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Digital transformation in SMEs: systematic review of factors, barriers and results

Transformación digital en PYMEs: revisión sistemática de factores, barreras y resultados

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Abstract

This systematic review synthesizes recent evidence on the factors that facilitate or hinder digital transformation in SMEs, as well as its organizational impacts. Following the PRISMA 2020 protocol guidelines, a search was conducted in the Scopus and Web of Science databases, yielding 200 records. From these, 30 studies were selected for qualitative analysis, applying inclusion criteria and the MMAT tool to assess methodological quality. The findings, organized according to the TOE and dynamic capabilities theoretical frameworks, identify key enablers as technological infrastructure, appropriate IT solutions, digitally-minded leadership, staff skills, efficient resource allocation, and an organizational culture receptive to change. External factors such as competitive pressures, regulations, customer demands, and the availability of financing also play a role. Key barriers include high implementation costs, a lack of digital skills, the existence of legacy systems, cybersecurity risks, and the complexity of current regulations. Overall, digital transformation is linked to significant improvements in operational efficiency, innovation, and performance, both in the market and in financial indicators. However, the diversity in methodological designs and metrics used reflects the need for more longitudinal and comparative studies that delve deeper into these effects.

Keywords: digitization, small and medium-sized enterprises, information technologies.

Resumen

Esta revisión sistemática sintetiza la evidencia reciente sobre los factores que facilitan o dificultan la transformación digital en las PYMEs, así como sus impactos organizacionales. Siguiendo las directrices del protocolo PRISMA 2020, se realizó una búsqueda en las bases Scopus y Web of Science, obteniendo 200 registros, de los cuales se seleccionaron 30 estudios para un análisis cualitativo, aplicando criterios de inclusión y la herramienta MMAT para evaluar la calidad metodológica. Los hallazgos, organizados a partir de los marcos teóricos TOE y de capacidades dinámicas, identifican como facilitadores clave la infraestructura tecnológica, soluciones de TI adecuadas, liderazgo con visión digital, competencias del personal, asignación eficiente de recursos y una cultura organizacional receptiva al cambio. Además, influyen factores externos como presiones

competitivas, regulaciones, demandas de clientes y la disponibilidad de financiamiento. Entre las principales barreras destacan los costos elevados de implementación, la carencia de habilidades digitales, la existencia de sistemas heredados, riesgos relacionados con la ciberseguridad y la complejidad normativa vigente. En conjunto, la transformación digital se vincula con mejoras significativas en eficiencia operativa, innovación y desempeño tanto en el mercado como en indicadores financieros. Sin embargo, la diversidad en diseños metodológicos y métricas utilizadas refleja la necesidad de realizar más estudios longitudinales y comparativos que profundicen en estos efectos.

Palabras clave: digitalización, pequeñas y medianas empresas, tecnologías de la información.

Introduction

In the digital era, digital transformation, defined as the integration of digital technologies into business processes and models to bring about profound changes in operations and value creation, has become a key factor for small and medium-sized enterprises (SMEs) in Europe. These enterprises account for over 99% of the European business landscape and are essential for employment and innovation (Eurofound & Cedefop, 2025). However, many SMEs face challenges in adopting advanced technologies and adapting their models, which raises the following research question: What factors facilitate or hinder digital transformation in European SMEs, and what are the effects on business performance? This question has gained particular relevance in the wake of the COVID-19 pandemic, which accelerated digitalization across numerous sectors.

The significance of this study lies in the need to synthesize recent evidence regarding digital transformation in SMEs amidst the rapidly growing body of literature. While research on corporate digital transformation has advanced swiftly, the topic remains relatively novel in the context of SMEs, with ongoing disagreements regarding its definition and scope (Lanzolla et al., 2018; Vial, 2019). Prior to 2019, there were few works focused on SMEs, but in recent years, there has been a notable increase in studies that interpret the concept in various ways (Eurofound & Cedefop, 2025). In this scenario, a systematic review helps to organize these studies and clarify trends, gaps, and lessons learned, providing a solid foundation for business decision-making and public policy.

From a theoretical perspective, this study is grounded in two complementary frameworks. The Technology-Organization-Environment (TOE) model, proposed by Tornatzky and Fleischer (1990), posits that the adoption of technological innovations depends on technological (infrastructure, compatibility), organizational (size, resources, culture), and environmental factors (competitive pressure, regulation). This framework systematically categorizes the enablers and barriers to digital transformation in SMEs. On the other hand, the dynamic capabilities theory (Teece, 2007) focuses on organizational abilities to detect and seize opportunities and reconfigure resources in changing contexts. In the digital realm, these capabilities translate into agility in implementing technologies and resilience in the face of disruptions. The combination of TOE and dynamic capabilities enhances our understanding of both external and internal conditions, as well as the competencies necessary for successful digital transformation in SMEs.

Regionally, the European Union has prioritized the digitalization of SMEs within its Digital Decade 2030 agenda, setting a goal that at least 90% of SMEs achieve a basic level of digital intensity by that date (Eurostat, 2023). However, currently, only about 74% have reached this milestone, and the proportion with “high” or “very high” levels of digitalization remains low (Eurostat, 2023). Furthermore, significant gaps exist between countries, with higher digitalization rates observed in northern and western nations compared to those in southern and eastern Europe (Eurofound & Cedefop, 2025). These disparities, coupled with the fact that many SMEs still operate with low levels of digitalization, underscore the urgent need to identify the factors that promote or hinder technological adoption and to assess whether digital transformation effectively translates into improvements in productivity, innovation, or internationalization.

Consequently, this study aims to analyze digital transformation in European SMEs. Specifically, it seeks to: (1) identify and analyze the primary enablers and barriers, categorizing them according to the TOE framework; (2) examine the effects of digital transformation on SME performance in terms of productivity, innovation, profitability, resilience, and export capacity; and (3) provide an integrative perspective based on dynamic capabilities theory, discussing how SMEs can develop competencies for successfully managing digital transformation. The following section outlines the methodology employed to achieve these objectives.

Methodology

The methodology used in this study is based on a systematic literature review, following the guidelines established by PRISMA 2020 to ensure a transparent process in searching, selecting, and reporting studies (Page et al., 2021). This procedure encompasses the stages of identification, screening, eligibility assessment, and inclusion of studies, which are illustrated in the PRISMA flow diagram (Figure 1). The review is classified as an exploratory documentary study.

For information retrieval, the Scopus and Web of Science databases were consulted, using combinations of terms in both English and Spanish related to “digital transformation,” “SMEs,” and “digitalization,” with a specific focus on the European context. Additionally, the references of relevant articles were reviewed to locate complementary studies. A total of 200 records were retrieved (130 from Scopus and 70 from WoS); after removing 30 duplicates, 170 proceeded to the title and abstract screening phase.

Inclusion criteria considered works published between 2020 and 2025 that: (a) explicitly addressed the digital transformation of SMEs in Europe or presented results applicable to the region; (b) provided original empirical evidence, whether quantitative, qualitative, or mixed, on factors or outcomes of that transformation; and (c) were published in peer-reviewed journals, conference proceedings, or high-quality technical reports. Conceptual documents, studies focused on large companies or other regions, and non-peer-reviewed sources were excluded. Based on these criteria, 120 records were eliminated, leaving 50 articles for complete evaluation.

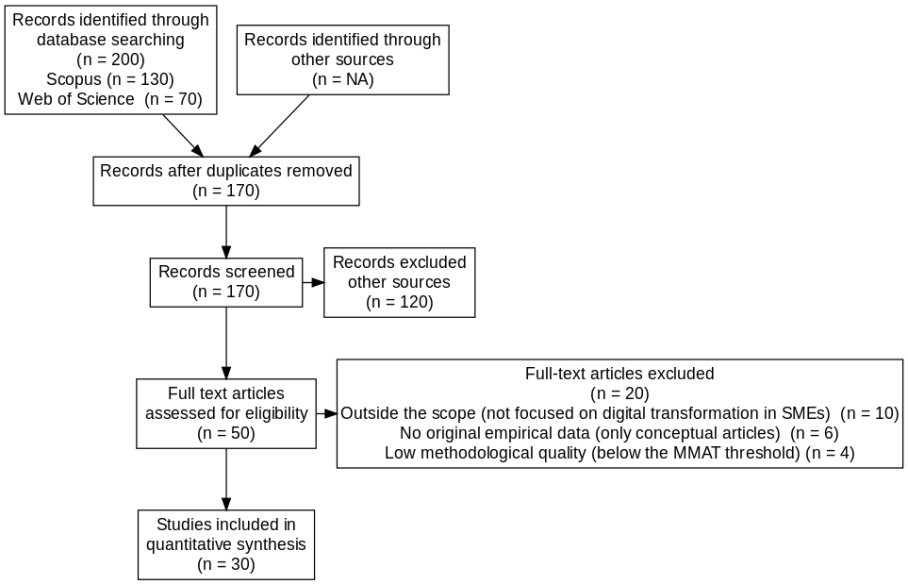
The assessment of methodological quality was performed using the MMAT 2018 tool, applied independently by two reviewers, including only those studies that achieved at least 50% compliance. In this phase, an additional 20 articles were excluded for not meeting specific requirements, such as lacking empirical data, insufficient methodological rigor, or not specifically addressing the topic in European SMEs (see Figure 1).

For synthesis, qualitative content analysis was conducted, identifying in each study the factors considered as enablers or barriers to digital transformation, as well as the key outcomes in organizational terms. The findings were coded and grouped according to the dimensions of the TOE framework (technological, organizational, and environmental), integrating, where possible, quantitative indicators such as adoption rates or performance improvements. These results are presented in a narrative that combines qualitative and quantitative evidence, structured into two fundamental blocks: the enabling factors and barriers, and the performance-related effects of digital transformation.

This methodological approach ensures the rigor and transparency necessary, adhering to the recommendations of PRISMA 2020 for systematic reviews.

Figure 1

PRISMA flow diagram of the identification, screening, eligibility, and inclusion process



Results

The reviewed studies agree that the successful adoption of digital technologies by SMEs depends on a set of multidimensional factors. Following the TOE framework, these factors can be categorized into technological, organizational, and environmental (contextual) elements. Within each dimension, there are factors that serve as enablers (facilitators) of digital transformation and others that represent barriers or constraints when absent or presented in an adverse manner. Table 1 summarizes the main factors identified in the literature, distinguishing between enablers and barriers in each TOE category.

Table 1

Enablers and barriers to digital transformation in European SMEs, classified according to the Technology–Organization–Environment (TOE) framework

TOE Category	Enablers	Barriers
Technological	Robust digital infrastructure (e.g., access to high-speed internet, available cloud tools) (OECD, 2023). Integrated information systems (ERP, CRM) that facilitate internal processes. Accessible and secure e-commerce solutions. Availability of emerging technologies suited to the business (Big Data, Artificial Intelligence, IoT, etc.).	Poor connectivity (digital divide, especially in rural areas) (OECD, 2023). Cybersecurity and data protection concerns (risk of breaches, GDPR compliance) (Kahveci, 2025). Incompatibility or complexity of technologies for SME scale (technologies not designed for small businesses). Lack of standards/interoperability between digital systems.
Organizational	Support and leadership from top management (strategic commitment to digitalization) (Held et al., 2025). Internal digital capabilities (staff with IT skills; ongoing training) (OECD, 2024). Innovative and change-oriented organizational culture (digital mindset) (Held et al., 2025). Clear digital planning and strategy aligned with business objectives. Flexible organizational structure that allows for agile adoption of new technologies.	Lack of digital skills among staff and management (skills gap) (Kahveci, 2025). Resistance to change from employees or managers (fear of the unknown; concern over job loss) (Kahveci, 2025). Limited financial resources for investing in technology and innovation (Kahveci, 2025). Absence of a digital strategy or long-term vision (ad-hoc and reactive initiatives instead of planned ones). Rigid organizational processes that hinder the implementation of technological changes.
Environmental	Government and institutional support (public funding programs, grants, training, and advisory services) (Eurofound & Cedefop, 2025). Competitive market pressure that encourages digitalization (digitized competitors; demand for online services). Collaboration in the ecosystem (alliances with tech providers, participation in business networks, innovation clusters) (OECD, 2023). Available external infrastructure (digital service providers, efficient e-commerce logistics). External shocks (e.g., economic crises) divert resources and attention away from digitalization.	Complex or uncertain regulatory framework regarding digital issues (e.g., cross-border e-commerce regulations, data protection) that impose compliance costs (Kahveci, 2025). Limited access to external financing for digital projects (reluctant investors; credit difficulties). Local environment with low digitalization (few local ICT provider offerings; reduced "demonstration effect"). Lack of knowledge or access to government support programs (OECD, 2024).

In the technological realm, a fundamental enabler is the availability of infrastructure and digital tools. Many European SMEs have progressed due to increased access to cloud services and software-as-a-service models, complemented by broadband connectivity, which helps reduce barriers to digitalization. However, deficiencies in infrastructure continue to pose significant obstacles, particularly in regions with lower digital development (OECD, 2023). Common barriers include the lack of fast and affordable internet, cybersecurity concerns, and the costs associated with compliance with regulations such as the GDPR (Kahveci, 2025). Moreover, the complexity of

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integrating new technological platforms with legacy systems often exceeds internal technical capacities, limiting the adoption of more advanced solutions.

On the organizational level, studies highlight the crucial role of the human factor. Leadership with a clear digital vision and the explicit allocation of resources foster the cultivation of an innovation-oriented culture, where employees feel encouraged to experiment with new tools (Held et al., 2025). Promoting a shared "digital mindset" is identified as a key enabler. In contrast, internal resistance to change emerges as one of the most recurrent barriers: employees accustomed to traditional processes may express fear of automation or changes in their tasks, particularly when training is insufficient. Additionally, a pronounced skills gap hampers many SMEs' ability to plan and implement technological projects (Kahveci, 2025). The limited availability of financial resources exacerbates these challenges, as investments in software, hardware, consulting, or training must compete with the need to maintain daily operations. Ultimately, the absence of a defined digital strategy leads to the tactical or reactive adoption of tools—such as launching online sales only in response to the pandemic—reducing the impact and sustainability of the transformation.

Concerning the environment, external support conditions become important. Public digitalization programs for SMEs, such as grants, vouchers, soft loans, or technical assistance, serve as essential enablers, particularly for resource-constrained firms (Eurofound & Cedefop, 2025). However, their effectiveness is often limited by a lack of awareness of these programs or perceptions of complex bureaucratic processes, resulting in low adoption rates (OECD, 2024). Competitive pressure and evolving customer preferences—such as the increased demand for digital channels since 2020—also drive transformation, as does integration into collaborative ecosystems, supply chains of large companies, clusters, or innovation centers (OECD, 2023). In terms of environmental barriers, notable issues include the lack of appropriate digital infrastructure in certain regions and the regulatory burden associated with e-commerce, digital taxation, and cybersecurity, which can be disproportionate for SMEs (Kahveci, 2025). External factors such as the COVID-19 pandemic have concurrently served as catalysts and sources of tension: numerous SMEs adopted digital solutions quickly and reactively to ensure business continuity, yet in many cases, such adoption lacked solidification due to insufficient structural preparation (Eurofound & Cedefop, 2025).

Business outcomes of digital transformation in SMEs

The business outcomes stemming from digital transformation in European SMEs demonstrate tangible benefits across various dimensions of performance, although the magnitude of these benefits is contingent upon the level of digitalization and the specific context of each enterprise. These outcomes can be categorized into five primary areas: productivity, innovation, profitability, resilience, and market expansion.

Firstly, improvements in productivity and operational efficiency are notable. The adoption of digital tools fosters more efficient internal processes and reduces administrative burdens. For instance, the automation of routine tasks frees up time for higher-value activities and enhances the quality of information for decision-making (OECD, 2024). Integrated management systems, such as ERP and CRM, minimize redundancies and streamline information flows, while data analytics and business intelligence tools optimize inventory, production, and logistics. According to OECD surveys, nearly 40% of SMEs report productivity gains related to digitalization, primarily through process automation (OECD, 2024; Savvakis et al., 2024).

Secondly, digital transformation stimulates innovation and the development of new products and services. It not only optimizes existing processes but also enables new business models and delivery channels, such as online platforms, mobile applications, and connected smart products. Participation in digital ecosystems facilitates open innovation and external collaboration. Recent studies indicate that SMEs leveraging Big Data and social media to better understand customers are quicker to launch tailored products and enhance offerings continuously (Kahveci, 2025). This digitalization often accompanies a cultural shift toward experimentation and agility.

Thirdly, there is an observed increase in profitability and sales growth. The successful integration of digital technologies contributes to improved financial performance through reduced operational costs and expanded revenue channels, particularly via e-commerce. SMEs engaging in online sales can reach geographically dispersed customers and operate nearly around the clock; digital sales can account for between 9% and 15% of revenue in moderately digitalized firms (Calviño, 2025). The most frequently cited benefit is the increase in domestic revenue, reported by 47% of SMEs, followed by expanded customer base (41%) (OECD, 2024). Although financial returns are not always immediate, panel studies find significant correlations between higher digital intensity and improved long-term financial indicators (Savvakis et al., 2024).

Fourthly, digital transformation contributes to greater resilience and adaptability. A key finding, particularly post-COVID-19 pandemic, is that more digitalized SMEs withstood external shocks better. The ability to operate remotely, sell online, and quickly reorganize processes enabled them to confront the crisis more robustly (Eurofound & Cedefop, 2025). Technologies such as cloud computing, teleworking software, and supply chain

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management facilitated impact absorption and fostered innovation (OECD, 2023). Moreover, diversifying channels (combining physical and online stores) reduces reliance on a single operational format, enhancing agility. This organizational agility is linked to dynamic capabilities that enhance flexibility and responsiveness in uncertain environments (Held et al., 2025).

Lastly, digital transformation facilitates market expansion and internationalization. E-commerce, digital marketing, and global platforms enable SMEs to offer products and services in other countries without the need for a physical presence. Instances exist where companies, after digitalizing their sales channels, saw a significant portion of their revenue come from external markets (Calviño, 2025). Digital tools lower traditional barriers to export, such as promotional costs and geographical distance, promoting export intensity—especially when direct web sales are combined with major platforms (Edeh et al., 2025). However, logistical, regulatory, and cultural challenges persist (Sobczak, 2025).

Collectively, the evidence indicates that digital transformation brings numerous benefits—both tangible and intangible—to European SMEs. The intensity of these benefits varies depending on the depth of the transformation—merely digitizing invoicing is not comparable to redesigning the business model around digital technologies—and also differs by industrial sector: for instance, manufacturing SMEs tend to report more significant productivity improvements, while those in the services sector highlight market outreach gains. An emerging finding is the accelerated adoption of cutting-edge technologies; nearly one in five surveyed SMEs indicated experimenting with generative artificial intelligence within a year of its public disclosure, primarily perceiving more opportunities than risks (OECD, 2024). This suggests that, in contexts with low entry barriers, SMEs can behave as agile actors in incorporating innovations, thereby contributing to invigorating European innovation ecosystems.

When relating these findings to theory, it becomes clear that SMEs developing digital dynamic capabilities—that is, the ability to learn, reconfigure resources, and continuously adapt in digital environments—are those that best leverage the aforementioned benefits. Thus, successful digital transformation is conceived more as a continuous process of learning and strategic renewal rather than a straightforward adoption of technological tools (Teece, 2007; Warner & Wäger, 2019). Therefore, this review emphasizes that the digitalization of SMEs should be understood as part of a comprehensive strategy for developing organizational capabilities and not merely as an isolated technological project.

Discussion

The results of this systematic review provide integrated evidence regarding how and why European SMEs undertake digital transformation, the obstacles they encounter, and the benefits they derive. Firstly, it is confirmed that digital transformation has ceased to be an option for SMEs and has become a competitive imperative in the current economy. Companies that advance in this process, despite the inherent difficulties, are achieving tangible improvements in efficiency, innovation, and market reach, thereby strengthening their position against larger competitors. Conversely, SMEs that delay their digitalization may widen the competitive gap and lose relevance in increasingly technology-driven markets. This finding supports the European Union's public policies aimed at accelerating SME digitalization by 2030 (Eurostat, 2023) and aligns with studies suggesting that digitalization helps level the playing field between large and small firms by facilitating access to previously inaccessible tools for the latter (Calviño, 2025; Savvakis et al., 2024).

Secondly, the review indicates that digital transformation in SMEs is a complex process influenced by technological, organizational, and environmental factors. It is insufficient to incorporate a singular technology; successful cases often involve a suitable combination of technological infrastructure, committed leadership, a conducive organizational culture, and external support. Persisting barriers, such as a lack of digital skills or resource scarcity, must be addressed through concrete strategies, such as investing in training, developing clear digital strategies, and leveraging existing support programs (OECD, 2024). Moreover, identifying these obstacles suggests that public policies and business initiatives should focus on reducing structural digital gaps, facilitating access to both technology and the necessary training and funding for efficient adoption. In this regard, governmental interventions should be designed in a segmented manner, adapting to different levels of digital maturity (micro-enterprises versus medium-sized, traditional sectors versus tech-driven) to maximize effectiveness (Eurofound & Cedefop, 2025).

Thirdly, the review highlights the concept of dynamic capabilities as a central element for achieving sustainable digital transformation in SMEs. Small and medium-sized enterprises that have internalized the ability to learn, adapt, and innovate continuously are those that best harness the benefits resulting from digitalization. This is reflected in their greater resilience during critical moments, such as the pandemic, and their agility in seizing new opportunities, particularly those emerging with novel technologies like artificial intelligence (Held et al., 2025).

Therefore, beyond merely implementing technological tools, SMEs must internally cultivate flexibility, a digital mindset, and an innovation-oriented culture. In other words, digital transformation is as much about people and organization as it is about technology itself. Change efforts should focus on aligning people, processes, and strategy with the demands of the digital age. This finding resonates with recent research linking digital leadership and organizational culture as key factors for success in transformation (Held et al., 2025; Warner & Wäger, 2019). For SME executives, this implies that building strong digital leadership—characterized by a forward-looking vision and data-driven decisions—and fostering a culture open to change are as critical as selecting the appropriate technologies.

Furthermore, significant heterogeneity is observed in digital advancements among European SMEs, with notable differences based on geographic location, economic sector, and size within the SME spectrum. While some medium-sized industrial firms have achieved profound transformations that include the integration of Big Data and advanced automation, many micro-enterprises in the service sector are only beginning to take basic steps, such as establishing a web presence or using social media. This diversity underscores the need for differentiated strategies: interventions must be tailored to the level of digital maturity and the specific barriers faced by each type of business. Additionally, sector-specific particularities must be considered, as relevant digital solutions for manufacturing (such as IoT in production) differ from those applicable to tourism (such as online booking platforms). Consequently, policies and initiatives could benefit from more precise regional and sectoral approaches, supported by local diagnoses of digital gaps (Eurofound & Cedefop, 2025).

Lastly, it is acknowledged that digital transformation presents certain challenges and risks. Not all digitalization efforts are successful; some may fail due to inadequate implementations or a lack of expected value generation. Issues such as information overload, cybersecurity threats, and technological dependence are realities that SMEs must navigate with caution. Therefore, it is essential to approach digital transformation with a strategic and prudent vision, avoiding the pursuit of technological trends without rigorous cost-benefit analyses adapted to each firm. This approach is emphasized by authors such as Vial (2019), who warns that the absence of a clear strategy can lead to unproductive digital investments. Consequently, advising SMEs on technological governance and change management becomes essential to mitigate risks and maximize success.

Conclusions

Based on the evidence gathered in this systematic review, several key conclusions emerge regarding digital transformation in European SMEs:

First, digital transformation is confirmed as a competitive imperative for SMEs and not merely a voluntary option. Companies that progress in their digitalization experience significant improvements in productivity, innovation, market reach, and resilience, thereby strengthening their position against larger competitors. In contrast, those that delay their digital process risk falling behind. This reality legitimizes both private efforts and public policies aimed at promoting the digitalization of smaller businesses.

Second, digital transformation in SMEs is a multidimensional phenomenon that depends on the interaction of technological, organizational, and environmental factors, as illustrated by the TOE framework. Successful cases typically integrate appropriate technological infrastructure, digital leadership, and a proactive organizational culture, alongside a favorable external environment that includes financial support and a demanding market. Barriers such as the skills gap, limited resources, and regulatory complexity necessitate targeted interventions, ranging from extensive training in digital competencies to the simplification of procedures and access to innovation-oriented financing for SMEs.

Third, beyond technology, internal dynamic capabilities—agility, continuous learning, and adaptability—are fundamental for sustainable digital transformation. SMEs should invest in human talent development, foster an innovative culture, and adopt flexible management mechanisms. Essentially, digital transformation is an organizational change process fundamentally guided by people.

Fourth, the heterogeneity in digital maturity among SMEs, based on size, sector, and geographic location, requires segmented strategies. Technological, training, and financial solutions must be tailored to the different realities of micro, small, and medium-sized enterprises, while also accounting for sectoral and regional particularities. This segmentation helps to close digital gaps and prevent the exacerbation of inequalities.

Finally, although the benefits of digitalization are numerous, they are not automatically guaranteed. Digital transformation must be strategically planned, assessing risks and ensuring that technological adoptions are accompanied by changes in processes, metrics, and, most importantly, a proactive attitude towards technology.

Regarding the limitations of this study, it is acknowledged that the review focused on academic sources and quality reports published up to 2025, primarily in English and Spanish. Consequently, very recent research or that published in other European languages may not have been captured. Additionally, the synthesis of results

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covers diverse contexts and thus presents a general character; specific cases may show differences relative to these trends. The methodological variety among the included studies—comprising surveys, qualitative analyses, and econometric approaches—precluded a formal statistical meta-analysis, leading to a narrative integration instead. This approach may introduce some interpretive bias when weighing findings. However, rigorous measures such as double coding and triangulation among authors were employed to ensure the reliability of the synthesis.

Overall, digital transformation in European SMEs is an expanding phenomenon that offers significant opportunities while also presenting considerable challenges. This systematic review provides an integrated perspective on the factors driving and hindering this transformation, as well as the benefits it can generate in business performance. The findings underscore the need to approach digitalization holistically, considering technological, organizational, and environmental aspects, and to develop the internal capabilities necessary to sustain transformation in the long term. It is hoped that this work will serve as a reference for scholars, policymakers, and executives interested in understanding and enhancing digital transformation in SMEs, guiding future efforts to help these enterprises fully capitalize on the opportunities offered by the digital age.

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