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MAPPING THE SCIENTIFIC LANDSCAPE ON SMES' DIGITAL ADAPTATION AFTER COVID-19: A SCIENTOMETRIC STUDY

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ABSTRACT

Digital transformation has become a key process for the survival and competitiveness of small and medium-sized enterprises (SMEs) in the post-COVID-19 era. This research aims to map the global scientific landscape on digital transformation and organizational resilience in SMEs through a bibliometric study complemented by qualitative analysis. The Scopus and Web of Science databases were used, and after applying thematic filters and removing duplicates, 186 documents published between 2019 and 2025 were analyzed. The analysis was conducted using Bibliometrix and VOSviewer, enabling the examination of publication trends, international collaboration, influential journals, and emerging thematic areas. The results reveal sustained growth in scientific production since 2020, peaking in 2023. Indonesia, India, and China stand out as leading countries in publications and collaborative networks. The predominant themes revolve around digital transformation, dynamic capabilities, organizational innovation, technology adoption, and business resilience. The qualitative analysis of the most cited articles identified five key thematic categories and significant gaps, such as the limited inclusion of sustainable approaches, longitudinal studies, and equity-related variables. This study contributes to understanding the current state of knowledge, identifies research gaps, and proposes new research lines aimed at inclusive digitalization. The findings have practical implications for designing public policies, strengthening SMEs' digital capabilities, and promoting resilient, contextualized, and sustainable transformation in both emerging and developed economies.

KEYWORDS: Organizational Innovation, Dynamic Capabilities, International Collaboration, Technology Adoption, Business Resilience.

1. INTRODUCTION

Digital transformation has emerged as a strategic imperative for small and medium-sized enterprises (SMEs), particularly in times of disruption such as the COVID-19 pandemic. This phenomenon accelerated the adoption of digital technologies across multiple sectors, forcing organizations to rapidly redefine their operational models, communication channels, and market strategies under conditions of high uncertainty and limited time (Priyono et al., 2020; Klein & Todesco, 2021).

In this scenario, SMEs faced particular challenges due to their limited financial resources, weaker technological infrastructure, and insufficient preparation for remote work or the digitalization of key processes (Eze et al., 2023). Nevertheless, many demonstrated a remarkable capacity for adaptation, showcasing what the literature refers to as organizational resilience—defined as the ability to anticipate, absorb, respond to, and adapt to significant disruptions (Chowdhury & Wolf, 2023; Khurana et al., 2022).

The intersection of digital transformation and resilience has gained increasing attention in the scientific community, becoming an emerging line of research that spans business management, technological innovation, organizational leadership, and public policy. However, to date, there has been no comprehensive systematization of the scientific landscape that clarifies how this thematic intersection has evolved globally, what the dominant approaches are, which geographical contributions stand out, or where the main research gaps lie.

In this context, the present study aims to map the global scientific landscape on digital transformation and organizational resilience in SMEs in the aftermath of the COVID-19 pandemic, through a bibliometric analysis complemented by a qualitative review of the most influential articles published between 2019 and 2025. The goal is to identify publication patterns, international collaboration, most cited journals, dominant thematic areas, and to contribute to the strengthening of the future research agenda in this field.

This analysis not only visualizes the current state of knowledge but also identifies opportunities to develop more integrative theoretical frameworks and better contextualized intervention policies. By addressing this critical convergence between digitalization and resilience, the study seeks to provide useful evidence for researchers, policymakers, entrepreneurs, and stakeholders in the entrepreneurial ecosystem who are working to build stronger, more adaptive, and sustainable SMEs in the post-pandemic era.

In addition to identifying empirical trends and research gaps, this study makes a theoretical contribution by integrating qualitative findings into an emerging typology of five thematic categories. These not only reflect current research lines but also expand and contextualize established theoretical frameworks. For example, the categories of "digital business models" and "technology adoption" directly engage with the TOE framework, demonstrating how technological factors (such as AI or e-commerce), organizational aspects (leadership, digital culture), and environmental conditions (health crises, institutional support) interact in real-world contexts. Similarly, the categories of "dynamic capabilities," "organizational resilience," and "strategic responses to COVID-19" deepen the dynamic capabilities approach (Teece et al., 1997), showing how these involve not only adaptation but also accelerated organizational learning, integration of emerging technologies, and structural evolution in the face of prolonged disruptions. This thematic classification thus enables the operationalization of complex theoretical constructs and allows their empirical manifestation to be observed in diverse geographical contexts, offering a more contextual, systemic, and updated perspective on digitalization processes in SMEs.

The main objective of this study is to map the global scientific landscape on digital transformation and organizational resilience in small and medium-sized enterprises (SMEs) in the post-COVID-19 context.

To achieve this, a mixed-method approach is proposed, combining a bibliometric analysis of publications indexed between 2019 and 2025 in the Scopus and Web of Science databases with a qualitative analysis of the content of the most cited articles in this field. The operational goal is to identify

1. Publication trends and international collaboration networks;
2. The most influential journals and their citation patterns;
3. Emerging thematic areas and their conceptual articulation;
4. The main theoretical and methodological approaches used in the most cited literature;
5. Research gaps and potential new lines of inquiry.

This study seeks to provide an up-to-date diagnosis of the state of the art, as well as strategic insights for the design of public policies, business practices, and future research in both emerging and developed economies.

2. METHODOLOGY

The methodology of this study consisted of four stages (1) database selection, (2) definition of terms and search equation, (3) initial search, document inclusion and exclusion, and (4) results analysis.

2.1. Bibliometric Analysis as a Methodological Approach

Bibliometric analysis is a quantitative method used to evaluate the development and impact of research within a specific field by examining patterns in academic publications. This technique allows for the systematic study of trends, author contributions, citation networks, and keyword co-occurrence in order to map the intellectual structure of the investigated domain (Indahsari et al., 2023). One of its main advantages is the ability to identify research gaps and emerging areas, thus providing valuable insights for both academics and decision-makers (Vagelas et al., 2023).

2.2. Database Selection

The Scopus and Web of Science (WoS) databases were used due to their broad thematic coverage and recognition in the academic community. These platforms ensure comprehensive and high-quality retrieval of scientific publications relevant to digital transformation and organizational resilience in SMEs.

2.3. Definition of Terms and Search Equation

To address the research topic, key terms related to digital transformation, SMEs, and the post-COVID context were defined. **The following search equations were applied**

- **Scopus** TITLE-ABS-KEY("digital transformation") AND TITLE-ABS-KEY("SMEs" OR "small and medium enterprises") AND TITLE-ABS-KEY("post-COVID" OR "COVID-19")
- **WoS** TS=("digital transformation") AND TS=("SMEs" OR "small and medium enterprises") AND TS=("post-COVID" OR "COVID-19")

These equations enabled the capture of a representative set of academic studies on the topic, covering various sectoral and geographic approaches.

2.4. Initial Search, Inclusion, and Exclusion of Documents

The search was conducted on July 1, 2025, yielding an initial total of 205 documents: 196 from Scopus and 109 from WoS. The following inclusion and exclusion criteria were applied:

1. Documents published from 2019 onwards were included.
2. All subject areas were considered.
3. The following document types were selected: articles, reviews, book chapters, and conference proceedings (excluded: n=10 in Scopus, n=5 in WoS).
4. Publications in English and Spanish were considered (excluded: n=0 in Scopus, n=2 in WoS).

After applying these filters and removing duplicates (n=53), a sample of 235 documents was obtained. Using the grepl function, titles and abstracts were reviewed to ensure thematic relevance, resulting in the exclusion of 49 records and a final sample of 186 documents for the bibliometric analysis.

2.5. Results Analysis

The analysis was carried out using VOSviewer version 1.6.20 and R version 4.3.3. These tools provide robust visualizations and detailed statistics to explore research dynamics around SMEs, digitalization, and resilience.

The following analytical metrics were applied

- Publication and citation trends: Evaluation of literature growth and impact.
- Country and institutional contributions: Identification of leading collaboration networks.
- Most influential journals: Top 10 journals by number of documents and achieved impact.
- Keyword maps: Visualization of the most researched topics and their interconnections.

2.6. Qualitative Analysis

To complement the bibliometric analysis, a qualitative analysis was conducted on the most cited articles (n > 15) regarding digital transformation and resilience in SMEs. This technique allowed for the extraction of key thematic patterns and methodological approaches used in the most influential literature (Krippendorff, 2019; Neuendorf, 2019).

- Article selection: Priority was given to the most cited studies.
- Thematic coding: Open coding techniques were employed to identify categories such as post-pandemic digital strategies, change management, emerging technologies, and operational resilience.
- Cross-validation: Several researchers independently coded the articles following standardized guidelines (Elo & Kyngäs, 2008).

- Triangulation: The results of the content analysis were integrated with the bibliometric findings to strengthen conclusions.

The integration of bibliometric and qualitative analysis was conducted through a sequential and convergent methodological triangulation process. In the first stage, bibliometric analysis was used to identify the most influential articles in the total corpus based on objective citation metrics. Subsequently, these documents were subjected to thematic content analysis using open coding and iterative categorization. Triangulation occurred at two levels

a) Results level, by comparing thematic clusters derived from keyword co-occurrence with the emerging categories from the qualitative analysis; and
b) Interpretative level, by contrasting the empirical and theoretical contributions of the most cited studies with the global trends identified in the bibliometric analysis.

This methodological convergence allowed for validation of key patterns, strengthening of theoretical inferences, and enrichment of the critical interpretation of the analyzed scientific landscape.

The combined quantitative and qualitative approach enabled a deeper understanding of the scientific evolution surrounding digital transformation and organizational resilience in post-COVID SMEs.

3. RESULTS

3.1. Productivity and Citation Analysis

The annual productivity analysis reveals a sustained growth in scientific output on digital transformation and organizational resilience in SMEs from 2020 to 2024 (see Figure 1).

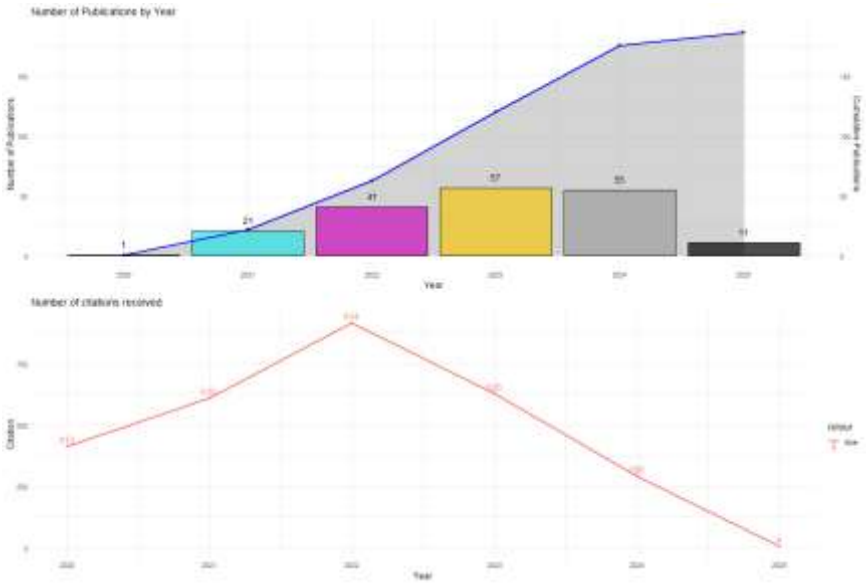

Figure 1: Annual Evolution of Publications and Citations on Digital Transformation and Organizational Resilience in SMEs (2020–2025). The Bars Represent the Number of Publications per Year, While the Line Indicates Annual Citation Counts. The Figure Illustrates the Rapid Growth in Scientific Output During 2021–2023 and the Temporal Lag in Citations for More Recent Publications.
Source: Own Elaboration With R Version 4.3.3.

Only one publication was recorded in 2020, followed by a significant increase in 2021 (n=21) and 2022 (n=41). The peak year was 2023, with 57 publications, and 2024 maintained a high level with 55 documents. For the first half of 2025, there is a noticeable decline (n=11), attributed to the proximity of the data collection date (July 2025), suggesting that new publications may still be added later in the year.

Cumulatively, the trend shows a steep upward curve, reaching a total of 186 publications, confirming growing scientific interest in this field. This pattern reflects the progressive consolidation of the topic as a relevant research line in the post-pandemic context, particularly between 2022 and 2024.

In terms of citations, the yearly distribution shows an inverse trend to the number of publications. The year with the highest number of citations was 2022, totaling 914, followed by 2021 (610) and 2023 (626). From 2023 onward, citations drop significantly, with 290 in 2024 and only 4 in 2025. This decrease in recent citations is expected, as newer articles have not had

enough time to accumulate citations. Moreover, the high impact of articles published in 2021 and 2022 suggests these were pioneering or foundational studies in the topic of digital transformation in SMEs during the critical post-COVID stage.

As for average impact, the 186 analyzed documents collectively accumulated 3,406 citations as of July 2025, equating to an average of 18.3 citations per document. This reinforces the idea that the field has rapidly gained academic visibility, with several highly cited contributions, especially between 2021 and 2023. However, there is high dispersion, with some papers exceeding 400 citations while others have few, indicating the coexistence of seminal work and more localized or exploratory studies.

Overall, these results indicate an expanding field that, after peaking in 2022, has maintained a steady flow of scientific output with the potential for further consolidation in the coming years, especially as new theoretical frameworks emerge and mid- and long-term impacts are assessed.

3.2. Country Contribution and International Collaborations

The international collaboration analysis, visualized in Figure 2 through a network map generated with VOSviewer, reveals a multicentric structure with several prominent nodes in scientific production on digital transformation and organizational resilience in SMEs. The map illustrates inter-country connections based on co-authorship in academic publications.

Indonesia stands out as the most central country in the network, with 16 publications and 659 citations, as well as the highest total link strength (13), reflecting strong collaborative activity. India (14 documents, 222 citations) and China (7 documents, 207 citations) also hold key positions, forming clusters with significant links to Brazil, Saudi Arabia, and Sri Lanka.

European countries such as Spain, Italy, Greece, and the Czech Republic also play prominent roles. Spain, for instance, contributed 7 publications and 282 citations, making it one of the most influential countries in terms of impact. Greece and Vietnam show more limited but still relevant bilateral collaborations.

In Latin America, Peru, Argentina, and Chile stand out, primarily through collaborations with Spain and Indonesia. This suggests a South–South and South–North knowledge exchange that enriches the regional perspective on digital transformation strategies for SMEs.

Although countries like Canada, Finland, and Tunisia have fewer publications, their presence in the map reflects active participation in international research networks, reinforcing the global nature of the topic.

These findings show that the study of post-COVID digital transformation in SMEs has drawn attention from various regions, encouraging transnational collaboration that strengthens global understanding and facilitates the dissemination of best practices and context-specific resilience frameworks.

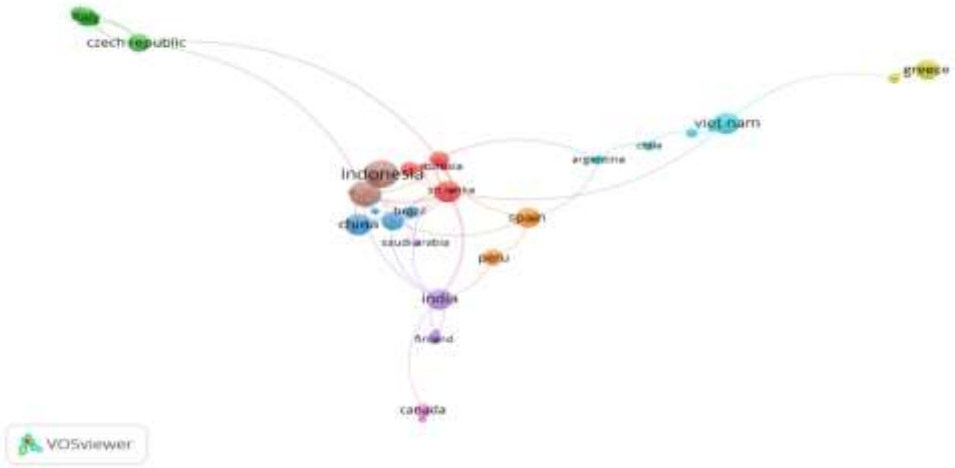

Figure 2: International Collaboration Map on Digital Transformation and Resilience in SMEs (VOSviewer, 2025). The Map Displays Co-Authorship Links Among Countries, Where Node Size Represents Publication Volume and Link Thickness Indicates Collaboration Strength. Larger Nodes (e.g., Indonesia, India) Highlight Countries With Stronger Contributions and Connectivity.

Source: Own Elaboration Based on Scopus and Web of Science.

3.3. Most Influential Journals

The analysis of publication sources reveals that literature on digital transformation and organizational resilience in SMEs post-COVID is primarily disseminated through open-access journals, specialized conferences, and editorial series focused on technological innovation and business management. Table 1 summarizes the top ten sources by number of documents and total citations.

Among the most prolific journals are Sustainability (Switzerland) and Springer Proceedings in Business and Economics, each with six documents. However, their impact differs significantly: Sustainability has 130 citations, positioning it among the most influential in terms of academic visibility, whereas Springer Proceedings has only one citation, suggesting low reach.

A similar case is found in the Journal of Open Innovation: Technology, Market, and Complexity, which, despite publishing only three documents, has accumulated 503 citations—making it the journal with the highest average impact per article (about 168 citations each). This indicates that some seminal works on SME digital transformation were published in this journal, likely due to its post-COVID innovation focus and business visibility.

Other journals like International Journal of Organizational Analysis (3 documents, 58 citations) and Cogent Business and Management (3 documents, 8 citations) show intermediate impact, suggesting moderate reception.

In contrast, other sources like Smart Innovation, Systems and Technologies (4 documents, 2 citations), Lecture Notes in Information Systems and Organisation (4 documents, 1 citation), Lecture Notes in Networks and Systems (3 documents, 6 citations), and conference proceedings such as ECIE and LACCEI have consistent publication volume but low citation impact. While they remain valid dissemination platforms, their theoretical influence appears more limited.

Overall, these findings highlight a diversity of publication channels but also underscore the importance of prioritizing journals with broader reach and higher impact to strengthen the visibility and citability of future research in this area.

Table 1: Annual Distribution of Publications and Citations (2020–2025).

Source Title	Documents	Citations
Sustainability (Switzerland)	6	130
Springer Proceedings in Business and Economics	6	1
Smart Innovation, Systems and Technologies	4	2
Lecture Notes in Information Systems and Organisation	4	1
Journal of Open Innovation: Technology, Market, and Complexity	3	503
International Journal of Organizational Analysis	3	58
Cogent Business and Management	3	8
Lecture Notes in Networks and Systems	3	6
Proceedings of the European Conference on Innovation and Entrepreneurship (ECIE)	3	1
Proceedings of the LACCEI International Multi-Conference	3	1

3.4. Thematic Area

The keyword co-occurrence analysis, visualized in Figure 3, reveals the main thematic areas shaping the academic debate on digital transformation and organizational resilience in SMEs in the post-COVID context. Based on 186 processed documents, 41 clusters of relevant terms were identified and organized into interconnected semantic networks that reflect both dominant research lines and emerging approaches.

The most frequently occurring keyword was "digital transformation" (n=48), followed by "SMEs" (n=37), "COVID-19" (n=36), "digitalization" (n=14), and "small and medium enterprises" (n=12). These terms form the conceptual core of the field, where processes of technology adoption intersect with organizational challenges brought on by the pandemic.

Emerging topics include terms such as "Industry 4.0," "digital maturity," "dynamic capabilities," "resilience," and "technology adoption," indicating a shift from a purely technological perspective toward a more strategic and organizational one. These themes point to the need for strengthening adaptive capacities, building mature digital infrastructures, and developing change management mechanisms that allow SMEs to respond agilely to high-uncertainty environments.

Additionally, the presence of terms like "innovation," "productivity," "e-commerce," "supply chain disruption," and "entrepreneurship" signals a growing interest in examining the impact of digital transformation on business performance, business models, and operational sustainability.

The cluster associated with "business resilience" and "crisis management" reflects a growing concern with strengthening post-crisis organizational structures. Meanwhile, the use of terms like "TOE framework," "fuzzy-AHP," and "digital supply chain transformation" suggests a methodological trend toward multi-criteria evaluation models and systemic approaches.

Furthermore, the map highlights the regional diversification of contributions, with countries like Vietnam, Croatia, and Poland emerging as relevant nodes. This suggests active participation from developing regions in the production of knowledge on SME digitalization.

Overall, the thematic analysis reveals that the field is entering a phase of growing maturity, with a solid conceptual foundation and openness to new issues such as digital resilience, sustainability, organizational innovation, and equity in technology adoption among small and medium-sized enterprises.

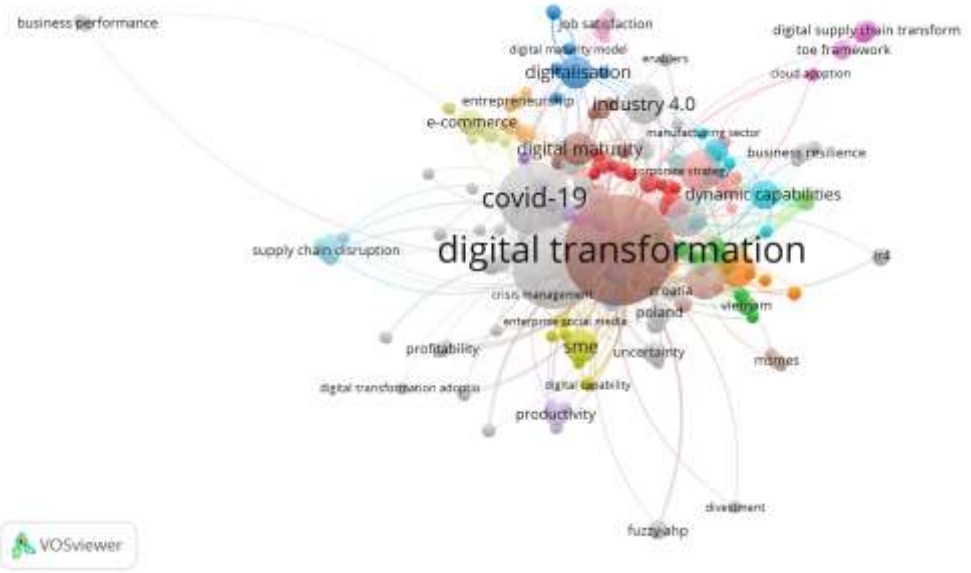

Figure 3: Keyword Co-Occurrence Map in Studies on Digital Transformation and Resilience in SMEs Post-COVID (VOSviewer, 2025). Node Size Indicates the Frequency of Keyword Occurrence, While Colors Represent Thematic Clusters. For Instance, the Red Cluster Emphasizes "Digital Transformation" and "SMEs," While the Blue Cluster Highlights Emerging Themes Such as "Dynamic Capabilities" and "Resilience." The Map Reveals Both Dominant Research Areas and Emerging Directions in the Field.
Source: Own Elaboration.

3.5. Qualitative Analysis

To complement the bibliometric analysis, a qualitative examination was conducted on the most cited articles related to digital transformation and organizational resilience in SMEs post-COVID. These studies, published between 2020 and 2025, were selected based on their total citation count in Scopus and Web of Science databases, as an indicator of high academic influence. Table 5 summarizes the reviewed studies and their main thematic categories, forming a solid basis for the critical interpretation of the most influential literature in this field.

3.5.1. Selection Criteria and Coding

Inclusion was based exclusively on citation metrics, prioritizing articles most frequently cited by other scientific works. This strategy acknowledges the relevance of these studies in the academic discourse and helps identify key theoretical, methodological, and practical contributions to SME digital transformation. Abstracts and keywords from each article were reviewed, and open coding was applied to group them into five main thematic categories

1. Innovation and digital business models
2. Organizational resilience
3. Technology adoption models
4. Dynamic capabilities
5. COVID-19 impact and strategic responses

3.5.2. Thematic Categories and Representative Findings

Innovation and Digital Business Models A

significant portion of the reviewed studies focused on how SMEs reconfigured their processes and organizational structures through digitalization.

- Priyono et al. (2020) proposed a model of digital transformation pathways, highlighting three routes: incremental, additive, and radical.
- Annarelli et al. (2021) explored the link between digital innovation and sustainability, suggesting that resilient business models integrate technological capabilities with sustainable practices.
- Al-Omoush et al. (2022) emphasized the role of digital ecosystems and networking in organizational innovation for SMEs.

Post-Crisis Organizational Resilience Several studies examined resilience as a critical capability for dealing with external disruptions.

- Khurana et al. (2022) analyzed how dynamic capabilities help SMEs adapt during systemic crises.
- Chowdhury & Wolf (2023) provided empirical evidence on the relationship between digital resilience and operational continuity in small manufacturing firms.
- Schiavi et al. (2021) investigated the strategic evolution of Brazilian SMEs in volatile environments, identifying mechanisms of organizational learning and structural flexibility.

Technology Adoption Models Many studies used the TOE framework (Technology–Organization–Environment) to understand the factors influencing the adoption of digital technologies.

- Eze et al. (2023) applied this model in Africa, identifying financial constraints, low digital literacy, and regulatory uncertainty as key barriers.
- Omar et al. (2022) adapted the TOE model for Middle Eastern SMEs, finding that institutional support and perceived usefulness significantly influence digital adoption. These studies highlight the need for contextualized approaches to technology implementation.

Dynamic Capabilities and Digital Leadership Several articles emphasized the importance of leadership and organizational competencies in enabling digital transformation.

- Rupeika-Apoga et al. (2022) found that digital orientation and organizational capacity directly predicted successful technology strategy implementation.
- Heredia et al. (2023), in a study of Peruvian SMEs, demonstrated that a combination of absorptive capacity and participatory leadership fostered agility and adaptability post-COVID.
- Chatterjee et al. (2021) proposed a framework of digital leadership competencies for small business leaders.

COVID-19 Impact and Strategic Response Numerous investigations explored the disruptive effects of the pandemic on SME operations and strategies.

- Klein & Todesco (2021) differentiated between defensive and offensive organizational responses to COVID-19.
- Winarsih et al. (2021) proposed a framework for sustainable digital transformation in times of crisis.
- Vargas et al. (2022) examined the role of e-commerce as a survival strategy in Latin American SMEs.

These studies consistently highlight the pandemic as a catalyst for digital transformation, accelerating processes that would have otherwise taken years to implement.

3.5.3. Methodological Synthesis of Reviewed Studies

From a methodological standpoint, the analyzed studies reveal a diversity of quantitative, qualitative, and mixed-methods approaches.

- Quantitative approaches are dominated by the use of structural equation modeling (SEM and PLS-SEM), as seen in studies by Ko et al. (2022), Ngo et al. (2022), and Baral et al. (2021). These were used to model relationships between digital capabilities, organizational resilience, business performance, and contextual factors. Other statistical techniques employed include multiple regression, confirmatory factor analysis, and multivariate analysis in varied empirical contexts.
- Qualitative studies often adopted case study designs (e.g., Priyono et al., 2020; Pfister & Lehmann, 2023), using semi-structured interviews, thematic coding, and narrative analysis to explore specific SME experiences in digitalization processes. This approach enables deeper understanding of organizational processes and decision-making in specific contexts.
- Mixed-methods studies are less common but valuable, combining surveys with interviews or document analysis (e.g., Ballerini et al., 2023; Jiménez-Zarco et al., 2021), enhancing result

triangulation. There is also an increasing use of techniques such as multi-criteria decision analysis (fuzzy-AHP), text mining, and scenario simulations, especially in research evaluating digital strategies under uncertainty.

Table 2: Most-Cited Studies and Main Findings.

Author and Year	Citations	Thematic Axis	Main Findings
Priyono et al. (2020)	413	Transformación digital y madurez tecnológica	Analyzes digital transformation in Thai SMEs for supply chain management in evolving environments.
Klein & Todesco (2021)	280	Resiliencia organizacional	Proposes a model to improve survival of sustainable SME supply chains, analyzed through multiple constructs via SEM.
Khurana et al. (2022)	221	Resiliencia organizacional	Emerging technologies like AI and robotics improve efficiency by over 26% in Korean manufacturing SMEs.
Rupeika-Apoga et al. (2022)	121	Transformación digital y madurez tecnológica	Malaysian SMEs require proactive leadership and sustainable frameworks to overcome post-pandemic operational and financial crises.
Winarsih et al. (2021)	110	Transformación digital y madurez tecnológica	Digital capabilities, supported by training and experience, influence SME growth in Latin America.
Hossain et al. (2022)	104	Resiliencia organizacional	Finds that innovation and digitalization drive sustainable development in Czech and Russian SMEs post-COVID.
Al-Okaily (2023)	83	Transformación digital y madurez tecnológica	Study in Hungary highlights the need for sustained policies to support SME adoption of Industry 4.0 technologies.
Khalil et al. (2022)	72	Resiliencia organizacional	Analyzes business ethics in Chinese SMEs, showing its positive impact on organizational resilience during the pandemic.
Chen et al. (2021)	63	Tecnología 4.0 y eficiencia operativa	Shows digital platforms support diversification, internationalization, and customer understanding in manufacturing SMEs.
Jabeen et al. (2022)	59	Innovación abierta y modelos de negocio	Finds that digitalized SMEs in Oman were more resilient to the pandemic; recommends investing in technological infrastructure.
Drydakis (2020)	51	Tecnología 4.0 y eficiencia operativa	Links SME resilience to organizational ambidexterity, paradoxical leadership, and digital public policies in Vietnam.
Mishrif & Khan (2023)	49	Transformación digital y madurez tecnológica	Case study of eight German SMEs shows high ROI in digitalization through data analytics.
Huang et al. (2022)	45	Gender, Public Policy and Institutional Context	Finds that digitalization enhances SME survival in developing countries by fostering resilience during COVID-19.
Penco et al. (2022)	45	Innovación abierta y modelos de negocio	AI reduces operational and financial risks in SMEs by enhancing dynamic capabilities amid the pandemic.
Kaftan et al. (2023)	44	Transformación digital y madurez tecnológica	Digital social marketing improves financial outcomes in women-led microenterprises in Spain.
Alam et al. (2022)	40	Gender, Public Policy and Institutional Context	Reveals cash flow shortages and supply chain disruption as barriers, but emphasizes digitalization as key for resilience.
Baral et al. (2022)	37	Resiliencia organizacional	Shows how entrepreneurial orientation enables Italian SMEs to view the crisis as a digital transformation opportunity.
Hwang & Kim (2022)	37	Tecnología 4.0 y eficiencia operativa	Demonstrates how dynamic capabilities and digital transformation strengthen business resilience in Indonesian apiculture SMEs.
Straková et al. (2022)	37	Transformación digital y madurez tecnológica	Evaluates public policies in Vietnam that enhance innovation and digital transformation in SMEs through IT capabilities.
Ko et al. (2022)	36	Transformación digital y madurez tecnológica	Confirms that COVID-19 disruptions accelerated digital supply chain adoption in Vietnamese SMEs more than in larger firms.
Ballerini et al. (2023)	32	Innovación abierta y modelos de negocio	Proposes an AI-based framework for predictive maintenance of industrial assets, improving operational decisions in SMEs during the pandemic.
Putritamara et al. (2023)	31	Transformación digital y madurez tecnológica	Compares Romanian SMEs' digital and sustainable readiness with EU averages, highlighting structural gaps.
Anatan & Nur (2023)	28	Gender, Public Policy and Institutional Context	Proposes a conceptual model based on resilience and knowledge management to guide digital transformation in SMEs.
Trieu et al. (2023)	28	Resiliencia organizacional	Identifies imbalances in core and support processes during business model digitalization in Central European SMEs.
Dossou et al. (2022)	28	Tecnología 4.0 y eficiencia operativa	Identifies digitalization barriers in Indonesian SMEs; suggests knowledge transfer from universities as a key solution.
Mai et al. (2023)	27	Gender, Public Policy and Institutional Context	Identifies three digital transformation trajectories based on maturity and social capital in manufacturing SMEs in Indonesia.
Ngo et al. (2022)	27	Transformación digital y madurez tecnológica	Shows that digital marketing promotes brand positioning and outreach in Kosovo-based SMEs.

Khalid & Naumova (2021)	27	Transformación digital y madurez tecnológica	Youth and digitalization sustain marine tourism through MSMEs in Indonesia during the pandemic.
Author and Year	**Citations**	**Thematic Axis**	**Main Findings**
Ramadani et al. (2022)	26	Transformación digital y madurez tecnológica	Develops a smart methodology to accelerate Industry 4.0 implementation in French manufacturing SMEs.
Ogrean & Herciu (2021)	24	Gender, Public Policy and Institutional Context	Develops a multilevel resilience model (micro, meso, macro) for SMEs arising from digital adoption during the pandemic.
Ngo et al. (2022)	23	Gender, Public Policy and Institutional Context	Confirms the mediating effect of digital transformation between digital orientation and business income performance.
Jiménez-Zarco et al. (2021)	23	Gender, Public Policy and Institutional Context	Assesses accounting system use in Jordanian SMEs, confirming that perceived usefulness influences adoption.
Pfister & Lehmann (2023)	22	Tecnología 4.0 y eficiencia operativa	Establishes links between digital agility, competitiveness, and innovative performance in Hungarian SMEs using PLS-SEM.
Endrodi-Kovács & Stukovszky (2021)	21	Gender, Public Policy and Institutional Context	Highlights the shift in mindset toward digitalization as a path to sustainability for SMEs amid crisis.
Gonzalez-Tamayo et al. (2023)	18	Transformación digital y madurez tecnológica	Studies digital transformation drivers in SME supply chains in Vietnam using the TOE framework.
Kurniawati et al. (2022)	17	Innovación abierta y modelos de negocio	Highlights the role of open innovation in business model transformation in SMEs during COVID-19.
Hu & Kee (2022)	17	Resiliencia organizacional	Reveals gender-based differences in leaders' perception of digital transformation in Australian regional SMEs.
Rojas-García et al. (2023)	16	Transformación digital y madurez tecnológica	E-commerce and digital platforms helped logistics SMEs redirect business models and maintain productivity.

These methodological patterns reflect a growing maturity in the empirical treatment of the phenomenon, although some limitations persist

- There is a lack of longitudinal studies assessing the sustainable effects of digitalization over time.

Most models fail to incorporate environmental or gender equity perspectives—elements critical to fostering truly inclusive and sustainable digital transformation.

4. DISCUSSION

The results obtained in this study reveal sustained growth in research on digital transformation and organizational resilience in SMEs during the post-COVID period, with a significant surge between 2021 and 2023. This trend supports the findings of Priyono et al. (2020), who identified three adaptive pathways—incremetal, additive, and radical—in Indonesian SMEs, depending on their digital maturity and access to resources. Complementarily, Klein and Todesco (2021) observed that many SMEs initially opted for defensive responses, such as temporary closures or improvised digitalization, reflecting the urgency for change amid disruption.

The analysis of international collaboration reinforces this narrative, highlighting the presence of Asian countries such as Indonesia, India, and China. This finding aligns with Khurana et al. (2022), who describe resilience as a second-order dynamic capability, nurtured by the entrepreneurial ecosystem. Similarly, Hossain et al. (2022) emphasize that in Bangladesh, digitalization played a key role in counteracting operational and supply chain disruptions. This pattern is echoed in the research of Putritamara et al. (2023) on beekeeping SMEs and of Mishrif & Khan (2023) in Oman's logistics sector.

The thematic distribution shows a conceptual shift from a purely technology adoption approach toward a more holistic view involving sustainability, organizational innovation, digital leadership, and dynamic capabilities. Rupeika-Apoga et al. (2022) and Mai et al. (2023) agree that digital orientation and government support are key drivers for promoting sustainable digital transformation in SMEs. Likewise, Khalil et al. (2022) demonstrate how digital technologies help mitigate crisis effects in developing countries by strengthening business resilience.

Several studies highlight the importance of leadership and digital culture in these processes. Baral et al. (2021) and Ballerini et al. (2023) identify digital skills and platform engagement as crucial determinants of organizational performance. Ko et al. (2022) and Trieu et al. (2023) link digital agility and organizational ambidexterity to SMEs' innovation outcomes.

The prevailing methodological approaches have been quantitative, with the use of PLS-SEM (Partial Least Squares Structural Equation Modeling) and multivariate analysis, as shown by Ngo et al. (2022),

Drydakis (2022), and Ramadani et al. (2023). However, qualitative contributions are also notable, such as the studies by Pfister and Lehmann (2023), who examined the return on investment (ROI) of digitalization in German SMEs, and by Anatan and Nur (2023), who highlight the need for knowledge transfer from universities to SMEs.

A critical aspect identified is the limited integration of environmental or gender equity variables within the analyzed frameworks. This has been noted by authors such as Gonzalez-Tamayo et al. (2023), who argue that digital maturity in Latin America depends heavily on digital skills training. Hu and Kee (2022) also recommend aligning business strategies with sustainability principles (ESG) to enhance post-COVID resilience. One reason for the persistence of these gaps is the dominance of short-term, crisis-driven research agendas in the aftermath of COVID-19, which prioritized immediate survival strategies over long-term sustainability or social equity concerns. Moreover, methodological limitations, including the scarcity of longitudinal datasets and the challenges of tracking SMEs across time, have hindered the development of studies that capture lasting impacts. In the case of gender equity, cultural and institutional biases in some regions contribute to its underrepresentation in digital transformation research, where economic and technological variables are often prioritized. To address these gaps, future research should adopt longitudinal designs that follow SMEs over multiple years, incorporate environmental and social indicators into digital transformation frameworks, and ensure gender-disaggregated data collection to reveal differentiated impacts. Collaborative projects between academia, governments, and industry can also provide the necessary resources to overcome data scarcity, while comparative studies across regions can illuminate how context shapes the inclusivity and sustainability of digital transformation.

From a sectoral and geographic perspective, there is active participation from regions such as Eastern Europe (Kaftan et al., 2023; Endrődi-Kovács & Stukovszky, 2021), Latin America (Gonzalez-Tamayo et al., 2023; Jiménez-Zarco et al., 2021; Rojas-García et al., 2024), and Asia (Al-Okaily, 2023; Kurniawati & Kohar, 2022; Chen et al., 2021). These contributions enrich the understanding of digital transformation processes across diverse contextual realities.

In terms of theoretical frameworks, several studies apply the TOE (Technology–Organization–Environment) approach, such as Al-Okaily (2023), Ngo et al. (2022), and Ogrean & Herciu (2021), to explain technology adoption. In this study, the framework is operationalized through categories such as digital innovation, business models, and technological adaptation, integrating technological, organizational, and environmental factors. Additionally, the dynamic capabilities approach (Teece et al., 1997) is materialized in studies such as those by Rupeika-Apoga et al. (2022), Drydakis (2022), and Khalid & Naumova (2021), showing that SMEs not only respond to disruptions but also proactively reconfigure their resources to face volatile scenarios.

Moreover, authors like Jabeen et al. (2022) and Strakova et al. (2022) underscore the role of open innovation and digital business model reconfiguration as adaptive mechanisms. Meanwhile, studies like Dossou et al. (2022) propose sustainable methodologies based on Industry 4.0 and intelligent technologies.

The accumulated evidence also confirms differences in digital maturity according to geographic context. For example, Ogrean and Herciu (2021) analyze digitalization barriers in Romanian SMEs, while Hwang and Kim (2022) demonstrate how emerging technologies significantly improved the technical efficiency of Korean manufacturing SMEs. These comparisons underscore the need for more robust and longitudinal comparative frameworks.

Finally, studies by Chen et al. (2021) and Jabeen et al. (2022) show that AI-driven tools, digital platforms, and predictive maintenance systems have led to tangible improvements in productivity, customer satisfaction, and strategic decision-making. This positions digitalization not merely as a crisis response, but as a lever for structural transformation.

5. PRACTICAL IMPLICATIONS AND FUTURE RESEARCH LINES

5.1. Practical Implications

This study offers valuable insights for policymakers, consultants, and leaders of small and medium-sized enterprises. The evidence underscores the importance of investing in digital capabilities and transformational leadership as key drivers of organizational resilience. However, to be truly effective, these recommendations must be adapted to different economic contexts. In low-income regions, where SMEs often face constraints in financing, infrastructure, and digital literacy, strategies should focus on low-cost and accessible technologies (e.g., cloud-based solutions, WhatsApp Business, mobile banking), microcredit schemes tailored for digital adoption, and public–private partnerships that

subsidize digital training. Conversely, in high-income regions, where basic infrastructure and digital literacy are more developed, policies should emphasize advanced innovation adoption (e.g., AI, blockchain, and data analytics), cybersecurity frameworks, and incentives for sustainable and green digital transformation. These differentiated strategies ensure that digitalization policies are not only inclusive but also responsive to the structural disparities across regions.

5.2. Future Research Lines

Based on the identified gaps, several directions for future research are proposed

- Longitudinal studies to evaluate the lasting impact of digitalization beyond the immediate post-COVID period.
- Inclusion of environmental and social dimensions (e.g., sustainability, gender equity, circular economy) in digital transformation frameworks.
- Comparative analyses between regions or economic sectors to identify different resilience patterns.
- Assessment of emerging technologies (e.g., artificial intelligence, blockchain, IoT) on SME operational and financial performance.
- Case studies in rural or digitally underserved regions to enhance the applicability of existing models.

6. STUDY LIMITATIONS

While this study provides a comprehensive view of digital transformation and organizational resilience in post-COVID SMEs, it is important to acknowledge certain limitations that may affect the generalizability of the findings.

- First, the bibliometric analysis was limited to documents indexed in Scopus and Web of Science, potentially underrepresenting relevant studies from regional databases or non-indexed journals. Contributions in languages other than English or Spanish may have been excluded.
- Second, although a qualitative review was conducted, it focused mainly on abstracts and keywords, which may have limited deeper interpretation of methodological or empirical content.
- Third, the selection of highly cited articles introduces a temporal bias, as newer publications may not yet have accumulated citations despite their theoretical or innovative relevance.
- Fourth, keyword co-occurrence analysis depends on the authors' terminology, which may limit the detection of relevant concepts expressed with alternative nomenclature.

Additionally, the results may reflect a geographical bias due to the overrepresentation of countries like Indonesia and India, which concentrate a significant portion of publications. This could skew thematic and methodological patterns, limiting generalization to underrepresented regions such as Africa or Central America. Future studies could apply stratified sampling or subregional analyses to balance geographic representation and better capture local diversity.

Finally, this study does not differentiate between economic sectors or specific SME sizes, which may be relevant in understanding variations in digital response capacities based on business type or available resources.

These limitations open opportunities for complementary research that is more specific, sector-focused, or based on mixed-methods with greater empirical depth.

7. CONCLUSION

Digital transformation has emerged as a critical factor for the survival and competitiveness of SMEs in the post-COVID-19 era. This study, through a scientometric approach complemented by qualitative analysis, mapped the most relevant scientific dynamics surrounding this phenomenon between 2019 and 2025.

The findings reveal sustained growth in scientific production, with a strong presence of Asian countries such as Indonesia and India, and a thematic concentration on dynamic capabilities, organizational resilience, and digital innovation. Furthermore, a conceptual evolution was identified—from mere technology adoption toward more integrative approaches that consider leadership, sustainability, and institutional context.

From a theoretical perspective, this study contributes to the field by operationalizing frameworks such as the Technology–Organization–Environment (TOE) model and dynamic capabilities through an emerging typology of five key categories. This effort enables a better empirical understanding of digital transformation in SMEs and suggests new paths for context-sensitive analysis.

In summary, this bibliometric mapping not only clarifies the current state of knowledge but also invites a rethinking of research agendas from a more inclusive, multisectoral, and regionally grounded perspective, especially relevant to emerging

economies.

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