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The Impact of Digital Transformation on the Production Activities of Small and Medium-Sized Enterprises in Vietnam's Textile and Garment Industry

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ABSTRACT: The article analyzes the impact of digital transformation (DT) on the production activities of small and medium-sized enterprises (SMEs) in Vietnam's textile and garment industry. In the context of global competition and increasing demands for supply chain transparency, DT has become a vital factor enabling SMEs to enhance productivity, reduce costs, and expand market reach. The study employs theoretical frameworks such as the Technology Acceptance Model (TAM), the Technology-Organization-Environment (TOE) framework, and Innovation Theory to evaluate the effectiveness of DT, while also outlining the stages of transformation from data digitization to the establishment of digital ecosystems. The findings reveal that DT contributes to a 20-30% increase in productivity and a 25-30% reduction in order errors. However, SMEs continue to face significant barriers, including limited financial resources, shortages of IT personnel, and the absence of clear strategies. The article proposes a seven-criterion framework for assessing the level of DT and emphasizes the importance of collaboration among enterprises, academic institutions, and government agencies to foster effective and sustainable digital transformation.

KEYWORDS: Digital Transformation, SMEs, Vietnam's Textile and Garment Industry, Supply Chain Transparency, Innovation Theory

1. INTRODUCTION

In the context of globalization and the Fourth Industrial Revolution, digital transformation (DT) has become an inevitable trend for enterprises, particularly small and medium-sized enterprises (SMEs). Vietnam's textile and garment industry-one of the country's key export sectors-is facing increasing competitive pressure from international brands, alongside growing demands for supply chain transparency, ESG standards, and rapid product innovation. According to the General Statistics Office (2023), SMEs account for approximately 97% of all enterprises in Vietnam, with the textile and garment sector representing more than 80%. However, data from VCCI (2023) indicate that 72% of SMEs remain uncertain about how to initiate DT, and only around 35% have dedicated IT personnel. This highlights the urgent need to assess the impact of DT on production, management, innovation, and competitiveness within SMEs in the textile and garment industry. This study aims to analyze, compare, and evaluate the effects of DT on SMEs in Vietnam's textile and garment sector, drawing upon theoretical frameworks such as the Technology Acceptance Model (TAM), the Technology–Organization–Environment (TOE) framework, and Innovation Theory, while integrating empirical data and scholarly sources from Google Scholar.

2. RESEARCH CONTENT

2.1. The Concept and Role of Digital Transformation in SMEs in Vietnam's Textile and Garment Industry

Digital transformation (DT) is defined as the process of integrating digital technologies into all aspects of business operations, leading to changes in business models, organizational culture, and value creation (Bharadwaj et al., 2013).

According to Duan et al. (2020), artificial intelligence (AI) and big data play a core role in digital transformation (DT) within the manufacturing sector. Seo and Lee (2019) argue that DT enhances both financial and non-financial performance. For SMEs in the textile industry, DT supports the optimization of production processes through the application of automation technologies and the Internet of Things (IoT). Brynjolfsson and McAfee (2014) demonstrate that the adoption of digital technologies can strengthen operational efficiency and minimize waste. DT also enables SMEs to access global markets via e-commerce platforms. McKinsey (2020) reports that enterprise-level e-commerce applications have the potential to accelerate market expansion, thereby increasing revenue and profitability. Digital technologies further assist SMEs in improving customer service by personalizing shopping experiences. Kotler and Keller (2016) emphasize that understanding customer needs is a critical factor in building brand equity and retaining customers. Westerman et al. (2014) highlight the pivotal role of leadership in driving successful DT initiatives.

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In Vietnam, Nguyen et al. (2022) found that digital transformation (DT) increased labor productivity in textile SMEs by approximately 20% and reduced production costs by up to 15%. A CB-SEM study conducted by HUTECH (2025) analyzing 500 SMEs revealed that leadership and organizational culture are decisive factors in the DT process. These studies emphasize that DT not only provides tangible benefits in terms of production efficiency and cost reduction but also relies heavily on leadership capacity and the internal cultural environment to ensure effective technology adoption. Nguyen Thi Thu Huong et al. (2025) focused on evaluating the impact of artificial intelligence (AI) on consumer intentions to purchase smart fashion products in Vietnam. Their findings indicate that AI plays a crucial role in enhancing customer experience through product and service personalization, thereby increasing satisfaction and purchase intention. Moreover, trust in AI technology and perceived benefits of smart fashion products further strengthen consumer motivation. This suggests that AI adoption in smart fashion not only improves business performance but also better meets the growing demands of modern consumers in Vietnam. Similarly, TTH Nguyen, TG Vu, VK Nguyen et al. (2025) analyzed the influence of green brand perception and perceived value on sustainable fashion purchasing behavior. Their results show that both positive perceptions of green branding and perceived value significantly contribute to consumer intentions to buy sustainable fashion. The study also highlights the role of DT in the textile and garment industry, where digital technologies enhance product traceability, improve customer experience, and strengthen green brand promotion. This underscores the interconnection between green brand perception, perceived value, and DT in fostering sustainable fashion consumption, thereby supporting the development of Vietnam's textile industry toward environmental friendliness and modernization.

2.2. Theoretical Foundations of Digital Transformation in SMEs in Vietnam's Textile and Garment Industry

In the textile and garment industry, digital transformation (DT) encompasses processes such as production line automation, the use of management software (ERP, MES), and the application of AI, IoT, big data, and e-commerce. A distinctive feature of SMEs in Vietnam's textile sector is that they account for more than 80% of all enterprises, yet they are typically small in scale, with limited investment capital and low technological capacity. Most operate under the Cut-Make-Trim (CMT) model, which generates low added value within the supply chain. These characteristics pose significant challenges for SMEs in the garment industry, including insufficient initial investment capital, shortages of digitally skilled personnel, and difficulties in transforming organizational culture. Enterprises can implement DT across four different levels, including:

Level 1: Data digitization and basic internal process automation, involving the conversion of physical data into digital formats. At this stage, textile enterprises transition from paper-based records to digital formats such as PDFs and Excel files. Examples include digitizing order data, invoices, and contracts, as well as employee records and technical documents, using tools such as scanners, accounting software (e.g., MISA), and Excel spreadsheets. This level of DT helps enterprises reduce errors, minimize document loss, facilitate easier data retrieval, save storage space, and accelerate information processing.

Level 2: Process optimization through the application of technologies to improve efficiency and system integration. At this stage, SMEs adopt production management software such as Manufacturing Execution Systems (MES), warehouse management solutions, and Customer Relationship Management (CRM) systems to synchronize processes from order placement to delivery. In the garment industry, integrated Enterprise Resource Planning (ERP) platforms such as FastWork, Bravo, or Odoo are commonly implemented. These systems provide significant benefits for enterprises, including process automation, error reduction, and enhanced operational efficiency.

Level 3: Business model innovation. Digital transformation (DT) provides the technological and data foundation for enterprises to redesign products, processes, distribution channels, and customer interactions. Digital technologies enable the development of new business models such as data-driven models, digital platforms, the sharing economy, and omnichannel strategies. Business model innovation through DT allows enterprises to adapt quickly to market changes, enhance competitiveness, and seize opportunities for sustainable growth. Typical forms of business model innovation enabled by DT include: (1) Comprehensive digitalized business models, where all production, management, and operational processes are digitized to create flexibility and high efficiency; (2) Data-driven business models leveraging big data and artificial intelligence (AI) to analyze customer behavior and optimize products and services; (3) Platform-based business models, such as e-commerce platforms or direct producer–customer connection platforms; and (4) Sustainable and green business models that apply digital technologies to monitor and manage resources and develop environmentally friendly products. Business model innovation through DT helps enterprises improve operational efficiency, reduce production and management costs, enhance customer experience via diverse digital channels and personalized interactions, strengthen market forecasting and responsiveness through data analytics, expand markets and distribution channels, increase revenue, and create new product and service lines, thereby building sustainable competitive advantages.

Level 4: Building a digital ecosystem. A digital ecosystem is a network of organizations, technologies, services, and people interacting through digital platforms to create shared value. Core technologies for developing digital ecosystems include cloud computing, which provides convenient infrastructure and reduces investment costs for SMEs; the Internet of Things (IoT), which enables monitoring and control of production processes and raw material management; artificial intelligence (AI) and data analytics, which support quality management, customer demand forecasting, and market trend prediction; and blockchain, which enhances transparency and product traceability in supply chains. For SMEs in the textile and garment industry, the digital ecosystem comprises manufacturers, raw material suppliers, technology partners, customers, financial and training support institutions, all interconnected through digital solutions and shared data. In this sector, DT not only optimizes production processes but also supports product personalization, supply chain transparency, and expansion into export markets. Vietnamese textile SMEs are currently concentrated at Levels 1-2, focusing mainly on data digitization and the use of standalone software such as accounting and warehouse management. According to IDC Center (2024), 64% of SMEs lack a clear DT strategy; GSO (2023) reports that 72% invest less than 1% of revenue in R&D; HUTECH (2025) finds that only 29% of SMEs have developed new products after DT adoption; and UNIDO (2023) indicates that 55% of SMEs face difficulties in system integration. In contrast, international enterprises have already reached Levels 3-4, integrating AI, IoT, and blockchain to build smart factories and digital ecosystems. Vietnamese textile SMEs are thus at the early stage of DT, with limited capital, human resources, and strategic planning slowing progress and creating fragmentation. Nevertheless, the potential for growth is substantial if supported by appropriate policies and strengthened technological collaboration.

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2.3. Theoretical Models Applied

When assessing the impact of digital transformation (DT), numerous authors have examined research models that analyze the influence of technology on enterprises' production and business processes.

The Technology Acceptance Model (TAM), developed by Davis (1989), posits that technology adoption depends on two key factors: perceived usefulness (PU), which reflects the extent to which technology improves performance, and perceived ease of use (PEOU), which indicates the degree to which technology is user-friendly and does not cause difficulties. In the context of textile SMEs, TAM is particularly relevant as it helps reduce order errors and accelerate processing speed. However, many employees are unfamiliar with software operations, which hinders implementation. For example, when applied at Minh Phat Textile, ERP usage increased from 40% to 85% after internal training. At TAL Apparel (Hong Kong), where employees received systematic training, PEOU was high from the outset. This demonstrates that internal training is a decisive factor in enhancing PEOU, thereby strengthening PU and improving DT effectiveness. Research by Venkatesh and Davis (2000) further confirms that SMEs are more likely to adopt technology when they perceive it as both useful and easy to use.

The Technology-Organization-Environment (TOE) framework, developed by Tornatzky and Fleischer (1990), analyzes three dimensions influencing digital transformation (DT): technology (including compatibility, cost, and complexity), organization (such as firm size, human resource capabilities, and organizational culture), and environment (competitive pressures and policy support). In practice, textile SMEs in Vietnam often adopt local ERP solutions such as Bravo or FastWork, which are relatively low-cost but lack advanced features. Moreover, traditional organizational cultures resistant to change, combined with fragmented and difficult-to-access policy support, create significant barriers to DT. SMEs therefore require clear policy frameworks and appropriate training–transfer models to overcome these TOE constraints. Research by Oliveira and Martins (2011) further demonstrates that factors such as enterprise size, financial resources, and external environmental pressures can significantly influence SMEs' decisions to pursue DT.

Innovation theory, as articulated by Schumpeter (1934), Rogers (2003), and Chesbrough (2003), emphasizes the role of sequential innovation (incremental improvements to existing products), disruptive innovation (creation of entirely new products), and open innovation (collaboration with external partners to leverage knowledge) in generating new value. Rogers' (2003) diffusion of innovation theory focuses on the process by which new ideas are accepted and spread within a community. According to this perspective, factors such as novelty, applicability, and economic benefits influence whether SMEs in the textile industry adopt and apply new technologies. For textile SMEs, incremental innovations such as upgrading fabric quality, improving cutting and sewing processes, and integrating RFID or AI into products are relatively more feasible. Larger textile enterprises provide illustrative cases: An Phu Textile increased productivity by 25% and reduced product defects by 30% after collaborating with a technology startup, while TNG-Thai Nguyen implemented a "digitization-greening-smartization" model across its entire production chain. These examples demonstrate that open innovation represents a strategic pathway for SMEs in the textile and garment industry to overcome internal limitations, create high-value products, and enhance international competitiveness.

In addition, several digital transformation (DT) models can be applied depending on enterprise size, industry, and strategic objectives. The Horizon-based Model divides the DT process into three stages (horizons) over time and levels of innovation: optimizing current processes; investing in new technologies and expanding capabilities; and innovating business models to create long-term value. This model provides enterprises with a clear roadmap and prevents overload during transformation. The Capability Maturity Model assesses the readiness of each department for DT, ranging from "initial" to "optimized," thereby identifying strengths and weaknesses to prioritize appropriate technology investments. The Business Architecture Model is based on organizational structures and processes to design digital solutions, suitable for enterprises with complex workflows requiring system integration. The Staged Roadmap Model implements DT step by step with clear objectives, timelines, and outcomes, making it easier to deploy and particularly suitable for SMEs or enterprises at the early stage. The Component Framework divides the DT process into separate elements such as data, technology, processes, and people, offering flexibility, manageability, and customization for each department. The Innovation-Centric Model emphasizes innovation culture and experimentation with new technologies, suitable for enterprises aiming to lead the market and create breakthroughs. The Lifecycle Evolution Model views DT as a continuous process rather than a one-time effort, enabling enterprises to adapt to market and technological changes. Finally, the Agile & Iterative Model implements DT in short cycles with continuous feedback, allowing enterprises to accelerate deployment and adjust easily to real-world conditions.

Vietnamese textile SMEs are currently at the initial stage of digital transformation (DT), focusing primarily on data digitization and process optimization. Theoretical models such as TAM, TOE, and Innovation Theory provide useful frameworks for explaining adoption behaviors and strategic approaches to DT implementation. Compared to international enterprises, Vietnamese SMEs face a significant gap in terms of technology, human resources, and business models. To promote effective DT, improvements in awareness, training, policy support, and open innovation linkages are essential. In practice, foreign studies often employ well-defined theoretical frameworks and digital maturity models, whereas Vietnam lacks standardized tools for assessing DT maturity. Therefore, learning from international models and developing localized evaluation frameworks is necessary to standardize the DT process.

2.4. Research Results and Discussion

2.4.1. Impact of Digital Transformation on Textile SMEs

Digital transformation (DT) has brought significant improvements to the production, management, and marketing activities of small and medium-sized enterprises (SMEs) in the textile and garment industry.

Table 1. Positive Impacts of Digital Transformation

Dicator	Value	Source
Increase in Labor Productivity	+20–30%	Nguyễn et al. (2022)
Reduction in Order Errors	–25–30%	HUTECH (2025)

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Revenue Growth after DT	+18%	An Phú Textile – sbiz.vn
Customer Satisfaction Rate	+22%	IDC Center (2024)

(Source: Compiled from Nguyen et al. (2022); HUTECH (2025); An Phu Textile – sbiz.vn; IDC Center (2024))

At Minh Phat Garment Co., Ltd., after implementing the domestic ERP software Bravo, order processing speed increased by 30% and error rates decreased by 25%. An Phu Textile Co., Ltd. collaborated with a technology startup to integrate RFID into its products, resulting in a 25% increase in productivity, a 30% reduction in product defects, and an 18% revenue growth after one year. Enterprises such as Minh Phat and An Phu have adopted domestic ERP systems, integrated RFID, CRM, and AI to improve production processes, warehouse management, and product personalization. For textile SMEs, the impact of DT is primarily at the process and product levels. In contrast, international enterprises (e.g., TAL Apparel, H&M) have achieved comprehensive transformation, influencing business models, supply chains, and ESG strategies. Digital transformation in Vietnamese textile SMEs has generated clear operational efficiency but has not yet reached the level of holistic restructuring seen in international enterprises. Expanding to higher levels-such as business model innovation and building digital ecosystems-is necessary to enhance competitiveness for Vietnamese textile SMEs.

Alongside the advantages of digital transformation implementation in Vietnamese textile SMEs, there still exist numerous barriers and challenges.

Table 2. Barriers to Digital Transformation in Textile SMEs

Barrier	Impact Rate	Source
Lack of investment capital for technology	70–80% SMEs	VITAS (2023)
Shortage of IT human resources	60% SMEs	VCCI (2023)
Difficulty in system integration	55% SMEs	LSCS (2023)
Absence of a clear DT strategy	64% SMEs	IDC Center (2024)

(Source: Compiled from VITAS (2023); VCCI (2023); LSCS (2023); IDC Center (2024))

Lack of investment capital for technology is the most significant barrier, with an impact rate of up to 80%. This reflects the reality that SMEs in the textile industry have limited financial resources to invest in new technologies. Insufficient capital makes it difficult for them to acquire modern digital systems, slowing down the digital transformation process and reducing competitiveness in international markets. The shortage of IT human resources, accounting for 60%, shows that most SMEs face difficulties in recruiting and retaining qualified IT staff. This limitation restricts their ability to effectively implement and operate digital solutions, while also affecting the development and maintenance of digital systems within enterprises. System integration is another major challenge for more than half of the surveyed SMEs. The reasons may include the diversity of software and equipment, as well as the lack of specialized technical knowledge to synchronize systems. This situation reduces the efficiency of digital solutions and causes disruptions in operational processes. Although many enterprises recognize the importance of digital transformation, more than 60% lack a clear, long-term strategy to implement it. The absence of strategy leads to ad hoc initiatives without concrete planning, resulting in inefficient investments and difficulty in achieving intended goals. These figures demonstrate that Vietnamese textile SMEs are facing significant challenges in digital transformation, particularly in terms of investment capital and IT human resources. The lack of strategy and difficulties in system integration are also barriers that cannot be overlooked.

2.4.2. Developing a framework for assessing the level of digital transformation

To enhance the likelihood of successful digital transformation, enterprises need support in terms of finance, workforce training, and appropriate strategic consulting. To overcome barriers, SMEs in the textile industry require specific support policies, suitable training and transfer models, as well as a shift in leadership mindset. To assess the level of digital transformation in textile SMEs, a maturity assessment framework has been developed, consisting of criteria such as technological infrastructure, digital workforce, leadership & awareness, supply chain, products & services, innovation, and operational efficiency, with each criterion scored up to 5 points. Among these, technological infrastructure-including hardware systems, software, and connectivity networks-serves as the foundation for all digital transformation activities. For textile SMEs, possessing modern and stable technological infrastructure enables them to easily implement digital applications, automate processes, and connect with partners and customers. Conversely, weak infrastructure makes it difficult for enterprises to fully leverage new technologies, increases operating costs, and reduces the effectiveness of digital transformation.

The digital workforce refers to employees equipped with skills and knowledge in information technology and digital solutions. They are directly responsible for operating, managing, and developing digital systems. In textile SMEs, the shortage of IT personnel reduces the ability to successfully adopt new technologies and maintain systems. Recruiting and training high-quality human resources play a crucial role in enhancing digital transformation capacity. In addition, leadership and awareness of digital transformation are decisive factors that shape strategy and determine the success of the process. When leaders have the right perception and demonstrate commitment, enterprises gain sufficient orientation, resources, and motivation to implement DT. Conversely, a lack of awareness or insufficient support from leadership leads to unfocused DT projects, which are easily disrupted or fail to deliver expected outcomes.

A digitized supply chain enables textile enterprises to enhance synchronization, transparency, and responsiveness to market demands. Digitalizing processes from raw material input, production, to distribution helps reduce costs, optimize inventory, and improve customer experience. If the supply chain is outdated, SMEs struggle to collaborate effectively with partners and face risks related to delivery times and raw material shortages. Product and service innovation on digital platforms is a way for enterprises to create new competitive advantages. Integrating technology into products (e.g., digital design, smart garments) or offering digital customer support services helps expand markets and increase added value. Textile SMEs that fail to innovate are likely to fall behind in an increasingly competitive market. Innovation capability not only covers products

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but also processes, business models, and applied technologies. Innovation supports enterprises in quickly adapting to market changes and leveraging opportunities from digital technologies. In the textile industry, innovation enables enterprises to create flexible production processes and reduce costs.

Operational efficiency measures the actual impact of digital transformation on productivity, costs, quality, and production speed. This is the criterion that most clearly reflects the benefits enterprises gain from DT. If DT does not improve efficiency, enterprises will find it difficult to sustain investment and expand the scale of digitalization. Building a "Triple Helix" linkage model among enterprises-institutes/universities-and the government is a strategic direction. Each enterprise needs to be assessed for its level of DT maturity in order to identify its technological position and develop a digital transformation strategy aligned with its specific conditions and roadmap (Table 3).

Table 3. Digital Transformation Maturity Assessment Framework for Textile SMEs

Criteria	Score (0-5)
Technological Infrastructure	
Digital Workforce	
Leadership & Awareness	
Supply Chain	
Products & Services	
Innovation	
Operational Efficiency	
Total Score	

All of the above criteria play an important role and interact closely in driving successful digital transformation in Vietnamese textile SMEs. A strong technological infrastructure combined with a capable digital workforce provides the foundation for leadership to build an effective DT strategy. Digitized supply chains and products/services enhance competitiveness, while innovation and operational efficiency serve as evidence of sustainable development in the digital era. Therefore, enterprises need to invest comprehensively and integrate these factors to maximize the benefits of digital transformation. Applying the DT assessment framework enables enterprises to monitor progress and identify appropriate strategies.

3. CONCLUSION AND RECOMMENDATIONS

3.1 Conclusions

Digital transformation has been creating positive changes for Vietnamese textile SMEs, particularly in improving productivity, reducing costs, enhancing product quality, and expanding markets. However, the process still faces many barriers related to capital, human resources, organizational culture, and policy support. Compared to international enterprises, Vietnamese SMEs still have a significant gap in terms of technology integration, internal capacity, and development strategies. To narrow this gap, textile SMEs in Vietnam need to build phased DT roadmaps, moving from digitization to optimization, and then to creative transformation. This requires collaborative training, fostering a culture of technological learning, developing digital human resources, and connecting with startups, research institutes, and universities to increase R&D investment and open innovation. Enterprises should also leverage supportive policies such as Decree 205/2025/NĐ-CP, LinkSME, and the National Technology Innovation Fund, while establishing a four-pillar linkage model: Government-Institutes/Universities-Technology-Enterprises (MAYTECH-LINK).

3.2 Recommendations

3.2.1. For the Government and regulatory authorities

Develop financial support policies: Establish preferential credit funds and provide tax reductions for enterprises investing in digital technologies.

Improve the legal framework: Issue standards on data, security, and supply chain transparency to give SMEs clear guidance in implementation.

Promote tripartite collaboration: Encourage cooperation among enterprises, institutes/universities, and regulatory agencies to create an innovation ecosystem.

3.2.2. Regarding textile SMEs

Develop a long-term digital transformation strategy: Focus not only on data digitization but also on innovating business models and building a digital ecosystem.

Invest in digital workforce: Strengthen internal training, recruit IT professionals, and foster a culture of innovation and readiness for change.

Leverage appropriate technologies: Prioritize cost-effective and easily integrated solutions such as ERP, CRM, IoT, and AI that fit the scale of SMEs.

3.2.3. For institutes, universities, and research organizations

Develop specialized training programs: Organize courses in information technology, digital management, and data analytics tailored for the textile workforce to enhance digital capabilities.

Strengthen applied research: Focus on technological solutions that are suitable for SMEs, easy to implement, cost-effective, and highly practical.

Support technology transfer: Act as a bridge between enterprises and technology partners, enabling SMEs to access digital solutions more quickly and effectively.

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