

# Mapping Global Research Trends on Digital Transformation, Innovation Capability, and Knowledge Management in Startup Competitive Advantage: A Bibliometric Study

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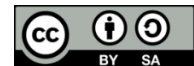
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## ABSTRACT

This study maps global research trends on digital transformation, innovation capability, and knowledge management within the context of startup competitive advantage using a bibliometric and science-mapping approach. Data were extracted from the Scopus database and analyzed using VOSviewer through network visualization, overlay mapping, density analysis, author collaboration mapping, and country collaboration networks. The findings reveal three dominant thematic clusters: digital transformation as an ecosystem-driven strategic capability, innovation capability as a core driver of entrepreneurial agility, and knowledge management as the foundation for organizational learning and adaptability. Temporal evolution analysis shows a shift from early digitalization research toward advanced topics such as platform ecosystems, sustainable digital entrepreneurship, and knowledge-intensive services. Overall, the study highlights that startup competitive advantage emerges from the integration of technological readiness, innovation-driven value creation, and dynamic knowledge flows. These findings provide a consolidated understanding of the field and identify promising directions for future research on digital competitiveness and entrepreneurial ecosystems.

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## 1. INTRODUCTION

In recent years, the rapid acceleration of digital technologies has reshaped the global business landscape, compelling organizations—particularly startups—to continuously adapt and innovate to sustain their competitive advantage (Chernova et al., 2022; Frick et al., 2020). Digital transformation (DT) has emerged as a critical strategic priority, enabling firms to optimize processes, enhance customer experience, and unlock new value-creation mechanisms. As highlighted in the most influential studies from the past decade, DT is no longer limited to technology deployment but represents a holistic organizational shift encompassing culture, leadership, capabilities, and ecosystem readiness. (Carolus et al., 2017; Eling & Lehmann, 2018), for instance, underscore that digital transformation challenges require multi-stakeholder strategies, reinforcing the notion that

startups must mobilize resources, talent, and networks to navigate increasingly volatile environments.

Alongside technological adoption, innovation capability plays a pivotal role in determining whether startups can survive within hyper-competitive digital markets. Innovation is widely acknowledged as a key driver of organizational agility, allowing firms to respond rapidly to market changes, create disruptive offerings, and strengthen long-term competitiveness. Research by (Ninglasari & Muhammad, 2021; Rebiazina & Haddadi, 2021) emphasizes that digital entrepreneurship fosters systemic innovation, paving the way for sustainable transitions and growth trajectories. In the context of startups—characterized by resource scarcity and dynamic learning environments—innovation capability becomes not only a strategic asset but also a determinant of survival.

Parallel to DT and innovation, knowledge management (KM) has evolved into a foundational element enabling firms to leverage organizational intelligence for strategic decision-making. The digital era amplifies the importance of knowledge flows, requiring organizations to capture, process, and disseminate insights at unprecedented speeds. Studies such as (Cillo & Verona, 2022; Kandybko et al., 2019; Rebiazina & Haddadi, 2021) illustrate how knowledge-intensive services increasingly depend on technology-enabled processes to remain competitive, highlighting a direct link between KM practices and the ability to innovate. Within startups—where team size is limited and knowledge tends to be tacit—effective KM systems support experimentation, iterative learning, and capability building.

Startups also operate within increasingly interconnected digital platform ecosystems, which shape both opportunities and constraints in their competitive strategies. (Budiman et al., 2025; Rajagopal & Davila, 2020; Verma et al., 2022) demonstrate how digital platforms influence business models, customer interfaces, and partnership arrangements, affecting how startups position themselves in crowded markets. Platform-based competition requires not only technological readiness but also the capability to integrate into broader digital value chains. These dynamics reinforce the necessity for startups to understand ecosystem-based competitive advantage, where collaboration, co-creation, and technological alignment determine strategic outcomes.

Despite the expanding body of literature, research on the intersection of digital transformation, innovation capability, and knowledge management remains fragmented, especially in the context of startup competitive advantage. Existing studies often focus on isolated dimensions—such as digital disruption in healthcare (Annas & Meilinda, 2023; Khuan et al., 2023), sustainability-driven business models (Mungila Hillemane, 2020), or corporate–startup collaboration through accelerators (Bryk et al., 2022) but seldom adopt an integrative, holistic perspective. The increasing volume of publications highlights the need for a systematic mapping of the intellectual structure, evolution, and thematic convergence across these domains. A bibliometric approach is therefore essential to capture publication patterns, identify leading authors and countries, and reveal emerging research clusters shaping this interdisciplinary field.

Given this background, the present study aims to map global research trends on digital transformation, innovation capability, and knowledge management within the framework of startup competitive advantage. By employing a science-mapping approach using network visualization, overlay analysis, density mapping, and country collaboration data, this study provides a comprehensive overview of how these domains interact and evolve. Understanding these relationships is crucial for scholars, practitioners, and policymakers seeking to develop strategies

that strengthen startup ecosystems, foster technological readiness, and sustain innovation-driven competitiveness. Ultimately, this study contributes to the consolidation of knowledge in a rapidly developing research area and offers insights into promising future research trajectories.

## **2. METHODS**

### **2.1 Design**

This study employed a descriptive–quantitative bibliometric approach to map global research trends related to digital transformation, innovation capability, knowledge management, and their collective contribution to startup competitive advantage. Bibliometric analysis is a widely used quantitative technique that allows researchers to systematically evaluate the intellectual structure, publication patterns, and thematic evolution of a scientific field. Through citation analysis, co-authorship mapping, keyword co-occurrence, and network visualization, the present study identifies influential contributions and emerging directions within the literature. The method integrates performance analysis and science mapping to ensure both breadth and depth of insights.

### **2.2 Data Source and Search Strategy**

The bibliometric dataset was extracted from the Scopus database, which is recognized for its comprehensive indexing of peer-reviewed scientific literature across disciplines. Scopus was selected due to its wide coverage, consistent metadata quality, and compatibility with bibliometric tools such as VOSviewer. The search query was formulated using combinations of terms related to digital transformation, innovation capability, knowledge management, and startup competitiveness. Boolean operators and field filters (TITLE-ABS-KEY) were applied to ensure the retrieval of relevant records. The retrieved dataset includes publication information, author names, affiliations, countries, keywords, citations, and bibliographic references. The most-cited articles listed in the dataset—such as Brunetti et al. (2020), Hermes et al. (2020), Satalkina & Steiner (2020), and Herrmann et al. (2018)—served as anchor points for understanding the core intellectual contributions within the field.

### **2.3 Data Cleaning and Preparation**

Prior to analysis, a series of data-cleaning procedures were conducted to ensure accuracy and consistency, including author name standardization to resolve variations in initials and spelling that could fragment co-authorship clusters, keyword harmonization by merging synonymous terms such as “digital transformation,” “digitalization,” and “digitization” into coherent analytical categories, affiliation normalization to consolidate institutional name variants that appeared with abbreviations or across multiple campuses, and duplicate removal to prevent repeated records from inflating publication or citation metrics. These steps collectively improved the reliability of the network visualizations and thematic mapping.

### **2.4 Bibliometric Tools and Analysis Techniques**

The cleaned dataset was imported into VOSviewer, a specialized software for bibliometric visualization, and four major analyses were conducted to generate the visual outputs used in this study. The co-authorship analysis examined collaboration patterns among authors, institutions, and countries, producing Author Visualization (Figure 4) and Country Visualization (Figure 5) to identify productivity hotspots and international research clusters. The co-occurrence of keywords was then analyzed to map major thematic clusters and the conceptual structure of the field, with the

Network Visualization (Figure 1) showing how digital transformation intersects with innovation capability, knowledge management, digital platforms, and startup competitiveness. Temporal evolution analysis was carried out using Overlay Visualization (Figure 2), which assigned color gradients based on publication year to reveal emerging trends such as platform ecosystems and entrepreneurial digital innovation. Additionally, Density Visualization (Figure 3) captured concentrations of frequently used keywords, highlighting dominant topics and research saturation areas. Citation and intellectual structure analysis further identified influential publications—including works by (Cremonezi & Souto, 2023; Fenerich et al., 2023; Xie & Lau, 2023) which provided the foundational theoretical and practical perspectives shaping the field.

Interpretation of the results followed a structured procedure that integrated multiple dimensions of the bibliometric outputs. Keyword clusters were examined to understand the conceptual structure of the field, while co-authorship networks provided insight into its social structure. Country collaboration patterns were analyzed to reveal geographic research dynamics, and citation influence was assessed to determine the intellectual roots and leading contributions. These analytical layers were then triangulated with established conceptual frameworks in digital transformation, innovation management, and knowledge management. This interpretive process ensured a comprehensive understanding of how these domains interact and collectively shape the competitive advantage of startups within an increasingly digital and knowledge-driven global environment.

### 3. RESULTS AND DISCUSSION

#### 3.1 Network Structure of Key Research Themes

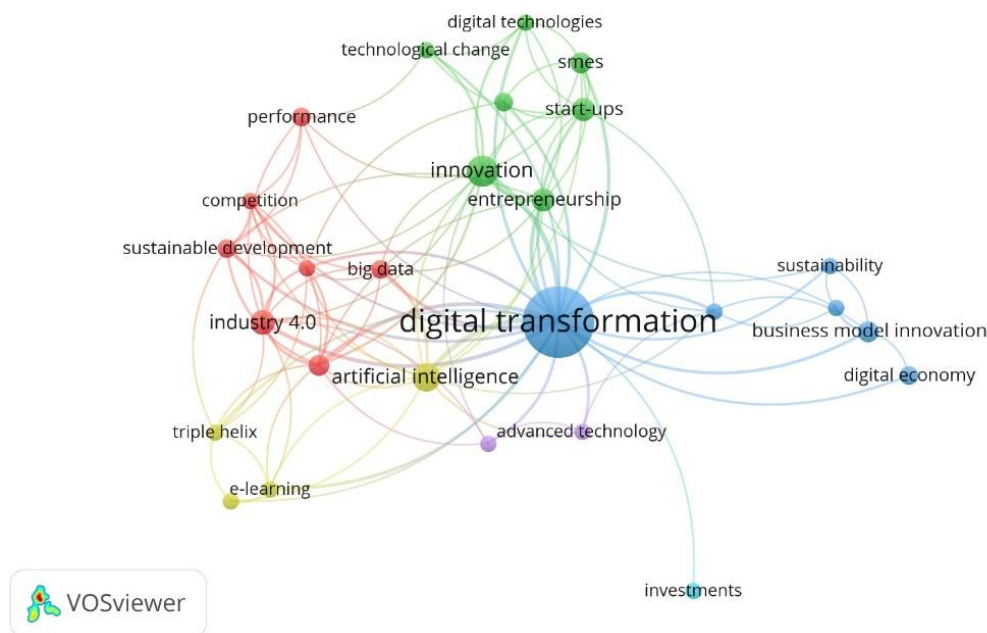


Figure 1. Network Visualization

Source: Data Analysis Result, 2025

Figure 1 illustrates the network structure of keyword co-occurrences within global research on digital transformation, revealing how core concepts cluster into distinct thematic communities while maintaining strong interconnections. At the center, “digital transformation” appears as the

most dominant node, emphasizing its role as the primary anchor linking technological, managerial, and market-related advancements. The green cluster highlights themes of innovation, entrepreneurship, SMEs, start-ups, and digital technologies, showing how technological change strengthens entrepreneurial capability and value creation. Meanwhile, the red cluster captures Industry 4.0, big data, performance, and competition, reflecting a performance-driven research stream where automation and analytics enhance efficiency and market positioning. Adjacent to this, the yellow-gold cluster emphasizes artificial intelligence, e-learning, and triple helix collaboration, signaling the importance of knowledge creation, learning systems, and multi-stakeholder partnerships in digital capability-building.

On the right side of the network, the blue cluster encompasses business model innovation, sustainability, digital economy, and investments, underscoring the strategic and economic implications of digital transformation in reshaping organizational value propositions and long-term resilience. Together, these interconnected clusters demonstrate that digital transformation research is inherently multidimensional, combining elements of technology, innovation, sustainability, and entrepreneurial ecosystems. The strong linkages across clusters confirm that competitive advantage in modern startups and organizations depends on their ability to integrate digital technologies, foster innovation capability, leverage knowledge systems, and navigate evolving digital ecosystems within an increasingly dynamic economic landscape.

### 3.2 Temporal Evolution of Research Focus

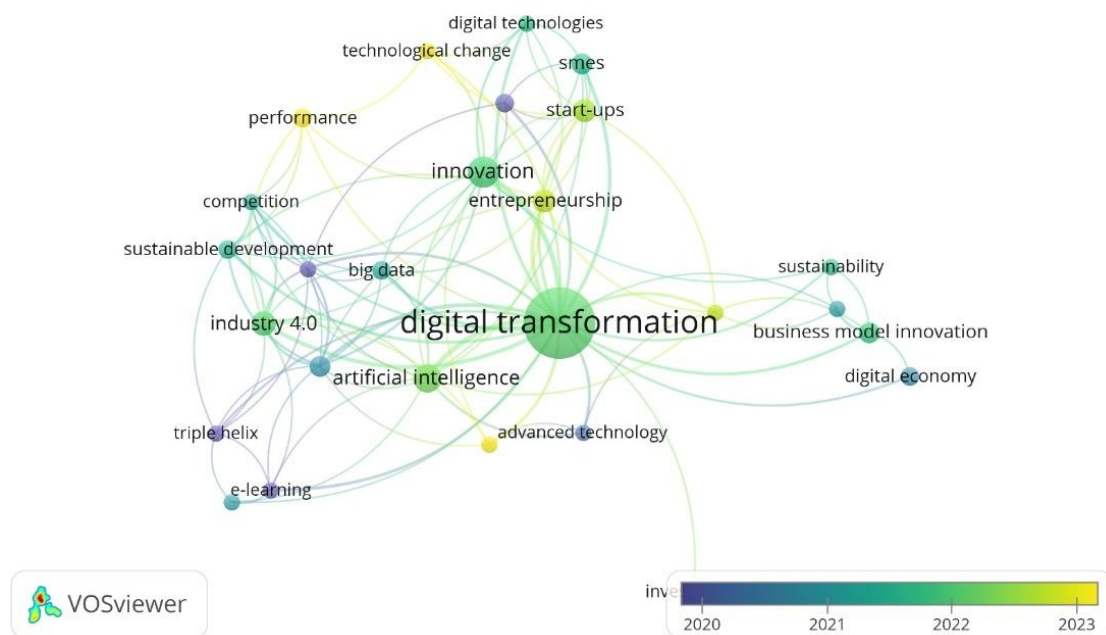


Figure 2. Overlay Visualization

Source: Data Analysis Result, 2025

The Overlay Visualization (Figure 2) illustrates a temporal shift from foundational research themes in earlier years toward more technologically sophisticated and platform-oriented topics in recent publications, with older blue-colored nodes reflecting early studies on digitalization, technology adoption, and organizational change, while newer yellow-colored nodes highlight emerging directions such as platform ecosystems and digital infrastructures, digital

entrepreneurship for sustainability transitions, innovation systems and capability-building mechanisms, and data-driven knowledge management in startups. This evolution demonstrates a widening disciplinary scope, showing that the field has progressed from understanding basic digital disruption toward examining dynamic capabilities and multi-level innovation processes, with startups increasingly serving as central analytical lenses due to their agility and technology-intensive nature.

### 3.3 Density Mapping of Research Concentrations

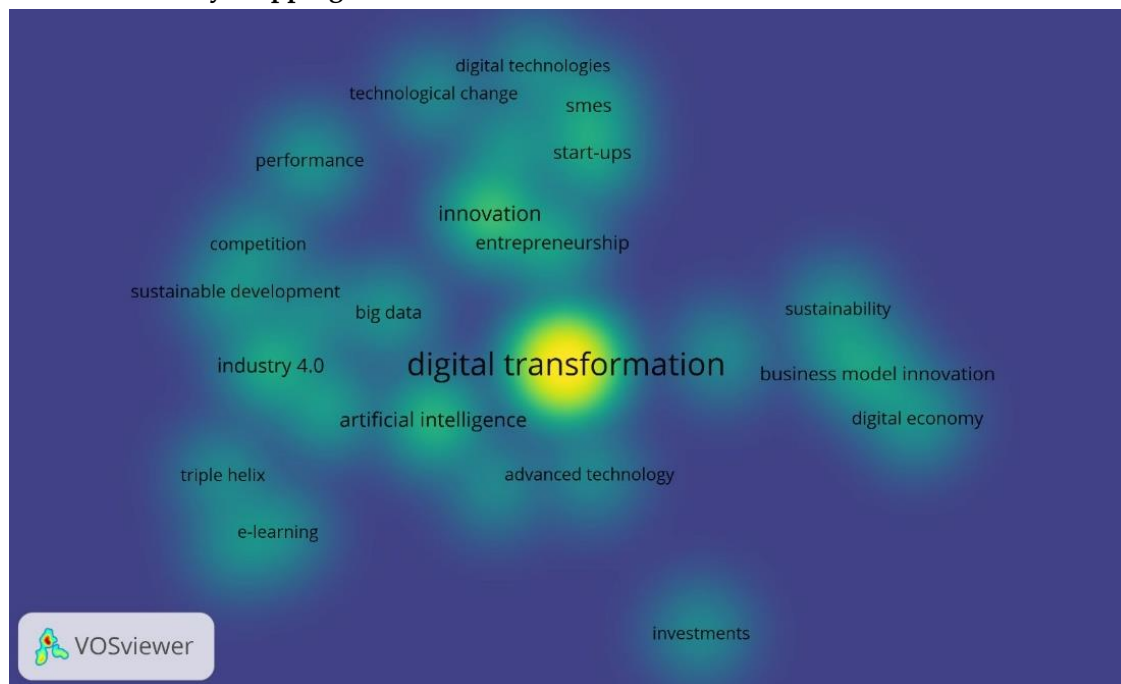


Figure 3. Density Visualization

Source: Data Analysis Result, 2025

The Density Visualization (Figure 3) shows areas of high research intensity—represented by warmer colors—indicating saturated and extensively explored topics, with the densest regions centering on digital transformation, innovation, entrepreneurship, business models, and knowledge management. These hotspots highlight that the literature largely converges on the relationship between digital technology adoption and strategic innovation outcomes, while less dense areas such as startup ecosystems, platform governance, and capability maturity point to promising opportunities for future research development. For startups, this pattern suggests that scholars increasingly view competitive advantage not merely as a result of adopting new technologies, but as the outcome of an integrated interplay between digital capabilities, knowledge flows, collaborative platforms, and continuous innovation.

3.4 Author Collaboration and Influence

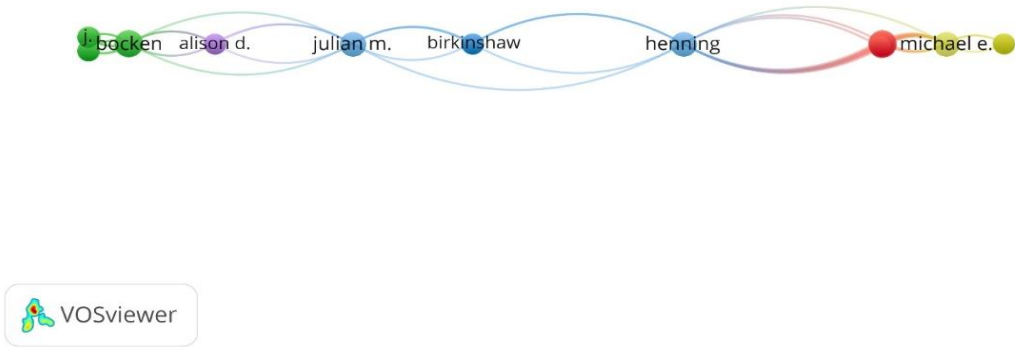


Figure 4. Author Visualization  
Source: Data Analysis Result, 2025

The Author Visualization (Figure 4) identifies several key authors contributing to the intellectual core of the field, with clusters of scholars such as Brunetti, Hermes, Steiner, Ruggieri, and Kupp forming distinct yet interconnected research communities whose works span diverse contexts—from healthcare digitalization and platform ecosystems to entrepreneurial innovation and digital business models—while collectively reinforcing the strategic importance of digital transformation. Strong collaboration links within these clusters indicate the growth of interdisciplinary networks that integrate perspectives from information systems, management, entrepreneurship, and technological innovation, supporting the view that digital transformation is inherently cross-disciplinary and requires frameworks that merge technological, managerial, and knowledge-based insights.

3.5 Country Collaboration and Global Research Distribution

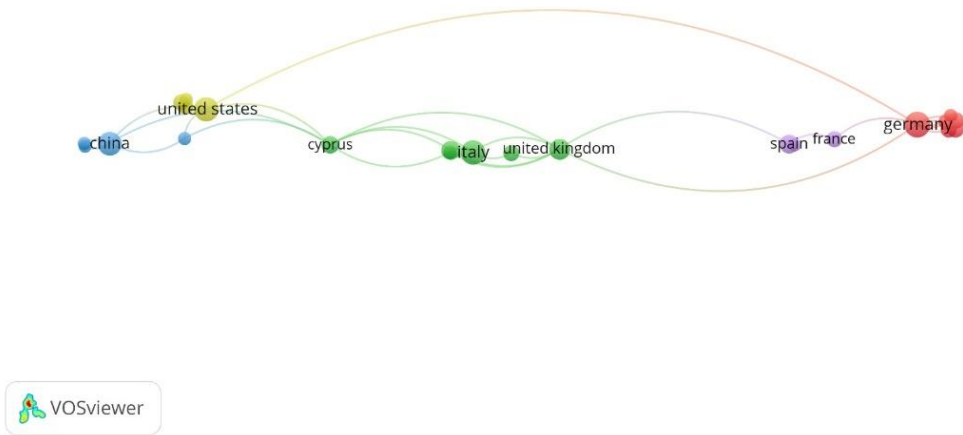


Figure 5. Country Visualization  
Source: Data Analysis Result, 2025



The Country Visualization (Figure 5) shows that research in this field is globally distributed, with strong contributions from European countries such as Italy, Germany, and Austria, alongside significant participation from North America and growing involvement from Asian economies. These collaboration patterns reflect both regional specializations and interconnected global research networks, where Europe tends to focus on sustainable digital entrepreneurship and capability building, while North America emphasizes platform ecosystems and digital disruption. The presence of multinational collaboration clusters indicates the increasing globalization of digital transformation research, aligning with the cross-border nature of digital technologies and startup ecosystems, and reinforcing the idea that competitive advantage in startups is shaped by knowledge and innovation flows that transcend geographical boundaries.

### 3.6 Most Influential Publications and Their Thematic Contributions

Table 1. The Most Impactful Literatures

Citations	Author	Title
358	Brunetti, F., Matt, D. T., Bonfanti, A., De Longhi, A., Pedrini, G., & Orzes, G. (2020).	Digital transformation challenges: strategies emerging from a multi-stakeholder approach
238	Hermes, S., Riasanow, T., Clemons, E. K., Böhm, M., & Krcmar, H. (2020).	The digital transformation of the healthcare industry: exploring the rise of emerging platform ecosystems and their influence on the role of patients
162	Satalkina, L., & Steiner, G. (2020)	Digital entrepreneurship and its role in innovation systems: A systematic literature review as a basis for future research avenues for sustainable transitions
111	Herrmann, M., Boehme, P., Mondritzki, T., Ehlers, J. P., Kavadias, S., & Truebel, H. (2018)	Digital transformation and disruption of the health care sector: Internet-based observational study
109	Felicetti, A. M., Corvello, V., & Ammirato, S. (2024)	Digital innovation in entrepreneurial firms: a systematic literature review
70	Ruggieri, R., Savastano, M., Scalingi, A., Dorina, B., & D'Ascenzo, F. (2018).	The impact of Digital Platforms on Business Models: An empirical investigation on innovative start-ups
63	Kupp, M., Marval, M., & Borchers, P. (2017).	Corporate accelerators: fostering innovation while bringing together startups and large firms
52	van Meeteren, M., Trincado-Munoz, F., Rubin, T. H., & Vorley, T. (2022)	Rethinking the digital transformation in knowledge-intensive services: A technology space analysis
35	De Bernardi, P., & Azucar, D. (2019)	Innovative and sustainable food business models

The citation table (Table 1) highlights the most influential works in the dataset, led by Brunetti et al. (2020), who provide multi-stakeholder digital transformation strategies; Hermes et al. (2020), who examine platform ecosystems and digital healthcare transformation; Satalkina and Steiner (2020), who connect digital entrepreneurship with innovation systems; Herrmann et al. (2018), who explore digital disruption in healthcare; Ruggieri et al. (2018), who detail the impact of digital platforms on business model innovation; and Kupp et al. (2017), who analyze corporate accelerators as mechanisms for fostering innovation. These publications form the intellectual backbone of the field and represent research streams that collectively link technological transformation, entrepreneurial capability, and evolving digital infrastructures.

Across these seminal contributions, several core insights emerge. First, digital transformation is inherently ecosystem-dependent, requiring strong alignment between stakeholders, platforms, and technological infrastructures, particularly within fast-evolving markets. Second, innovation capability stands out as a decisive factor for startup survival under



conditions of digital turbulence. Third, knowledge management enhances organizational agility and strategic decision-making, enabling startups to adapt, learn, and harness new technological opportunities. Finally, platform-based business models reshape competitive dynamics by emphasizing connectivity, co-creation, and network effects. Together, these insights reinforce the view that digital transformation and knowledge-based innovation are inseparable foundations of sustainable startup competitiveness.

### Discussion

The combined results across visualizations and citation analysis highlight several key implications for the competitive advantage of startups. Digital transformation is not merely a matter of technological adoption but a multi-layer capability that integrates IT infrastructure, organizational culture, leadership readiness, and ecosystem participation; startups that transform digitally at scale gain superior speed, flexibility, and market responsiveness. Innovation enables startups to create unique value, disrupt established industries, and build adaptive business models, positioning innovation capability as the primary driver of entrepreneurial resilience. Effective knowledge management systems further strengthen competitiveness by converting data into strategic insights, supporting continuous learning cycles, and fostering collaboration across teams, solidifying knowledge as a vital intangible asset that fuels digital innovation. In addition, startups must strategically engage with platform ecosystems that increasingly determine market access, customer engagement, and opportunities for co-creation, as digital platforms simultaneously provide advantages and impose constraints that require careful strategic alignment. Bibliometric patterns also reveal the global nature of digital transformation, compelling startups to benchmark their capabilities against international standards of agility, innovation, and collaboration.

Overall, the findings demonstrate that digital transformation, innovation capability, and knowledge management are deeply interconnected in shaping sustainable startup competitiveness. The research landscape in this field has expanded significantly, shifting toward more complex themes such as platform ecosystems, sustainable digital entrepreneurship, and knowledge-driven innovation systems. These developments underscore that future competitive advantage will depend on a startup's ability to seamlessly integrate technological transformation, ongoing innovation, and dynamic knowledge flows within increasingly interconnected digital ecosystems.

### 4. CONCLUSION

This bibliometric study provides a comprehensive examination of how digital transformation, innovation capability, and knowledge management collectively shape the competitive advantage of startups in the global research landscape. The network, overlay, and density visualizations reveal that these domains form an interconnected conceptual structure, with digital transformation serving as a strategic capability, innovation as a critical driver of differentiation, and knowledge management as the backbone of organizational agility. The most influential publications—particularly those by Brunetti et al., Hermes et al., Satalkina & Steiner, and Ruggieri et al.—demonstrate that contemporary scholarship emphasizes ecosystem-based digital strategies, platform-oriented business models, and knowledge-driven innovation systems. Temporal analysis further shows an evolutionary shift from foundational digitalization themes toward more advanced concerns such as platform ecosystems, sustainable digital entrepreneurship, collaborative

accelerators, and knowledge-intensive services, while author and country collaboration patterns highlight increasing global engagement and cross-disciplinary integration within this field.

Overall, the study concludes that startup competitive advantage depends on the synergy between technological readiness, innovation capability, and effective knowledge flows. Startups capable of integrating these elements are better positioned to navigate digital disruption, leverage platform ecosystems, and participate meaningfully in global innovation networks. These findings consolidate the intellectual foundations of the field and offer clear pathways for future research aimed at strengthening digital competitiveness, enhancing entrepreneurial ecosystems, and accelerating innovation-driven growth.

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