

Explaining Heterogeneous Performance Outcomes in SME Technology Adoption: A Cluster-Based Integrative Review

Explicando los resultados heterogéneos de desempeño en la adopción tecnológica de las pymes: una revisión integradora basada en clústeres

Gustavo Alli Cruz Pérez^a  Gabriel Vouga Chueke^{b*} 

^a) Universidad Popular Autónoma del Estado de Puebla (UPAEP)

^b) Fundação Dom Cabral

* Corresponding contact: gabrielbrasil@gmail.com (Gabriel Vouga Chueke)

Abstract

Why do similar technological investments generate heterogeneous performance outcomes across small and medium-sized enterprises (SMEs)? Although research on SME technology adoption has expanded significantly, theoretical perspectives have largely evolved in isolation, limiting cumulative integration. This study addresses this fragmentation through a cluster-based bibliometric review of 377 peer-reviewed articles published between 1982 and 2024. Combining co-occurrence network analysis based on Visualization of Similarities (VOS) mapping with Normalized Local Citation Scores (NLCS), we identify five interrelated thematic clusters. The findings indicate that SME technology adoption is best conceptualized as a capability-mediated and context-contingent orchestration process rather than as a linear technology-performance relationship, providing a foundation for configurational and multilevel explanations of performance heterogeneity.

Keywords: technology adoption; small and medium-sized enterprises (SMEs); bibliometric analysis; systematic integrative literature review

JEL Classification: L25; M15; O32; O33

Resumen

¿Por qué inversiones tecnológicas similares generan resultados de desempeño heterogéneos entre las pequeñas y medianas empresas (pymes)? Aunque la investigación sobre la adopción tecnológica en las pymes ha crecido significativamente, las distintas perspectivas teóricas han evolucionado en gran medida de forma aislada, lo que ha limitado su integración acumulativa. Este estudio aborda esta fragmentación mediante una revisión bibliométrica basada en clústeres de 377 artículos revisados por pares publicados entre 1982 y 2024. Combinando el análisis de redes de coocurrencia basado en el mapeo mediante Visualization of Similarities (VOS) con los Normalized Local Citation Scores (NLCS), identificamos cinco clústeres temáticos interrelacionados. Los resultados indican que la adopción tecnológica en las pymes se conceptualiza mejor como un proceso de orquestación mediado por capacidades y condicionado por el contexto, en lugar de como una relación lineal entre tecnología y desempeño. Esta perspectiva proporciona una base para desarrollar explicaciones configuracionales y multinivel de la heterogeneidad en los resultados de desempeño.

Palabras clave: adopción tecnológica; pequeñas y medianas empresas (pymes); análisis bibliométrico; revisión sistemática e integradora de la literatura.

Clasificación JEL: L25; M15; O32; O33

Introduction

The economic centrality of SMEs has been reaffirmed by recent evidence: these firms constitute the majority of business entities worldwide and account for a substantial share of employment and value creation in both advanced and emerging economies (Zamani, 2022; Prasetyani et al., 2025; Elsa et al., 2025). In parallel, the accelerated diffusion of digital technologies, intensified by the COVID-19 pandemic and the consolidation of Industry 4.0, has turned technology adoption into a survival condition rather than a strategic option for smaller firms (Ghobakhloo et al., 2022; Khurana et al., 2022; Schwaeke et al., 2024). Recent empirical evidence reinforces the strategic importance of adoption while exposing a persistent challenge: performance gains do not follow automatically from adoption but depend on the alignment of digital technologies with innovation, sustainability strategies, and organizational maturity (Gomes et al., 2026; Lara-Pérez et al., 2026). This disjunction between widespread adoption and uneven returns explains why performance heterogeneity has moved to the center of the research agenda.

Part of this heterogeneity is rooted in the very nature of the SME category. Small and medium-sized enterprises do not constitute a universally homogeneous category, as their definitions vary across countries, industries, and institutional settings (Dwivedi & Sahu, 2014; Mittal et al., 2019; Zamani, 2022). Although firm size is generally assessed through tangible indicators, including workforce size, annual turnover, total assets, and capital investment, the specific thresholds differ across national contexts; SMEs are therefore best understood as a context-dependent category rather than one defined by a universal cutoff (Prasetyani et al., 2025; Gomes et al., 2026). However, SMEs tend to share distinctive organizational traits: centralized decision-making, relatively informal structures, limited financial and technological resources, and close managerial involvement in operational activities (Rauch & Hatak, 2016; Mittal et al., 2019). This heterogeneity is directly relevant to technology adoption research because firms classified under the same SME label may differ substantially in financial capacity, specialized personnel, digital infrastructure, managerial capabilities, and access to external knowledge—precisely the characteristics that shape their ability to evaluate, acquire, implement, and derive value from new technologies (Mittal et al., 2019; Qalati et al., 2021). Despite the expansion of research on this subject, a persistent theoretical puzzle remains unresolved: why do similar technological investments generate heterogeneous performance outcomes across SMEs?

Reflecting this concern, scholars have explicitly called for further research on this topic. Zamani (2022) urges a more holistic, multilevel understanding of adoption, arguing that single-technology studies obscure the organizational and contextual conditions under which adoption succeeds. Santini et al. (2023) call for clarification of the mediating mechanisms that link information technology adoption to firm performance, precisely because their meta-analytic evidence shows that this relationship is indirect and contingent. De Mattos et al. (2024) and Elsa et al. (2025) likewise highlight the need to integrate fragmented conceptualizations of new technology adoption in smaller firms, as conceptual dispersion has prevented cumulative theory building. These calls converge on the unresolved question of performance heterogeneity that motivates the present study and connects the economic relevance of SMEs directly to our research question.

Existing research offers multiple explanatory lenses. Diffusion-oriented models emphasize perceived usefulness and relative advantage (Davis, 1989; Rogers, 2003), resource-based and dynamic capability perspectives focus on internal resources and reconfiguration processes (Barney, 1991; Teece et al., 1997), and institutional theory highlights regulatory pressures and legitimacy concerns (DiMaggio & Powell, 1983). While each stream provides valuable insights, they have largely evolved in parallel, generating what can be described as conceptual siloing. As a result, the field lacks an integrative understanding of how internal capabilities, technological readiness, human capital, and institutional conditions interact to shape adoption outcomes.

In this study, technology adoption is treated as the overarching construct, referring to the decision and process through which a firm acquires, implements, and assimilates a new technology (Rogers, 2003; Xu et al., 2021). Accordingly, throughout this article, the term technology adoption is used as the umbrella concept under review, while digitalization and digital transformation are treated as its most prominent contemporary manifestations. This distinction is maintained consistently across the search strategy, analysis, and interpretation of the results.

To address this research gap, we map the intellectual structure of SME technology adoption research through a cluster-based bibliometric analysis of 377 peer-reviewed articles published between 1982 and 2024. Using co-occurrence network analysis (Van Eck & Waltman, 2007; Zupic & Čater, 2015) combined with Normalized Local Citation Scores (Waltman & Van Eck, 2015), we identify the thematic configurations that organize the field and the anchor publications that stabilize each domain. While co-occurrence mapping reveals the relational architecture of concepts, NLCS highlights the influential works that have shaped theoretical trajectories, enabling a multidimensional understanding of both structure and intellectual influence.

Our paper also differs from, and builds upon, previous review efforts. Prior bibliometric analyses have mapped technology adoption research in general (Xu et al., 2021), digitalization and digital transformation

in SMEs (Shama et al., 2023; Tripathi, 2024; Elsa et al., 2025; Syah et al., 2025), Industry 4.0 adoption in manufacturing SMEs (Ghobakhloo et al., 2022), digitalization and cybersecurity (Arroyabe et al., 2024), and the links between digital transformation and sustainable development (Philbin et al., 2022). Systematic reviews and meta-analyses have likewise synthesized adoption drivers and outcomes (Zamani, 2022; Santini et al., 2023; Prasetyani et al., 2025). Valuable as these contributions are, they share recurring limitations: most rely on a single database, employ restricted search terms or time periods, concentrate on a specific technological domain or region, and remain predominantly descriptive, emphasizing publication patterns and thematic evolution rather than the mechanisms that convert adoption into performance (Xu et al., 2021; Tripathi, 2024; Prasetyani et al., 2025). Consequently, these contributions stop short of connecting the intellectual structure of the field to the question of performance heterogeneity.

Our findings uncover five interrelated clusters that delineate the core knowledge domains of SME technology adoption: (1) internal enablers and digital performance, (2) technological readiness and organizational transformation, (3) organizational adaptation and human aspects, (4) contextual and institutional enablers, and (5) information systems and absorptive capacity. Rather than representing isolated streams, these clusters collectively reveal that SME technology adoption is best conceptualized as a capability-mediated and context-contingent orchestration process, in which technological, organizational, human, and institutional elements interact dynamically.

This study contributes to research on SME technology adoption in three ways. First, it clarifies the intellectual architecture of SME technology adoption by integrating fragmented research traditions into empirically derived thematic clusters and complementing recent bibliometric and systematic reviews (Marino-Romero et al., 2024; De Mattos et al., 2024). In doing so, it explicitly connects performance heterogeneity to capability configurations. Second, it advances theory by reframing adoption not as a discrete technological event but as an evolutionary process of capability configuration, building on resource-based (Barney, 1991), dynamic capabilities (Teece et al., 1997), and institutional perspectives (DiMaggio & Powell, 1983), while aligning with recent work that emphasizes resilience, ecosystem embeddedness, and dynamic capability development (Khurana et al., 2022; Christofi et al., 2023; Marozau et al., 2023; Schwaeye et al., 2024). Third, it provides a structured foundation for future configurational and multilevel research capable of explaining heterogeneous performance outcomes, responding to recent calls for integrative and context-sensitive theorizing in SME digital transformation research (De Mattos et al., 2024; Marino-Romero et al., 2024). Moreover, by combining co-occurrence mapping with normalized citation analysis—an integrative design also advocated in adjacent bibliometric research (Casado-Belmonte et al., 2021; Molina-García et al., 2023)—this study explicitly links the thematic architecture of the field to capability-based explanations of heterogeneous outcomes, constituting its distinctive contribution relative to earlier reviews.

The remainder of this article is organized as follows. The Methodology section describes the search strategy, inclusion and exclusion criteria, and analytical techniques employed. The Results and Discussion section presents the evolution of the field, the keyword co-occurrence analysis, and the five clusters derived from the Normalized Local Citation Scores. The Conclusion summarizes the study's contributions and practical implications, discusses its limitations, and outlines directions for future research.

Methodology

To ensure transparency and methodological rigor, our literature review process was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page et al., 2021; Boell & Cecez-Kecmanovic, 2015). PRISMA was selected because it provides a standardized and auditable protocol for the identification, screening, and inclusion of studies, thereby reducing selection bias and enhancing review replicability, both of which are increasingly demanded in business and management research (Kraus et al., 2020; Paul & Criado, 2020; Snyder, 2019). Scopus and the Web of Science Core Collection (WoS) were searched as benchmark databases for bibliometric research (Donthu et al., 2021; Zupic & Čater, 2015). Table 1 presents the search strategy used to identify relevant studies in the field.

Table 1 Scopus and WoS database search query

Source: Authors

Database	Filters	Search terms	No.
Scopus	Timespan: 1982-2024	(title-abs-key (tech* and adoption) or title-abs-key (tech* and implemen*) and title-abs-key (smes) or title-abs-key (small and companies) or title-abs-key (small and medium and enterprises) or title-abs-key (small and medium-sized and businesses)) and (limit-to (subjarea , "busi")) and (limit-to (doctype , "ar")) and (limit-to (language , "english")) and (limit-to (pubstage , "final"))	2,617
	Language	English	
	Pub. Type	Finished articles	
	Date of data export	December 2024	
WoS	Timespan: 1982-2024	TS= (tech* and adoption) or ts=(tech* and implemen*) and (ts=(smes) or ts=(small and companies) or ts=(small and medium and enterprises) or ts=(small and medium-sized and businesses)) and dt=(article) and la=(english)	5,703
	Language	English	
	Pub. Type	Finished articles	
	Date of data export	December 2024	

Boolean operators were applied to titles, abstracts, and keywords to capture variations of technology adoption and implementation (e.g., "tech* AND adoption" and "tech* AND implemen*"), where the wildcard ensured inclusion of terms such as technology, technological, and technologies. These were combined with expressions referring to small and medium-sized enterprises (e.g., "SMEs," "small companies," "small and medium enterprises," and "small and medium-sized businesses") to maximize conceptual coverage while preserving relevance. The search was restricted to the Business subject area, peer-reviewed journal articles in English, and final published versions.

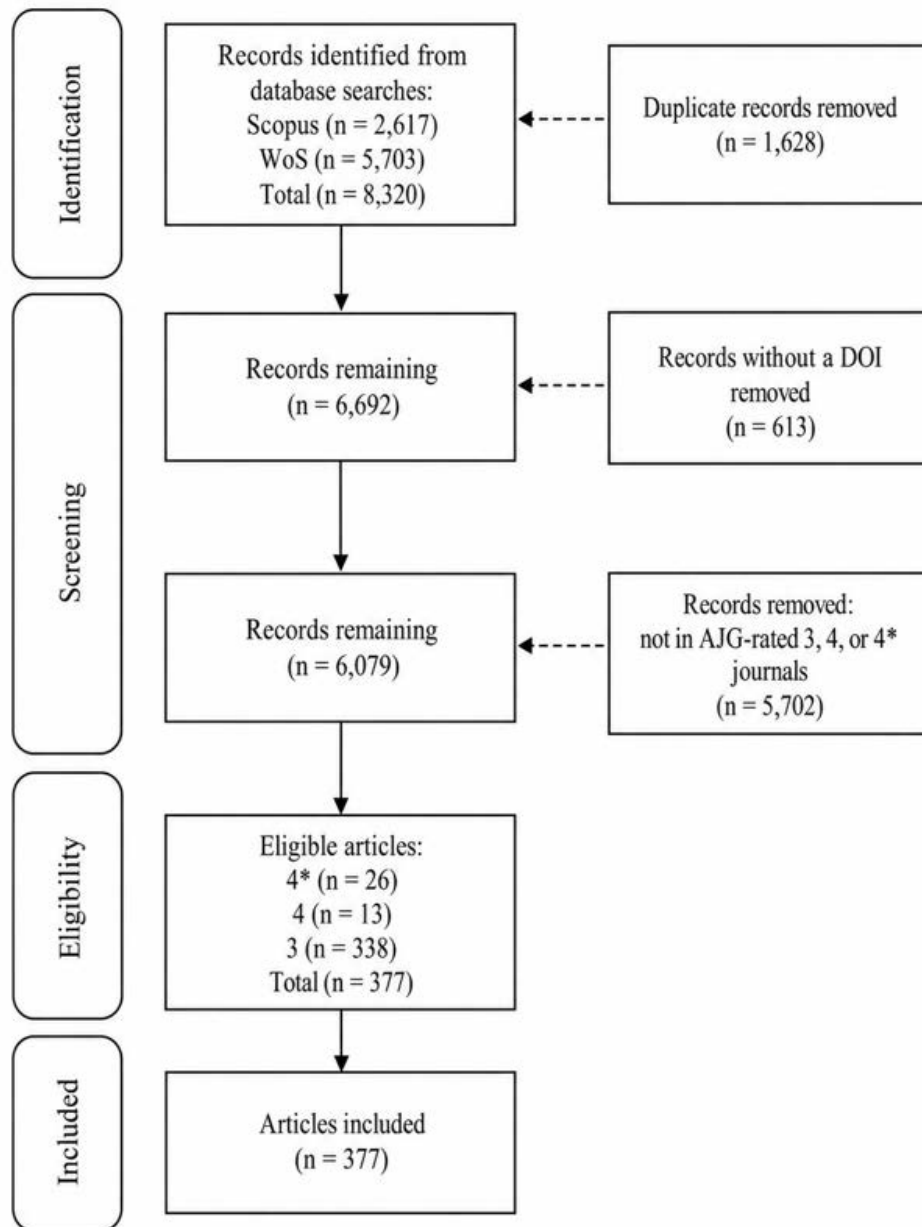
The scope of this review is therefore explicitly delimited to small and medium-sized enterprises: the search string, the screening criteria, and the interpretation of the results consistently target SMEs, and the terminology employed throughout the article reflects this delimitation (Zamani, 2022; Prasetyani et al., 2025).

After removing duplicates using the bibliometrix package in R (Aria & Cuccurullo, 2017), titles and abstracts were screened to retain studies directly addressing SME technology adoption (Kraus et al., 2020). Records lacking a Digital Object Identifier (DOI) were excluded because a persistent digital identifier is required for accurate deduplication, citation matching, and metadata completeness in bibliometric software, and its absence is typically associated with non-final or editorially unverified versions of a document (Aria & Cuccurullo, 2017; Donthu et al., 2021). To ensure disciplinary rigor, the sample was limited to journals ranked 3, 4, or 4* in the Academic Journal Guide (AJG), representing the upper tiers of the ranking and progressively higher levels of scholarly quality and standing in business and management research (Hudson & Laband, 2013; Vogel et al., 2017; Paul & Criado, 2020). This criterion ensured that only studies published in well-established and highly regarded academic outlets were considered eligible for the final sample. The final dataset comprised 377 articles published between 1982 and 2024.

Thematic clusters were identified through keyword co-occurrence analysis using the Visualization of Similarities (VOS) mapping technique (Van Eck & Waltman, 2007), which groups terms based on association strength and modularity (Zupic & Čater, 2015; Boyack & Klavans, 2010). To enhance interpretive robustness, NLCS was calculated to identify influential anchor publications within each cluster (Garfield, 1980; Waltman & Van Eck, 2015). High-NLCS studies were analyzed in relation to the VOS-derived clusters to ensure conceptual coherence (Donthu et al., 2021; Paul & Criado, 2020). Together, these procedures delineated complementary knowledge domains that capture distinct yet interconnected dimensions of SME technology adoption. Figure 1 summarizes the PRISMA study selection process.

Figure 1. PRISMA statement for selection

Source: Authors



Results and Discussion

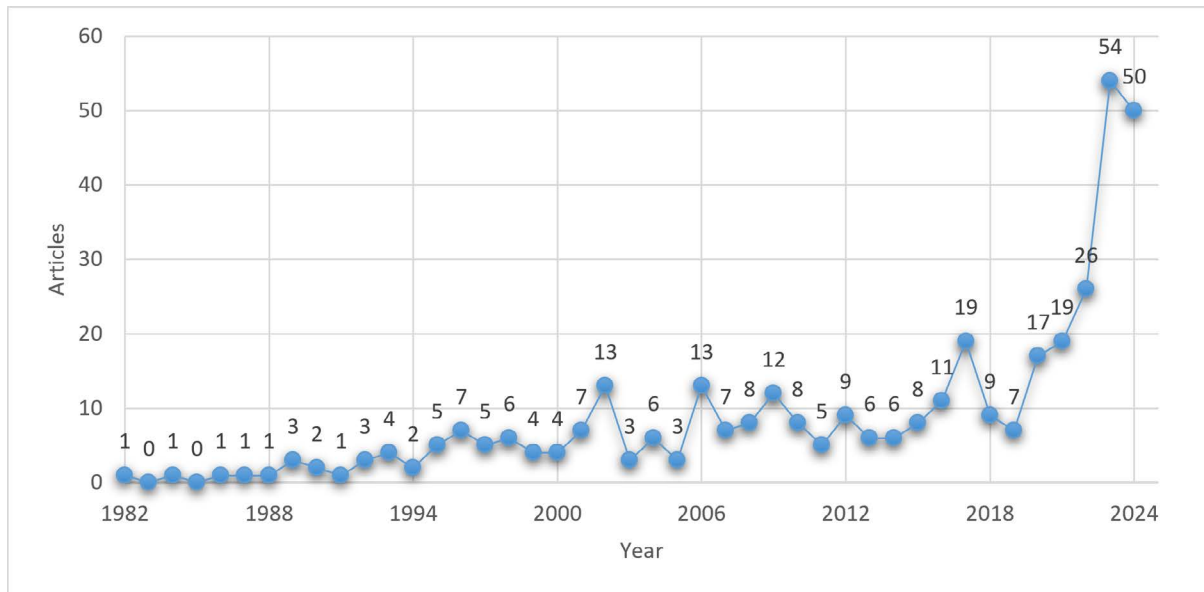
State of the Art on Technology Adoption in SMEs

As shown in Figure 2, research on technology adoption in SMEs has expanded steadily since the 1990s, with a sharp increase between 2020 and 2024, peaking at 54 publications in 2023 and 50 in 2024. This growth aligns with intensified debates on competitiveness, resilience, and technological upgrading, particularly in the context of Industry 4.0 (Shen et al., 2022; Chatterjee et al., 2021a; Masood & Sonntag, 2020).

Earlier studies emphasized structural constraints, such as limited financial resources, managerial capabilities, and human capital, that restrict SME technology adoption (Moeuf et al., 2017; Masood & Sonntag, 2020). More recent contributions increasingly address platform technologies, supply chain pressures, and sustainability concerns (Bag et al., 2021; Pandya et al., 2024; Lu et al., 2024). Overall, the field demonstrates both quantitative growth and thematic diversification.

Figure 2. Production over time

Source: Authors

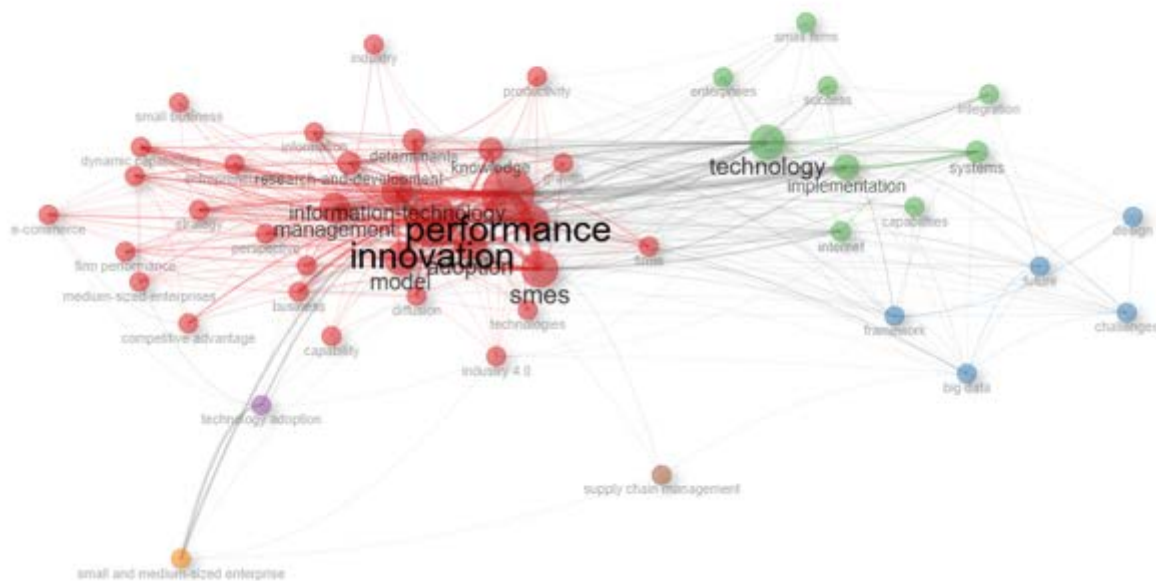


Keyword Co-occurrence Analysis (VOS Mapping Technique)

Figure 3 displays the co-occurrence network of keywords generated using the Visualization of Similarities (VOS) technique. Keywords that frequently appear together in the same articles are positioned closer to one another, forming groups that represent the conceptual structure of the field or distinct research streams (Van Eck & Waltman, 2007; Zupic & Čater, 2015). In the specific case of SMEs, where research is dispersed across multiple disciplines, co-occurrence analysis provides a robust lens for detecting complementarities, intellectual silos, and emerging research streams, each represented by a different color.

Figure 3. Keyword Co-occurrence Map (VOS Technique)

Source: Authors, using the bibliometrix package in R



These research streams highlight how research on SMEs and technology adoption is organized around overlapping but distinct areas, including innovation, performance, strategy, and digital transformation. It is worth noting that co-occurrence clusters are relational groupings rather than mutually exclusive categories: the VOS technique assigns each keyword to a single cluster on the basis of association strength, yet cross-cutting concepts, most notably innovation, operate as bridging terms whose semantic reach extends across streams (Van Eck & Waltman, 2007; Zupic & Čater, 2015; Casado-Belmonte et al., 2021). Hence, the recurrence

of innovation-related vocabulary across streams reflects the integrative role of this concept in the field rather than redundancy in the classification, and the three streams should be interpreted as overlapping conceptual regions organized around distinct gravitational centers.

Research Stream 1 - Innovation, Performance, and Strategic Management (Red)

The largest research stream, represented in red, revolves around *innovation* (105 occurrences), *performance* (84), *impact* (36), and *strategy* (28). This group highlights the central role of innovation management as a lens for understanding SME competitiveness. Studies in this area focus on the measurement of performance outcomes (Hervas-Oliver et al., 2014; Audretsch & Belitski, 2021; Yang et al., 2023), the development of innovation models, and the impact of technological adoption on firm growth and survival. Keywords such as *dynamic capabilities* (24) and *knowledge management* (19) reinforce the connection with the *resource-based view* (RBV) and its extensions (Battistoni et al., 2022; Marozau et al., 2023; Marino-Romero et al., 2024).

Research Stream 2 - Digital Transformation and Industry 4.0 (Green/Blue)

The second major thematic stream, visualized in green and blue, emphasizes the technological dimension of SMEs. Central terms include Industry 4.0 (29), technological innovation (28), digital transformation (18), systems (25), and Internet (21). This group of articles aligns with the global debate on the challenges and opportunities of the Fourth Industrial Revolution (Marozau et al., 2023; Chatterjee et al., 2024). The prominence of business (29) and research and development (29) reflects the growing interest in how SMEs adapt to advanced manufacturing, smart production systems, and Internet of Things (IoT)-based solutions (Mittal et al., 2018; Del Giudice et al., 2021). Importantly, the literature stresses both the potential for productivity gains and the risks of exclusion for smaller firms that lack resources to invest in digitalization (Masood & Sonntag, 2020).

Research Stream 3 - Entrepreneurship and Open Innovation (Purple/Orange)

A third thematic stream, represented in purple and orange, is centered on entrepreneurship (23), open innovation (23), framework (22), and knowledge (29). This stream connects SME studies to broader discussions in entrepreneurship and innovation ecosystems. The emphasis here is on collaborative innovation processes (Jin et al., 2022) and the role of SMEs in regional development and ecosystem building (Radas & Božić, 2009; Khurana et al., 2022). It also integrates conceptual frameworks that explain how smaller firms leverage external partnerships, absorptive capacity, and entrepreneurial orientation to overcome structural barriers.

Together, this body of literature confirms a dual orientation in SME research: (i) innovation and performance as theoretical anchors and (ii) Industry 4.0 and digital transformation as practical challenges shaping firm strategies. A complementary orientation around entrepreneurship and open innovation connects these two dimensions, suggesting that SMEs are simultaneously adopters of technology, drivers of innovation, and critical nodes in entrepreneurial ecosystems.

Highly Cited Publications by Cluster (Normalized Local Citation Score - NLCS)

Table 2 presents the most influential publications ranked by their Normalized Local Citation Score (NLCS), a bibliometric indicator that adjusts local citation counts by publication year to ensure comparability across time (Waltman & Van Eck, 2015). Whereas the VOS co-occurrence analysis (Figure 3) revealed the conceptual structure of the field through keyword linkages, NLCS highlights the specific publications that have most strongly shaped and sustained these knowledge domains. In this sense, NLCS complements the VOS analysis by identifying the “anchor works” that provide theoretical and empirical foundations for the dominant research streams (Zupic & Čater, 2015; Donthu et al., 2021). Table 2 covers technology adoption in its broad sense; the prevalence of digital technologies among the anchor publications reflects the empirical dominance of digital tools in recent SME research rather than a shift in the unit of analysis (Xu et al., 2021; Verhoef et al., 2021).

The results reveal five thematic clusters that represent distinct but interconnected lines of inquiry into how digital technologies influence adoption processes, organizational performance, and strategic transformation in SMEs. Together, the two analyses provide a multidimensional understanding of the field: VOS mapping uncovers the structure of ideas, while NLCS rankings reveal the sources of influence driving those ideas.

Table 2. Top 29 publications on technology adoption as a determinant of SME performance.

Source: Authors

Cluster	Thematic Focus	Representative Anchor Publications (NLCS)	Contribution to SME Technology Adoption
Cluster 1 - Internal Enablers and Digital Performance	Organizational enablers (managerial commitment, information technology competence) and capability mechanisms (innovation, knowledge sharing, strategic learning).	Popa et al. (2018); Sirén et al. (2012); Soto-Acosta et al. (2014); Parida et al. (2012); Jiao et al. (2023); Khan & Mahmood (2018)	Demonstrates that adoption outcomes are mediated by knowledge-based capabilities, linking digital tools to heterogeneous performance, innovation, and learning processes.
Cluster 2 - Technological Readiness and Organizational Transformation	Technological readiness, managerial innovation, supply chain integration, and knowledge flows as assimilation enablers.	Gunasekaran et al. (2009); Hervás-Oliver et al. (2016); Kritchanchai et al. (2010); Yao et al. (2020); Chatterjee et al. (2021b); Jia et al. (2024); Kumar et al. (2024); De Mattos et al. (2024)	Shows that technology adoption requires sustained assimilation mechanisms, with managerial practices, organizational routines, and contextual alignment critical for long-term transformation.
Cluster 3 - Organizational Adaptation and Human Aspects	Organizational size, human-resource-enhancing practices, microfoundational digital skills, and performance measurement systems.	Del Giudice et al. (2021); Scuotto et al. (2021); Taylor & Taylor (2014); Rauch & Hatak (2016); Malodia et al. (2023); Christoff et al. (2023); Schwaake et al. (2024)	Highlights the role of human capital, organizational adaptation, and context-sensitive practices in enabling technology adoption and sustaining SME competitiveness.
Cluster 4 - Contextual and Institutional Enablers	Leadership, organizational readiness, information and communication technology, social media, sustainability-oriented practices, and institutional pressures.	Dwivedi & Sahu (2014); Qalati et al. (2021); Mittal et al. (2019); Rodríguez-Espindola et al. (2022); Dey et al. (2023)	Demonstrates that digitalization outcomes depend on the alignment of internal readiness with institutional and market conditions, linking adoption to sustainability, resilience, and multidimensional performance.
Cluster 5 - Information Systems and Absorptive Capacity	Information architectures, enterprise resource planning, internalization, absorptive capacity, and social commerce.	Abed et al. (2016); Sharma et al. (2012); Khurana et al. (2022)	Shows how SMEs leverage absorptive capacity, information systems, and trust-based digital platforms to internalize information technology value and expand market reach in resource-constrained environments.

Cluster 1 – Internal Enablers and Digital Performance

Cluster 1 advances an inside-out understanding of SME technology adoption, showing that performance gains stem less from the mere presence of digital tools and more from the depth and integration of internal enablers into knowledge routines. Managerial commitment and technological competence consistently emerge as critical determinants of adoption quality (Khan & Mahmood, 2018; Soto-Acosta et al., 2014). Within this cluster, digital tools generate value through organizational innovation, knowledge sharing, and strategic learning processes (Popa et al., 2018; Sirén et al., 2012). Yet adoption outcomes remain heterogeneous, as the link between adoption and performance is mediated by capability mechanisms and moderated by firm size, age, information technology (IT) maturity, and institutional embeddedness (Sirén et al., 2012; Jiao et al., 2023).

Drawing on diffusion of innovations (DOI) theory and the technology-organization-environment (TOE) framework, Khan & Mahmood (2018) identify key determinants, such as relative advantage, managerial competence, perceived complexity, and leadership support, underscoring that resources and commitment shape both adoption likelihood and downstream effectiveness. In line with a knowledge-based view, e-business adoption enhances performance indirectly through innovation (Popa et al., 2018), while Web 2.0 value creation depends more on internal technological and organizational resources than on external pressures (Soto-Acosta et al., 2014). Learning and innovation pathways are also contingent. Sirén et al. (2012) demonstrate that entrepreneurial orientation triggers strategic learning differently depending on firm characteristics, while Parida et al. (2012) show that openness modes generate distinct outcomes: sourcing supports radical innovation, whereas scouting and vertical collaboration favor incremental change. Jiao et al. (2023) further reveal a curvilinear openness-innovation relationship: moderate breadth fosters innovation, but excessive search erodes gains unless reinforced by IT maturity and institutional ties. Overall, this cluster consolidates the view that internal enablers act as generative mechanisms of digital performance rather than as simple antecedents of adoption, extending resource-based and dynamic-capability perspectives by explaining how managerial commitment, IT competence, and learning routines jointly transform digital tools into firm-specific advantages.

Cluster 2 – Technological Readiness and Organizational Transformation

Cluster 2 conceptualizes SME technology adoption as a multidimensional transformation rather than a linear adoption process. Structural enablers such as technological readiness, infrastructure, and system integration are necessary but insufficient for long-term success (Gunasekaran et al., 2009). Evidence shows that adoption outcomes depend on how firms align technical investments with managerial innovation, organizational routines, and learning processes that convert resources into sustained performance (Hervas-Oliver et al., 2016). Beyond efficiency gains, digitalization functions as an organizational renewal mechanism in which managerial innovation and leadership commitment complement technology adoption (Kritchanchai et al., 2010; Chatterjee et al., 2021b). Knowledge sharing and absorptive capacity reinforce these effects, particularly when supported by IT infrastructure and strategic alignment (Yao et al., 2020). More recent studies embed these dynamics within institutional contexts, showing that digital transformation requires the orchestration of technological, organizational, and strategic dimensions to ensure alignment with market and regulatory environments (Jia et al., 2024; Kumar et al., 2024; De Mattos et al., 2024). Taken together, this cluster advances a capability-configuration view of technology adoption, emphasizing that digital readiness becomes a source of sustained advantage only when embedded in managerial innovation and contextual alignment. It thus extends the dynamic-capabilities lens by explaining how SMEs transform infrastructural investments into adaptive organizational systems.

Cluster 3 – Organizational Adaptation and Human Aspects

Cluster 3 highlights the human and adaptive foundations of SME technology adoption. Rather than replicating large-firm models, small enterprises rely on flexibility, informality, and entrepreneurial cognition to interpret and integrate digital tools (Taylor & Taylor, 2014). Human-resource-enhancing practices—training, empowerment, and motivation—strengthen innovation and performance, particularly in younger firms and constrained contexts (Rauch & Hatak, 2016). At the micro level, digital literacies in information and software use emerge as decisive enablers of innovation and growth (Scuotto et al., 2021; Del Giudice et al., 2021). These findings connect the microfoundations of human capital to firm-level capabilities, showing that technology adoption depends as much on people and culture as on technologies. Simultaneously, institutional pressures and market dynamics act as external catalysts or inhibitors (Malodia et al., 2023; Christofi et al., 2023; Schwaewe et al., 2024). In theoretical terms, this cluster contributes a microfoundational extension of the capability-based view, demonstrating that SME competitiveness arises from the interaction between human resource (HR) practices, digital skills, and contextual adaptation. It underscores that technology adoption is not simply a technological trajectory but a human-driven learning process that enables continuous renewal.

Cluster 4 – Contextual and Institutional Enablers

Cluster 4 situates SME technology adoption within broader institutional and market environments. Leadership commitment and organizational readiness appear as universal enablers, while institutional pressures, stakeholder demands, and sustainability imperatives shape the contextual conditions under which adoption translates into performance (Dwivedi & Sahu, 2014; Mittal et al., 2019). Human-resource practices and IT expertise further mediate this relationship, fostering knowledge exchange and employee engagement when aligned with external dynamics (Qalati et al., 2021). Empirical evidence links contextual enablers to sustainability-oriented innovation: government incentives, customer pressure, and circular-economy initiatives promote digital adoption that yields economic, social, and environmental value (Rodriguez-Espíndola et al., 2022; Dey et al., 2023). This cluster therefore bridges technology adoption and institutional theory perspectives, revealing that external forces are not merely constraints but also generative contexts that define what “effective adoption” means in each environment. Theoretically, it advances an institutionally embedded view of digital transformation, highlighting the interplay between internal readiness and external legitimacy and reframing SME digital adoption as a co-evolutionary process in which sustainability and resilience emerge from institutional alignment rather than technological sophistication alone.

Cluster 5 – Information Systems and Absorptive Capacity

Cluster 5 focuses on the information-system architectures and knowledge-absorption mechanisms that enable SMEs to convert digital tools into strategic capabilities. Absorptive capacity acts as a dynamic capability mediating the relationship between technology investment and organizational learning (Sharma et al., 2012; Khurana et al., 2022). Efficient data integration and cross-functional routines allow firms to internalize external knowledge, improving decision-making and innovation performance. Beyond internal processes, digital platforms and social commerce create market-facing mechanisms that expand customer reach and trust-based engagement (Abed et al., 2016). This outward dimension connects information systems (IS) research with entrepreneurial perspectives, demonstrating that technological value is co-created through network participation and customer interaction. Overall, this cluster articulates a multi-layered capability system in which absorptive capacity, information-system design, and relational trust jointly determine the strategic impact of technology adoption. It extends resource-based view (RBV) and dynamic capabilities view (DCV) insights by specifying how information architectures operate as learning infrastructures that embed adaptability and scalability within SMEs.

Taken together, the five clusters delineate a cumulative understanding of SME technology adoption as a capability-mediated, context-contingent, evolutionary, and adaptive process. Each cluster contributes a complementary perspective: internal enablers explain the microfoundations of adoption quality (Sirén et al., 2012); technological readiness and organizational transformation capture the dynamic configuration of systems and routines (Hervas-Oliver et al., 2016); human adaptation reveals the behavioral and cognitive underpinnings of renewal (Scuotto et al., 2021); contextual enablers position adoption within institutional legitimacy and sustainability dynamics (Dwivedi & Sahu, 2014); and information systems highlight the integrative infrastructures that connect internal learning to external competitiveness (Sharma et al., 2012). These interrelated streams converge toward an integrative theoretical model in which SME technology adoption is not a discrete event but a continuous process of capability orchestration. This synthesis advances the resource-based view (Barney, 1991), the dynamic-capabilities framework (Teece et al., 1997), and institutional theory (DiMaggio & Powell, 1983) by demonstrating that the sources of SME competitiveness lie in the alignment of technological, organizational, human, and institutional elements into a coherent system of digital transformation (Popa et al., 2018; Hervas-Oliver et al., 2016; Rodriguez-Espíndola et al., 2022; Dey et al., 2023).

Conclusion

This study addresses a central puzzle in SME research: why do similar technological investments generate heterogeneous performance outcomes across SMEs? Through a cluster-based bibliometric analysis of 377 peer-reviewed articles, we mapped the intellectual structure of SME technology adoption and identified five interrelated knowledge domains: (i) internal enablers and performance mechanisms; (ii) technological readiness and organizational transformation; (iii) human microfoundations; (iv) institutional and contextual influences; and (v) information systems and absorptive capacity. Rather than representing isolated streams, these clusters collectively reveal that SME technology adoption is best understood as a capability-mediated and context-contingent orchestration process.

This study clarifies how previously fragmented research traditions, such as diffusion models (Davis, 1989; Rogers, 2003), resource-based and dynamic capability perspectives (Barney, 1991; Teece et al., 1997), and institutional approaches (DiMaggio & Powell, 1983), converge within identifiable thematic configurations (Mendoza-Silva, 2021; Donthu et al., 2021). By integrating these streams into empirically derived clusters, the study moves beyond linear technology-performance assumptions and advances cumulative theorizing. Recent scholarship further supports this integrative logic by emphasizing configurational dynamics, ecosystem

pressures, and capability development as central to explaining heterogeneous adoption outcomes (Khurana et al., 2022; De Mattos et al., 2024; Schwaeke et al., 2024). In this sense, the findings reinforce the view that performance differences stem not from technology per se, but from how firms orchestrate technological, organizational, and institutional elements into coherent capability systems.

The contributions of this study can be summarized in three complementary dimensions. Theoretically, it reframes SME technology adoption as a capability-mediated and context-contingent orchestration process, integrating diffusion, capability-based, and institutional traditions that previous reviews have largely treated in isolation (Xu et al., 2021; Zamani, 2022; Ghobakhloo et al., 2022). Methodologically, it demonstrates the value of combining VOS co-occurrence mapping with Normalized Local Citation Scores to connect the structure of a field with its sources of intellectual influence, extending integrative review designs employed in adjacent domains (Casado-Belmonte et al., 2021; Molina-García et al., 2023). From a practical perspective, the results underscore that technology adoption in SMEs cannot be reduced to investment intensity or technological characteristics alone. Competitive outcomes depend on the alignment between internal capabilities, organizational routines, and contextual pressures (Popa et al., 2018; Rodríguez-Espíndola et al., 2022). Moreover, the findings suggest that government support for SME technology adoption should go beyond financial incentives and include capability-building initiatives. Policies should strengthen managerial competencies, digital skills, and access to external knowledge while adapting support to firms' different levels of technological readiness and institutional contexts (Mittal et al., 2019; Qalati et al., 2021; Khurana et al., 2022; Gomes et al., 2026). The goal should be not only to increase technology adoption but also to help SMEs translate technological investments into sustained performance gains.

This study has limitations. The dataset is restricted to peer-reviewed journal articles indexed in Scopus and Web of Science, potentially excluding regionally embedded contributions. Moreover, the definition of small and medium-sized enterprises varies substantially across countries, so the primary studies do not necessarily examine equivalent populations. In this regard, future research could adopt harmonized size thresholds or report results by firm-size segment, following recent efforts to model digital maturity specifically in SMEs (Gomes et al., 2026). Finally, the restriction to English-language sources may underrepresent evidence from Latin America, Africa, and non-Anglophone Asia, regions in which SMEs are most economically significant (Lara-Pérez et al., 2026). Multilingual review designs therefore constitute a promising avenue for addressing this potential bias.

Beyond these limitations, the five clusters delineate concrete directions for future research on technology adoption, defined here as the process through which firms decide on, implement, and assimilate new technologies. The internal enablers cluster invites longitudinal research on how the capabilities that sustain technology adoption are accumulated under resource constraints and on whether firms that adopt technology before developing these capabilities can build them along the way or systematically underperform (Rauch & Hatak, 2016). The technological readiness cluster calls for studies that treat technology adoption as a staged process rather than a single decision, examining how readiness conditions determine which technologies firms can assimilate, and in what sequence, before adoption can translate into performance (Mittal et al., 2019; Gomes et al., 2026). The human microfoundations cluster points to multilevel designs that trace how individual competencies and attitudes toward new technologies aggregate into firm-level adoption behavior, addressing the underexplored link between who adopts technology within the firm and how the firm adopts it (Scuotto et al., 2021). The institutional cluster suggests comparative research across emerging economies on how ecosystem and regulatory conditions alter not only the propensity to adopt but also the type and depth of adoption that firms undertake (Qalati et al., 2021; Lara-Pérez et al., 2026). Finally, the absorptive capacity cluster highlights the need to open the black box between adoption and performance, specifying the mediating mechanisms through which adopted technologies become embedded in routines and converted into results (Sharma et al., 2012; Santini et al., 2023). Cutting across all five domains, configurational methods are especially promising, since the central lesson of this review is that adoption outcomes reflect combinations of technological, organizational, human, and institutional conditions rather than isolated determinants (De Mattos et al., 2024).

Overall, by reframing SME technology adoption as a capability-mediated and context-contingent process, this study strengthens the analytical coherence of the field and provides a structured foundation for explaining performance heterogeneity in technology adoption by small and medium-sized firms.

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AI Assistance Statement

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