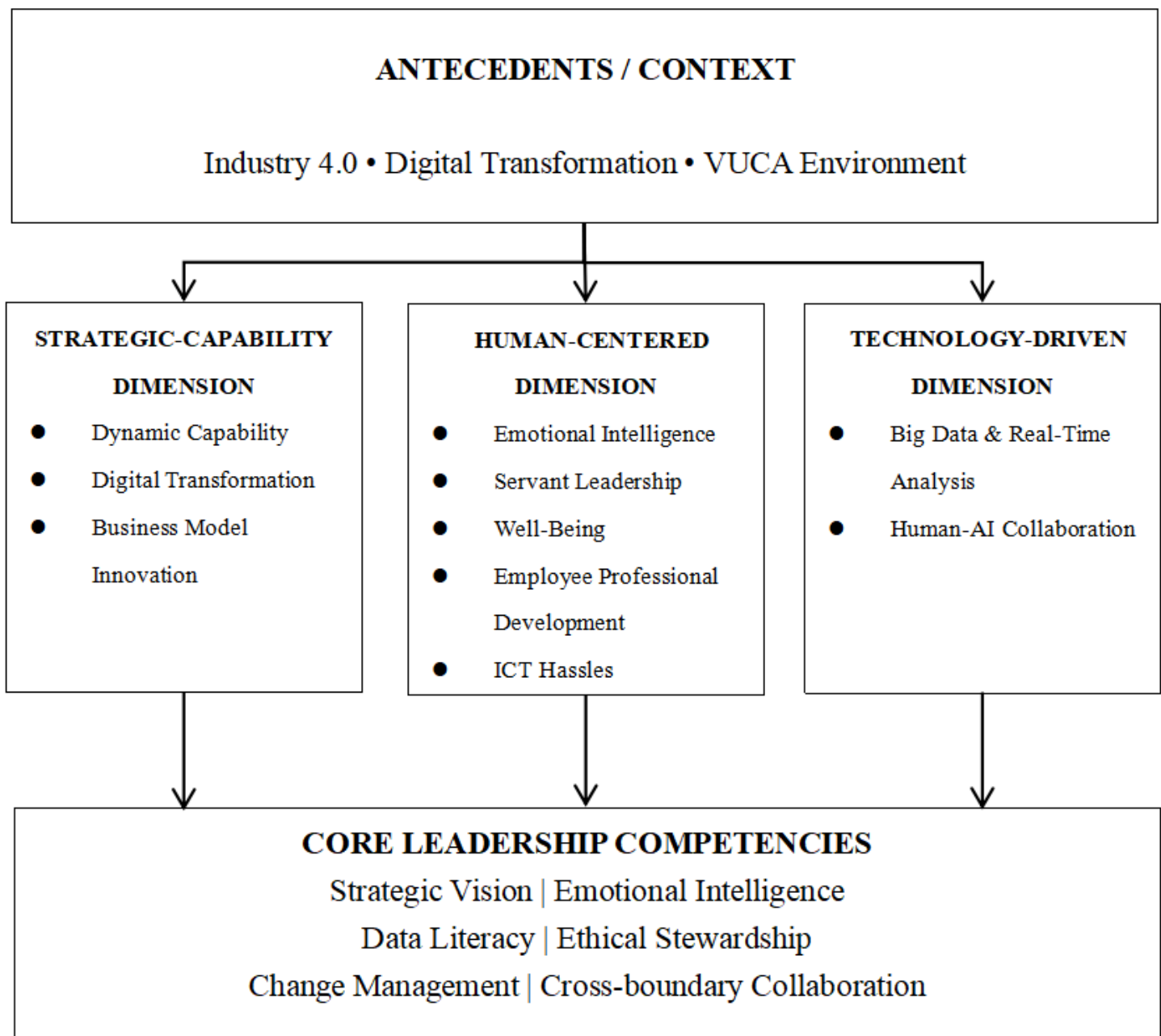


Figure 8

An Integrated Framework of Digital Leadership

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [Table11.docx](#)