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Article

Digital Transformation in SMEs: Enablers, Interconnections, and a Framework for Sustainable Competitive Advantage

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Abstract: This study identifies critical success factors contributing to the digital transformation of SMEs. Despite their crucial role in the economy, limited research explores how they navigate digitalization challenges. This study addresses this gap by proposing the DASAT framework with four cyclically interrelated elements: Digital Awareness, Digital Strategy and Roadmap, Digital Adoption and Implementation, and Digital Transformation Continuous Improvement. Using a Total Interpretive Structural Modeling (TISM) approach, we construct a hierarchical model analyzing the interconnections among key factors. The findings align with the dynamic capability framework and digital transformation theory, emphasizing digital literacy, digital inclusion, and organizational flexibility for SMEs' successful digital transformation. This study contributes theoretically by extending the digital transformation literature with a structured capability-building framework. It provides a practical roadmap for SMEs to strengthen their competitive advantage in an increasingly digital business environment.

Keywords: digital transformation; SMEs; adaptation strategies; digital literacy; digital inclusion; digital awareness; digitalization strategy

1. Introduction

Digital transformation is a key driver of modern economic transformation but is often misunderstood as implementing automation without modifying underlying business operations. True digital transformation extends beyond digitization to incorporate value creation, revenue generation, and business model innovation (Kraus et al., 2021; Li et al., 2018). In this study, digital transformation represents a strategic and operational shift that impacts external relationships, internal business processes, and resource allocation—including physical assets, human capital, corporate culture, and financial resources. Successful digital transformation requires a company-wide transformation (Anshin & Bobyleva, 2021; Gomez-Trujillo & Gonzalez-Perez, 2022; Sousa-Zomer et al., 2020).

SMEs, despite their crucial role in global economies, face distinct challenges in adopting digital technologies (DTs) due to resource constraints, skill gaps, lack of awareness, and structural limitations. Several factors influence SME digitalization, including physical infrastructure, human capabilities (Kuusisto, 2017; Rachinger et al., 2019), organizational structure (Kuusisto, 2017; Rachinger et al., 2019), owner–manager behavior (Li et al., 2018; Rossato & Castellani, 2020; Sousa-Zomer et al., 2020), and external conditions such as market dynamics and regulatory policies (Meier, 2021). These factors highlight both challenges and opportunities for SMEs in adopting DTs. Unlike large enterprises, SMEs exhibit significant heterogeneity, which impacts their digital transformation process. However,



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there is limited research that systematically outlines the linkage among these factors to provide a practical, structured process for SME digitalization (Kim & Jin, 2024).

This study aims to bridge this gap by developing a framework that identifies and integrates the key enablers of SME digital transformation, using the Total Interpretive Structural Modeling (TISM) approach. Unlike prior studies that focus on isolated factors (Annarelli & Palombi, 2021; Ben Slimane et al., 2022; Butt, 2020; Garzoni et al., 2020; Leal-Rodríguez et al., 2023; Nwaiwu et al., 2020; Reis et al., 2018; Yoshikuni et al., 2024), this study provides a holistic, hierarchical structure of digitalization enablers, offering a practical roadmap for SMEs to navigate their digital transformation process. The findings contribute to both the academic literature and policy discussions by offering practical insights into SMEs' digitalization development process. While the primary focus is on SMEs, the methodology and findings have broader applicability to other business environments.

Successful digital transformation requires firms to demonstrate flexibility, make strategic decisions, and adapt their operations to changing circumstances. SMEs, in particular, must develop adaptive capacity—the ability to dynamically adjust and restructure operations in response to external changes—to implement digital transformation effectively. This study addresses the following research questions:

- What factors enable SMEs to achieve digital transformation?
- What connections and interdependencies exist among these factors?
- How can these factors be integrated to facilitate digital transformation successfully?

The remainder of this paper is structured as follows: Section 2 presents the literature review and offers the conceptual background on SMEs' digital transformation. Section 3 outlines the methodology, detailing the TISM framework and the factors used in the study. Section 4 discusses the results and presents the hierarchical factor relationships. Section 5 concludes the study with a summary of key insights. Section 6 offers some policy recommendations to support SME digital transformation efforts.

2. Theoretical Framework

2.1. Digitalization and Digital Transformation

Digital transformation is defined as the process of doing things differently by creating new business designs through digital technology (DT) applications. It goes beyond merely automating or incorporating technology into existing processes (digitalization) to optimize the current value chain. Digital transformation involves modifying the business model, altering the value chain, and creating new products and services through DT applications. This leads to improved ways of delivering customer value (Ben Slimane et al., 2022; Kahveci et al., 2024a; Li et al., 2018; Robledo, 2017).

2.1.1. Benefits and Enablers of Digitalization

Several benefits of digital transformation are grouped into different categories in the literature. We sorted these benefits enablers of the operations:

- Automating routine tasks, streamlining business processes, and improving data management (Saáry et al., 2022).
- Creating opportunities for accessing new markets, facilitating the establishment of numerous new businesses, and building new relationships (Matalamäki & Joensuu-Salo, 2022).
- Enhancing collaborations and coordinating across geographic regions, such as employees and suppliers working on a single project (Browder et al., 2024; Garzoni et al., 2020; Rossato & Castellani, 2020).

- Facilitating access to financial services and supporting global expansion, which is particularly advantageous for resource-constrained SMEs (Kutlu & Özturan, 2008; Vide et al., 2022), helping them overcome scale inefficiencies.
- Improving integration, interaction, and knowledge sharing while stimulating innovation (Fauzi & Sheng, 2022; Khin & Ho, 2019; Quinton et al., 2018; Santos & Neumeier, 2023).
- Enhancing workforce capabilities, new skills, and expertise, fostering innovation through the introduction of novel products and processes (Radicic & Petković, 2023).
- Boosting customer satisfaction through personalized products and services and improving employee morale (Kalidas et al., 2020; Rossato & Castellani, 2020).
- Strengthening customer loyalty, building a trustworthy image, and delivering differentiated services (Alonso-Almeida et al., 2015).
- Enabling SMEs to rethink and adapt their business models (Moeuf et al., 2018).

These enablers impact cost and revenue structure, and enhance efficiency, productivity, and decision-making, contributing to SMEs' competitiveness (Pfister & Lehmann, 2023; Schönberger, 2023). Specifically, DTs help SMEs in the following:

- Reducing cost (Amankwah-Amoah et al., 2021; Bettioli et al., 2023; Kahveci, 2023; Lányi et al., 2021; Saáry et al., 2022; Vide et al., 2022).
- Enhancing operational and financial efficiency (Amankwah-Amoah et al., 2021; Fauzi & Sheng, 2022; Kahveci, 2023; Khin & Ho, 2019; Saáry et al., 2022; Vide et al., 2022).
- Improving productivity, (Schönberger, 2023), performance, and growth (Jun et al., 2022; Matalamäki & Joensuu-Salo, 2022; Silva et al., 2023).
- Increasing revenue (Matalamäki & Joensuu-Salo, 2022).

Ultimately, these benefits support long-term business strategies (Costa & Castro, 2021; Lányi et al., 2021; Rossato & Castellani, 2020; Vide et al., 2022), enabling SMEs to gain a competitive advantage (Ciurea et al., 2021; Costa & Castro, 2021; Kahveci, 2021; Neumeier et al., 2021; Rossato & Castellani, 2020; Sousa-Zomer et al., 2020).

Although digitalization is a costly investment, SMEs should see this process as an opportunity for business transformation (Moeuf et al., 2018).

2.1.2. Barriers and Challenges of Digitalization

Despite the numerous benefits and although SME managers recognize the importance of DT, they encounter several significant challenges, including the following:

- Limited financial resources for digital initiatives (Amankwah-Amoah et al., 2021; Amaral et al., 2019; Costa & Castro, 2021; Dörr et al., 2023; Hasyim & Bakri, 2024; Moeuf et al., 2018; Pfister & Lehmann, 2023; Schönberger, 2023; Teltz, 2020).
- Concerns over data protection and GDPR compliance, risks of cybersecurity threats, and data breaches (Vide et al., 2022).
- Employee resistance due to fear of job displacement and reluctance to change familiar processes (Pfister & Lehmann, 2023).
- Lack of digital skills: deficiency in the expertise and necessary digital mindset needed for transformation (Moeuf et al., 2018; Pfister & Lehmann, 2023; Schönberger, 2023; Solberg et al., 2020).
- Lack of awareness and understanding of the benefits, risks, and effective integration of DTs into business models and processes, leading to skepticism (Hasyim & Bakri, 2024; Pfister & Lehmann, 2023; Sousa-Zomer et al., 2020; Vide et al., 2022).
- Lack of critical digital infrastructure, such as high-speed internet connections (Amankwah-Amoah et al., 2021; Kahveci, 2023; Neumeier et al., 2021).
- Lack of digital transformation strategy and resistance to change (Pfister & Lehmann, 2023; Radicic & Petković, 2023).

Some SMEs also view digital tools as impersonal, emphasizing that direct interactions and emotional connections are crucial to their business model (Pfister & Lehmann, 2023). Additionally, various platform fees can negatively impact profitability and competitiveness. These challenges often result in resistance to change and hesitation to fully embrace digitalization. These challenges collectively contribute to the hesitancy in fully embracing digital transformation.

Big data can influence various core activities of companies and their key partners, whereas social media mainly relates to communication channels. Both the quantitative data and case studies emphasize that using big data and social media enables the implementation of companies' strategies within their business models, resulting in increased innovation and improved performance (Bouwman et al., 2018).

2.2. Digital Literacy and Inclusion

According to the United Nations, digital inclusion refers to the ability of individuals and businesses to safely access, use, lead, and design digital technologies, services, and associated opportunities (UN, 2025).

In the literature, digital literacy is broadly defined as the awareness, attitude, and ability of individuals to effectively use digital tools to identify, access, manage, integrate, evaluate, analyze, and synthesize digital resources, construct new knowledge, create media expressions, and communicate with others, in the context of specific life situations, to enable constructive social action; and to reflect upon this process. (Gurak, 2008; Kumar et al., 2024; Martin & Grudziecki, 2006).

Martin and Grudziecki (2006) propose a three-level framework for digital literacy (Figure 1) where each level is interconnected:

- Digital competence includes fundamental skills, knowledge, attitude, and awareness related to digital technology.
- Digital usage involves utilizing digital skills in the application of digital tools for problem-solving and information processing.
- Digital transformation: Individuals leverage digital tools to drive innovation, create new knowledge, and develop novel activities.

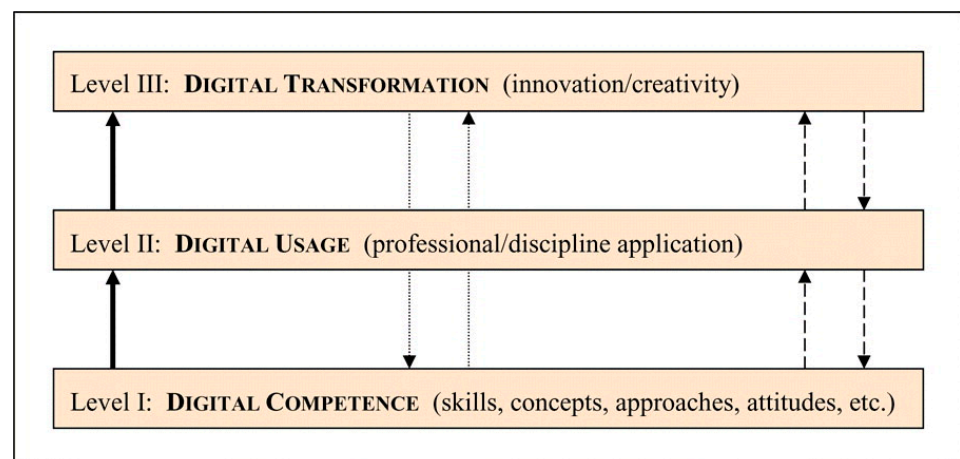


Figure 1. Digital literacy framework (Martin & Grudziecki, 2006).

Reddy et al. (2020) further emphasize that digital literacy involves a comprehensive understanding of ICT technologies, the ability to navigate and assess digital information (Reddy et al., 2020). For SMEs, fostering digital literacy is essential for overcoming resistance to digital transformation and ensuring effective integration of digital tools into

business models. Without a strong foundation in digital competence, SMEs may struggle with adoption, limiting their ability to compete and innovate in the digital economy.

To successfully adopt and integrate digital technologies into their business process, SMEs must perceive them as inclusive, useful, and trustworthy. Digital literacy is a key component of digital inclusion, enabling SMEs to harness digital technologies effectively. Digital inclusion also involves utilizing these technologies efficiently to increase productivity, improve operational effectiveness, and achieve sustainable competitive advantage. Furthermore, flexibility, adaptability, and upskilling are also essential for SMEs to exploit the opportunities presented by the digital environment (UN, 2025).

2.3. Adaptation Capacity

In the literature, terms like “dynamic capability”, “adaptability”, “strategic agility”, “absorptive capability”, “resilience”, and “flexibility” are often used interchangeably to describe how firms adapt to dynamic and uncertain environments (Apasrawirote & Yawised, 2024). While these concepts are interrelated, each has distinct characteristics in relation to firm responses to changes and disruptions.

Adaptability, a feature of an organization’s production system, focuses on adjusting cost performance in response to fluctuating demand. Adaptable firms reorganize their cost structures by converting fixed costs into variable ones, utilizing both organizational and technological solutions to improve profitability during periods of declining customer demand. Operational adaptability (OA) aims to lower fixed costs and reduce the break-even thresholds. Katayama and Bennett (1999) argue that OA and adaptability work together to enhance responsiveness to customer demands, maintain cost sensitivity, and optimize resource efficiency. In the literature, adaptive or adaptation capacity refers to the ability to design and implement strategies to reduce the impact of external disruptions (Ingirige et al., 2008; Wedawatta & Ingirige, 2012). While originally discussed in the context of climate-related challenges, the concept applies equally to other external shocks, such as digitalization, which requires businesses to adapt to significant operational changes.

While flexibility can effectively address uncertainty, it typically results in increased costs (Santos Bernardes & Hanna, 2009). A flexible firm adjusts its processes or structures in response to changing circumstances, while agility emphasizes the speed of these adjustments. The key distinction lies in their focus: flexibility absorbs uncertainty, while agility exploits environmental changes to capitalize on market opportunities (Santos Bernardes & Hanna, 2009). Firms with operational agility and dynamic capabilities are particularly well-equipped to sense, seize, and transform opportunities that arise during crises.

On the other hand, dynamic capabilities encompass flexibility and adaptability while enabling firms to sense, seize, and transform in response to evolving market opportunities and threats (Teece, 2007). As the main source of sustainable competitive advantage, dynamic capabilities refer to a firm’s ability to integrate, develop, and reconfigure internal and external competencies in rapidly changing environments (Teece et al., 1997). This flexibility becomes crucial during digitalization challenges, enabling businesses to identify and adapt to new opportunities while maintaining operations. These dynamic capabilities empower firms to reallocate resources, redesign processes, and re-engineer their operations to maintain or even enhance their competitiveness (El Idrissi et al., 2023). Research indicates that dynamic capabilities and strategic flexibility are closely interrelated and play an essential role in responding efficiently to environmental changes and crises (Muneeb et al., 2023). Empirical evidence from Su et al. (2023) further confirms that dynamic capabilities and agility directly support technology adoption. The dynamic capabilities framework emphasizes firms’ ability to build, integrate, and reconfigure resources and capabilities in response to changing business conditions.

Rashidirad and Salimian (2020) propose a framework for dynamic capabilities in SMEs consisting of four dimensions: sensing, learning, integrating, and coordinating. Successful firms in dynamic markets continuously search for opportunities (sensing), generate new ideas and explore technological advancements (learning), integrate information and activities across the organization (integrating), and reconfigure resources as needed (coordinating capabilities). The authors emphasize the importance of IT-related tools and web-based systems in managing dynamic capabilities and creating value. These internet-based tools provide SMEs with borderless connections and broad geographical coverage, enhancing their strategic flexibility and streamlining transactions (Rashidirad & Salimian, 2020). Alonso-Almeida et al.'s (2015) study corroborates this view, demonstrating that dynamic capabilities, generated through proactive strategies, positively impact companies' competitive success during economic downturns by strengthening customer loyalty, building trust, and delivering differentiated services (Alonso-Almeida et al., 2015). Recent research by Bai et al. (2023) demonstrates that IT capability directly enhances firm agility and indirectly improves performance through this enhanced agility. As a dynamic capability, IT enables firms to adapt to changing markets, fostering agility and supporting competitive advantages. (Bai et al., 2023).

The commitment to adopting DTs and effectively managing their integration is crucial for the survival of SMEs (Kahveci et al., 2024b). Start-up SMEs, characterized by young leaders with high digital literacy, motivated employees, and agile structures (Kuusisto, 2017), typically find digital transformation more manageable. Traditional SMEs, on the other hand, face greater challenges in adapting their established business models to digitalization. Firms with strong adaptation skills can pivot towards digital transformation as a means of resilience. This shift may not have been a one-time adaptation but a strategic advantage that allowed them to capitalize on new digital tools and opportunities in the long run for their sustainable competitive advantage.

This paper employs the concept of adaptation capacity to explore how SMEs adjust to changing circumstances and revise their strategies in response to environmental changes. This term encompasses a dynamic process of adaptation, highlighting the critical elements of flexibility and responsiveness that are essential in times of change. Firms possessing the necessary abilities and skills to dynamically adapt and respond to external disruptions are better positioned to cope with challenges such as digitalization.

3. Materials and Methods

The Total Interpretive Structural Modeling (TISM) approach is employed in this study, an enhanced iteration of the ISM method (Sushil, 2012). This is a common methodology for understanding the relationships and hierarchies between different elements used in several studies (Jena et al., 2017; Kaur et al., 2019; Kumar et al., 2024; Nasim, 2011; Sushil, 2012). We followed Kumar et al.'s (2024) method.

Illustrating the Steps of the TISM Process

Step I: Identify the factors: A total of four factors have been identified through an in-depth literature review. After gathering the factors from the literature, they are categorized into four elements with the help of experts' opinions.

1. Digital Awareness (Digital Literacy and Digital Inclusion) (DA) (Ardiansyah, 2023; Garzoni et al., 2020; Ragazou et al., 2022; Rossato & Castellani, 2020);
2. Digital Strategy and Roadmap (DSR) (Dörr et al., 2023; Gyamerah et al., 2025; Pfister & Lehmann, 2023; Silva et al., 2023);
3. Digital Adoption and Implementation (DAI) (Appio et al., 2024; Audretsch et al., 2025; Faiz et al., 2024; Rajala & Hautala-Kankaanpää, 2023);

4. Digital Transformation Continuous Improvement (DTCI) (Lányi et al., 2021; Zhang et al., 2022).

Step II: The contextual link between the specified factors is defined as follows: create a structural self-interaction matrix (SSIM) by comparing each pair of elements and determining the relationship between them.

Step III: Analysis of the interconnections between specified factors: convert the SSIM into an initial reachability matrix using binary values (0 and 1). Then, check for transitivity (if A leads to B and B leads to C, then A leads to C) and create the final reachability matrix with transitivity (Table 1).

Table 1. Final reachability matrix with transitivity.

Element	DA	DSR	DAI	DTCI	Driving Power
1. DA	1	1	1	0	3
2. DSR	1	1	1	1	4
3. DAI	1	1	1	1	4
4. DTCI	1	1	1	1	4
Dependence Power	4	4	4	3	4

Step IV: Separate the elements into different levels based on their reachability and antecedent sets, which helps establish the hierarchy of elements in the system. Level portioning is given in Table 2.

Table 2. Level portioning.

Element	Reachability Set	Antecedent Set A(i)	Intersection $R(i) \cap A(i)$	Level
1. DA	DA, DSR, DAI	DA, DSR, DAI, DTCI	DA, DSR, DAI	Level I
2. DSR	DA, DSR, DAI, DTCI	DA, DSR, DAI, DTCI	DA, DSR, DAI, DTCI	Level 2
3. DAI	DA, DSR, DAI, DTCI	DA, DSR, DAI, DTCI	DA, DSR, DAI, DTCI	Level 2
4. DTCI	DA, DSR, DAI, DTCI	DSR, DAI, DTCI	DSR, DAI, DTCI	Level 3

1. Reachability Set: Set of all elements that can be reached from element i;
2. Antecedent Set: Set of all elements that can reach element i;
3. Intersection Set: Intersection of Reachability and Antecedent sets.

Step V: The TISM framework utilizes the interpretive matrix and the diagram. This encompasses the analysis and understanding of every connection inside the established model. The interpretive matrix given in Table 3 explains why one element influences another. All elements are at the same level due to the circular nature of digital transformation where each element feeds into the next in a continuous improvement cycle. There is a cyclical feedback loop from DTCI to DA as organizations refine understanding and adapt to new technological advancements, and from DAI to DSR, as they require adjustments based on operational challenges. This dynamic enables organizations to quickly respond to emerging challenges or opportunities without waiting for a complete transformation cycle. As implementation reveals new information, strategy can be immediately adjusted, which in turn guides implementation refinements. This increases a firm's agility within the larger transformation process.

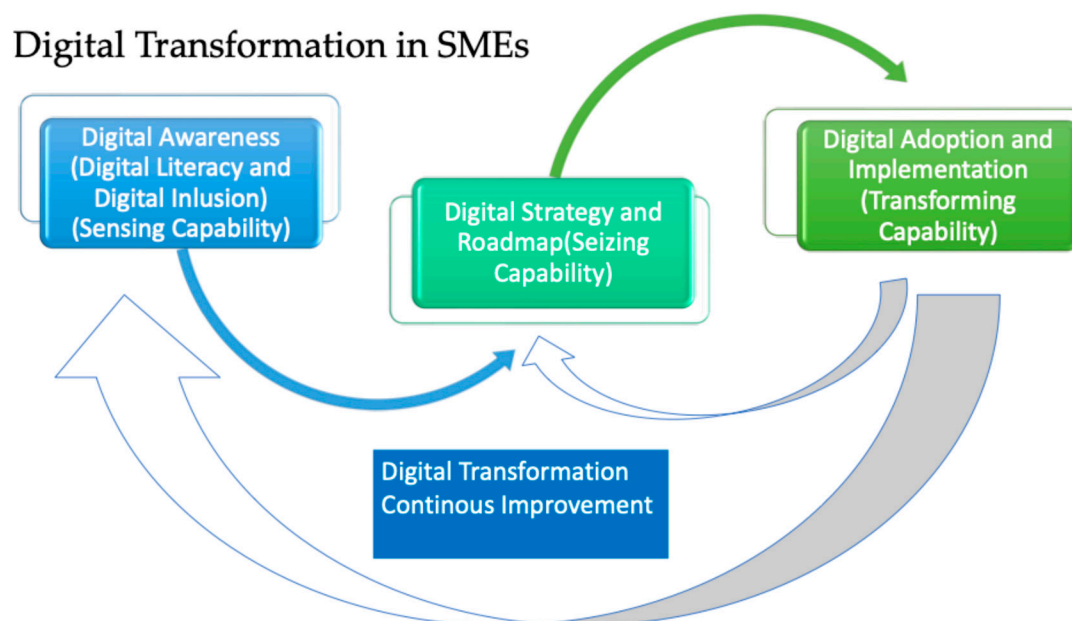
Table 3. Interpretive matrix.

Element Pair	Interpretation of Relationship
DA → DSR	Digital awareness and literacy provide the knowledge foundation needed to develop effective digital strategies and roadmaps.
DSR → DAI	Digital strategies guide successful digital adoption and implementation initiatives by providing clear direction, prioritization, and resource allocation.
DAI → DSR	Implementation experiences provide real-world feedback that refines strategy.
DAI → DTCI	Digital implementation experiences generate organizational learning and insights for continuous improvement.
DTCI → DA	Continuous improvement processes enhance organizational digital awareness and literacy.

4. Results and Discussion

As mentioned in several research papers, SMEs frequently lack the expertise and necessary digital mindset for digital transformation (Moeuf et al., 2018; Pfister & Lehmann, 2023; Schönberger, 2023; Solberg et al., 2020). They usually do not have a digital transformation strategy (Becker et al., 2017; Gyamerah et al., 2025; Pfister & Lehmann, 2023; Radicic & Petković, 2023) in place. The dual challenge faced here by the firm's management is to keep the business on track while at the same time sustaining the long-term health of the company by achieving digital transformation.

This study addresses this gap by proposing the DASAT framework (Figure 2), which consists of four interrelated elements: Digital Awareness, Digital Strategy and Roadmap, Digital Adoption and Implementation, and Digital Transformation Continuous Improvement. Using a Total Interpretive Structural Modeling (TISM) approach, we construct a hierarchical model that analyzes the interconnections among these key factors.

**Figure 2.** DASAT, Digital Transformation Framework.

The TISM analysis reveals the DASAT framework (Digital Awareness, Digital Strategy and Roadmap, Digital Adoption and Implementation, and Digital Transformation—Continuous Improvement) as a structured, cyclical approach to guide SMEs in navigating digital transformation. Unlike existing models that focus on isolated aspects of digitalization, DASAT integrates key components into a comprehensive framework tailored

specifically to SMEs' unique constraints and opportunities. The DASAT framework aligns with Garzoni et al.'s (2020) four-level approach, Teece's (2007) dynamic capability framework, Rashidirad and Salimian's (2020) framework, and the work of Ardiansyah (2023), Alrub and Sánchez-Cañizares (2025), and Christofi et al. (2024). The findings contribute to the literature by offering a practical roadmap that SMEs can follow, addressing common challenges, offering a strategy, and ensuring smooth digital transformation.

4.1. Digital Awareness

The first step in digital transformation is digital awareness, which involves understanding the available technologies—such as cloud computing, AI, automation, and digital payments—and recognizing their potential impact on business operations. Firms cannot manage what they do not know. This is aligned with Garzoni et al.'s (2020) digital awareness level and aligns Teece's (2007) concept of "sensing" and Rashidirad and Salimian's (2020) "sensing and learning" framework, where organizations scan, search, and explore opportunities and threats across technologies and markets, and is aligned with the research of Christofi et al. (2024).

One of the major barriers for SMEs is the lack of digital skills, including both technical expertise and the digital mindset required for transformation (Moeuf et al., 2018; Pfister & Lehmann, 2023; Schönberger, 2023; Solberg et al., 2020). Without these skills, SMEs fail to recognize the benefits, risks, and integration of digital technologies often leading to skepticism and resistance to change (Klein & Todesco, 2021; Skouloudis et al., 2020). Business success relies on integrating technical knowledge with market knowledge. SMEs with better digital awareness can identify relevant technologies, assess their strategic fit, and develop realistic implementation plans based on a clearer understanding of technological possibilities and limitations.

Digital Awareness, Literacy, and Inclusion

This stage ensures SMEs understand how digitalization can support their business. Digital literacy minimizes resistance to change and helps firms grasp the potential benefits (Pfister & Lehmann, 2023; Radicic & Petković, 2023; Sousa-Zomer et al., 2020). Once SMEs develop digital literacy, they must incorporate digital tools to foster digital inclusion—ensuring that all stakeholders can effectively participate in digital transformation.

Without digital literacy, firms miss opportunities for growth and efficiency (Kumar et al., 2024). By strengthening digital literacy, SMEs can expand their marketing networks, drive business growth, and improve their technology absorption capacity, which enhances technology adoption, boosts operational efficiency, creates value, and fosters innovation. Digital literacy will enable SMEs to be convinced about the benefits coming from the adoption of DT along their processes.

To achieve this, SMEs can participate in government-sponsored digital skills programs, follow industry associations' digital transformation workshops, utilize online learning platforms for employee upskilling, and partner with technology providers offering training on their solutions. Improving digital literacy ensures firms enhance technology absorption capacity, positively influencing technology adoption and, in turn, boosting efficiency, value creation, and innovation activities.

4.2. Digital Strategy and Roadmap

After developing digital awareness, SMEs must convert this knowledge into actionable strategies, effectively applying it to their production systems and business processes. This stage aligns with Teece's (2007) seizing capability, Rashidirad and Salimian's (2020) integrating capability—which emphasizes leveraging opportunities through new products,

processes, or services—and the studies of [Ben Slimane et al. \(2022\)](#), [Kringelum et al. \(2024\)](#), [Gomez-Trujillo and Gonzalez-Perez \(2022\)](#), and [Gyamerah et al. \(2025\)](#).

SMEs must assess how to integrate digital technologies into their business processes and models. Developing a digital transformation strategy is essential for embedding digitalization into their corporate strategy. Successful digitalization requires viewing transformation as an integral part of overall business strategy and developing an organizational structure that facilitates digitalization.

A primary barrier at this stage is limited resources for strategy development and implementation planning. SMEs need to evaluate both the benefits and challenges associated with digital transformation, translating their digital awareness into concrete strategic actions. This strategic planning is crucial for successful digital integration, ensuring sustainable growth and competitive advantage in an increasingly digitalized landscape.

4.3. Digital Adoption and Implementation

The third step after integrating digitalization strategy into business strategy is implementing and adopting digital technologies. For SMEs, developing adaptation capability is essential to integrate digital tools and address transformation challenges. Adaptation capacity enables operational flexibility and strategic adjustments during digital transformation. This matches [Teece's \(2007\)](#) transforming capability and [Rashidirad and Salimian's \(2020\)](#) coordinating capabilities, and [Meechang et al. \(2025\)](#), and [Loh and Tan's \(2025\)](#) agility perspective.

Successful transformation requires organizational change, process adjustments, and overcoming internal resistance. Adaptation capacity enables SMEs to mobilize resources, restructure their operations, and embrace digital transformation, enhancing sustainability and competitive advantage. By leveraging their flexibility and addressing resistance, SMEs can successfully integrate digital tools, increase efficiency, and achieve long-term success. Adaptation capacity facilitates this transformation by providing SMEs with the organizational flexibility and resilience needed to thrive in uncertain environments.

A major barrier is employee resistance, often stemming from fear of job displacement and reluctance to abandon familiar processes. Employees are a key resource in realizing the benefits of digital transformation, which include cost reduction, improved efficiency, enhanced performance, and increased revenue and company growth. This highlights the cyclical nature of the DASAT framework, as strong digital awareness from the first step directly reduces implementation resistance. When employees understand digital transformation's purpose and benefits, they are less likely to fear job loss. Management must actively address the concerns by communicating the benefits of digital transformation and ensuring digital inclusion, reinforcing the importance of comprehensive digital awareness before implementation begins.

4.4. Digital Transformation Continuous Improvement

Empirical evidence suggests that the processes of sensing, seizing, and transforming are interconnected ([Hermawati, 2020](#); [Klein & Todesco, 2021](#)). Continuous improvement represents a meta-capability that reinforces the cyclical nature of dynamic capabilities as an ongoing process. Digital transformation requires a willingness to change, the digitization of business processes, and rationalizing and simplifying existing processes while developing new key processes essential for business restructuring. This stage ensures that digital transformation is not a one-time event but an ongoing process. After technology adoption, SMEs must continuously track technological advancements, and leverage data-driven decision-making.

Firms identify improvement mechanisms during implementation, provide feedback to refine their digital strategy and roadmap, and simultaneously define necessary upskilling and knowledge areas to raise the overall digital competency of the organization. This completes the cycle, feeding back into enhanced digital awareness.

5. Conclusions

To maintain productivity and performance, companies must adapt by aligning goals, values, resources, and capabilities with changing environments. This requires screening the internal and external environments, understanding emerging technologies, and analyzing how to exploit them. The research confirms managers perform better when applying frameworks and strategic decision-making approaches (Kahveci, 2008; Tomšík & Svoboda, 2010).

This paper presents the DASAT framework for SME digital transformation based on the TISM model, aligning with Garzoni et al.'s (2020) four-level approach, Teece's (2007) dynamic capability view, and the work of Ardiansyah (2023), Alrub and Sánchez-Cañizares (2025), Rashidirad and Salimian (2020), and Christofi et al. (2024). The study highlights the interconnected nature of the Digital Awareness, Digital Strategies, Digital Adoption, and Digital Transformation Continuous Improvement framework. Together, these factors create a cyclical framework guiding SMEs to become digitally equipped organizations. Findings contribute theoretically by extending the digital transformation literature with a structured capability-building framework.

The DASAT framework consists of four key phases: First, digital awareness (Ardiansyah, 2023; Garzoni et al., 2020; Ragazou et al., 2022; Rossato & Castellani, 2020) builds literacy and inclusion regarding digital tools and their integration into business operations. Second, SMEs develop digital strategies (Dörr et al., 2023; Gyamerah et al., 2025; Pfister & Lehmann, 2023; Silva et al., 2023) by integrating digitalization into corporate strategy. Third, digital adoption (Appio et al., 2024; Audretsch et al., 2025; Faiz et al., 2024; Rajala & Hautala-Kankaanpää, 2023) implements these technologies efficiently, reducing costs and enhancing performance. Finally, continuous improvement (Lányi et al., 2021; Zhang et al., 2022) ensures ongoing adaptation and refinement. Critical to this process is developing adaptation capacity through digital literacy and inclusion.

This research offers fresh insight into SMEs' digital transformation and provides means to analyze situations and manage the digital transformation process to sustain competitiveness. The DASAT framework empowers management to make rational, calculated decisions and facilitates the coordination of functions and processes in today's challenging business environment.

6. Policy Recommendations and Future Research

Several recommendations can be drawn from these findings. Policymakers should strengthen initiatives promoting digital technology adoption among SMEs to help them address market challenges. Digital transformation should be encouraged through targeted funding schemes, training programs, reskilling initiatives, and mentorship opportunities. Knowledge-sharing platforms and regional support centers providing technological guidance can accelerate transformation and build competitive resilience. Different SME types may require tailored policy support that emphasizes innovation, internationalization, and networking. Thus, targeted R&D and innovation support is particularly critical. Industry associations and technology partners should develop SME-focused programs, offering affordable solutions, collaborative implementation support, and sector-specific digital transformation roadmaps.

Our DASAT framework could be tested through a practical survey involving a sample of SMEs within a single sector or across various sectors, as well as in different country

contexts. It can also be applied to MSMEs and large enterprises at both the industry and country levels.

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Abbreviations

The following abbreviations are used in this manuscript:

DA	Digital Awareness (Digital Literacy and Digital Inclusion)
DSR	Digital Strategy and Roadmap
DAI	Digital Adoption and Implementation
DTCI	Digital Transformation Continuous Improvement
SMEs	Small and Medium Enterprises
DT	Digital Technology
MSMEs	Micro, Small, and Medium Enterprises
DASAT	Digital Awareness, Strategy, Adoption, Transformation Framework

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