

STRENGTHENING SUPPLY CHAIN COLLABORATION IN VIETNAM'S TEXTILE AND GARMENT INDUSTRY THROUGH DIGITAL TECHNOLOGIES: CURRENT SITUATION AND SOLUTIONS

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ABSTRACT

Digital transformation is profoundly reshaping societies and industries through the application of digital technologies. In this context, supply chain collaboration enabled by digital transformation is no longer optional but has become a strategic necessity for building more flexible, resilient, and sustainable supply chains amid persistent economic challenges and risks. This issue is particularly important for the Vietnamese textile and garment supply chain, which continues to occupy a low value-added position in the global value chain and therefore requires stronger and more sustainable collaboration among supply chain participants. Addressing this challenge requires practical solutions enabled by digital technologies. Accordingly, this study aims to provide a broader assessment of the current state of collaboration in the Vietnamese textile and garment supply chain and to propose practical digital transformation-based solutions for strengthening collaboration and supporting the sustainable development of the industry.

Keywords: Digital technology, digital transformation, collaboration, supply chain, textile industry.

1. INTRODUCTION

Digital transformation, a defining feature of the digital era, has increasingly reshaped economic and social activities through the adoption of digital technologies across sectors such as education, healthcare, manufacturing, and distribution, due to the benefits that digital technology brings. Since the approval of the National Digital Transformation Programme to 2025, with a vision to 2030, in 2020 [1], digital technology adoption has accelerated across Vietnam's economic sectors. The issue of researching and applying digital transformation is no longer just a task or objective for individual enterprises, but has become the responsibility and goal of the entire supply chain, considered within a broader context [2]. Therefore, the textile supply chain in Vietnam is also part of this positive transformation, adapting to the new advancements brought by digital technology, while significantly influencing the collaboration among enterprises in the textile supply chain in Vietnam and across all sectors of the economy.

The linkages between participants in the textile supply chain in Vietnam currently reveal numerous flaws, with barriers arising from a lack of trust and transparency throughout the entire production process, from raw materials to finished products within the chain. This has resulted in a collaboration level that is neither sustainable nor long-lasting with foreign suppliers and partners [3]. Promoting collaboration within the supply chain is a key objective

for fostering the development of the Vietnamese textile industry, and it is an urgent solution highlighted in many previous studies [3], [4], [5], [6].

However, the contribution of digital technology to the management stages of the supply chain would bring about significant changes to this issue. Numerous studies have demonstrated that digital technology enhances the capabilities of organizations and networks in processing information while simultaneously reducing the time required to handle information in a business environment characterized by uncertainty and volatility [7]. Furthermore, expanded collaboration on the digital transformation platform will increase the level of digitization within the supply chain, driving the development of a connected, intelligent, and sustainable supply chain [2].

Numerous risks, such as the Covid-19 pandemic, canal congestion, natural disasters, and other catastrophes, have continuously disrupted supply chains. In such cases, weaknesses in collaboration among supply chain partners exacerbate the losses suffered by organizations. Therefore, it is necessary to study the urgency of strengthening collaboration through digital transformation platforms, also known as digitalization, and to propose feasible solutions, especially for the case study of the Vietnamese textile and garment supply chain. In this context, the author analyzes the current state of collaboration in the Vietnamese textile and garment supply chain and based on this analysis, the paper will clarify the research issues including: What are the current barriers to collaboration in the supply chain of the Vietnamese textile and garment industry? Digital transformation, especially through CPFR (Collaborative Planning, Forecasting and Replenishment); What practical solutions can be proposed to improve supply chain collaboration in the digital landscape of Vietnam's textile and garment industry?

2. THEORETICAL FOUNDATION

2.1. Supply chain collaboration

According to [8], the foundation for the theory of supply chain collaboration was established by the Efficient Consumer Response Movement (ECR) in 1995, when the organization identified four core business areas that could achieve efficiency through collaboration and integration. Based on this [8], developed the concept of Collaborative Planning, Forecasting, and Replenishment (CPFR), considering collaboration as the coordination of two or more parties to jointly plan promotions and build synchronized forecasts, which then guide production and supply activities.

[9] states that the empirical foundation for collaboration research dates back to the works of [10], [11], [12]. Building on this perspective, [13] defines supply chain collaboration as the cooperation of independent companies in planning and implementing activities, yielding superior results compared to working individually.

[14] adds that to establish collaborative relationships, enterprises must overcome barriers, build common processes that add value, and introduce breakthroughs to meet customer needs. At the same time, [15] asserts that collaboration should focus on long-term benefits, resource sharing, and enhancing the ability to respond to changing demands. In this spirit, [16] defines collaboration as cooperation between two or more partners to jointly develop and implement plans, based on negotiation and shared rules to manage effective interdependent relationships within the supply chain.

Thus, supply chain collaboration helps control quality, establish sustainable production standards, and improve efficiency. It provides significant advantages over individual operations, making it a vital research topic both in academia and in practice. Furthermore, by basing the theory on the CPFR framework for understanding collaboration in the supply chain

and placing it within the context of the Vietnamese textile and garment industry, this theory will help explain the extent of collaboration among parties in the Vietnamese textile and garment supply chain, based on planning, forecasting, and supplementation. This will provide a basis for identifying and arguing for limitations in collaboration among parties, identifying which stages of the CPFR are being implemented well and which are not, and simultaneously providing insights into how to improve coordination among suppliers, manufacturers, and retailers to mitigate these limitations.

2.2. Digital Transformation

According to the study by [17], digital transformation is a term used in the private sector, primarily associated with the need to adopt new technologies to maintain competitiveness in the Internet era, where services and products are provided both online and offline.

Digital transformation is widely applied in both public and private sectors. In the public sector, digital transformation involves the use of digital tools and the digitization of processes, which leads to the improvement of procedures and services, further providing benefits such as cost reduction, societal contributions, and reinforcing democratic principles [17]. From the private sector perspective, digital transformation relates to changes in business models, leading to alterations in products, organizational structure, or process automation. These changes can be observed in the increasing demand for Internet-based media, resulting in a transformation of the entire business model (for example, e-commerce business) [18], [19]

More specifically, digital technology focuses on leveraging new digital applications, such as social media, mobile devices, data analytics, or integrated smart electronic devices, cloud computing, and big data [20], aiming to bring significant improvements in business, such as enhancing customer experience, optimizing operations, or developing new business models [21], [22], [23].

Thus, digital transformation is the process of applying new digital technologies to improve the operations and competitiveness of organizations, both in the public and private sectors. In the public sector, digital transformation helps improve administrative processes, reduce costs, and reinforce democratic principles. In the private sector, it leads to changes in business models, products, organizational structure, and the adoption of digital technology, thereby optimizing operations and developing new business models. By using a transformation theory framework to explain the current state of Vietnam's textile and garment industry, examining the level of digital technology exploitation by stakeholders in the supply chain, the extent of widespread adoption, the scale of investment among stakeholders in the chain, and digital transformation including digital tools such as IoT, cloud computing, and AI, key findings emerge to identify remaining limitations in the digital transformation process in its true nature.

2.3. The role of digital technology in the supply chain

Several studies suggest that from a supply chain perspective, the strong adoption of digital transformation will significantly impact product development, warehouse management, logistics visibility, and the ability to trace origins and quality, leading to improved efficiency in the supply chain network and business processes [24]. Specifically, digital transformation enhances the visibility of the supply chain, reduces information asymmetry between partners, and strengthens the ability to exchange information within the supply chain [3], while increasing the transparency of processes and transactions. This allows companies to focus more accurately on customer needs and deliver more efficient, tailored solutions [25], [26].

Moreover, the interconnectivity within the supply chain is further strengthened when participants collaborate on a digital platform to create synergy and stability across the entire supply chain. This enhances financial performance, innovation performance, and new product

development, while also enabling the creation of industry value chain models [3]. More specifically, it fosters close collaboration between consumers and organizations throughout the entire value chain, including co-design, co-creation, co-production, co-marketing, co-distribution, and co-financing [21].

Conversely, digital transformation will reach its full potential through collaboration in the supply chain, where various types of digital transformation can fully leverage their role in enhancing the sustainable innovation capacity of enterprises [27]. The digitalization process will involve three aspects of the business: business models, operational processes, and organizational structures. These aspects are interconnected with digital technologies; for instance, digital transformation will change the business model from a traditional one to an e-commerce platform, which in turn changes business processes. As processes evolve, organizational structures will also adapt, such as integrating technology into decision-making and forecasting, which will deepen over time [28].

Thus, based on the above research findings, digital technology is an essential objective for high-tech applications in supply chain enterprises. From an organizational perspective, it improves business performance and management across many aspects of the enterprise. From a supply chain perspective, digitalization creates synergies for collaboration and better responsiveness between partners in the chain, reinforcing the sustainability of the entire chain, ultimately enhancing the capacity of the supply chain.

3. RESEARCH METHODOLOGY

This study adopts a qualitative and exploratory research design because its main objective is not to test causal relationships between variables, but to interpret the current state of supply chain collaboration in Vietnam's textile and garment industry and to identify major barriers and digital technology-related trends affecting such collaboration. A qualitative approach is therefore appropriate for capturing the complexity of inter-organizational relationships, structural constraints, and sector-specific transformation pressures within the industry.

The study primarily relies on secondary data collected from official and credible sources, including scientific publications, the Vietnam textile industry outlook report, descriptive statistics from the Vietnam Textile and Apparel Association, the General Department of Customs, the General Statistics Office, and workshop materials related to enterprise collaboration in the textile supply chain. In addition, survey data from 257 textile enterprises regarding information technology issues were used as supplementary evidence to reflect firm-level concerns. The use of secondary data is suitable for this study because the research addresses an industry-level phenomenon that requires broad contextual, institutional, and market-based evidence rather than data from a single organization or a small number of cases.

To ensure the validity of the analysis, the study applied three principles in data selection and interpretation. First, sources were selected based on reliability, timeliness, and relevance to the research topic. Second, data triangulation was used by comparing information across official statistics, industry reports, academic studies, workshop content, and survey findings in order to identify recurring patterns and reduce dependence on any single source. Third, the analysis focused on consistent themes emerging across the data, such as fragmented linkages among supply chain actors, dependence on imported raw materials, technological constraints among SMEs, and increasing pressure for green and circular transformation.

Nevertheless, this study has several limitations. Because it mainly uses secondary data, it does not provide in-depth primary insights from individual firms through interviews or case studies. In addition, although survey data from 257 firms were incorporated, the study does not employ a full quantitative design to test causal relationships or measure the magnitude of

the effects of digital technologies on collaboration performance. Therefore, the findings should be interpreted as exploratory and diagnostic, providing a grounded basis for future empirical studies using interviews, comparative case analysis, or quantitative modeling.

4. THE CURRENT STATE OF SUPPLY CHAIN COLLABORATION IN VIETNAM'S TEXTILE AND GARMENT INDUSTRY IN THE DIGITAL AGE

4.1. Overview of Vietnam's textile and garment supply chain.

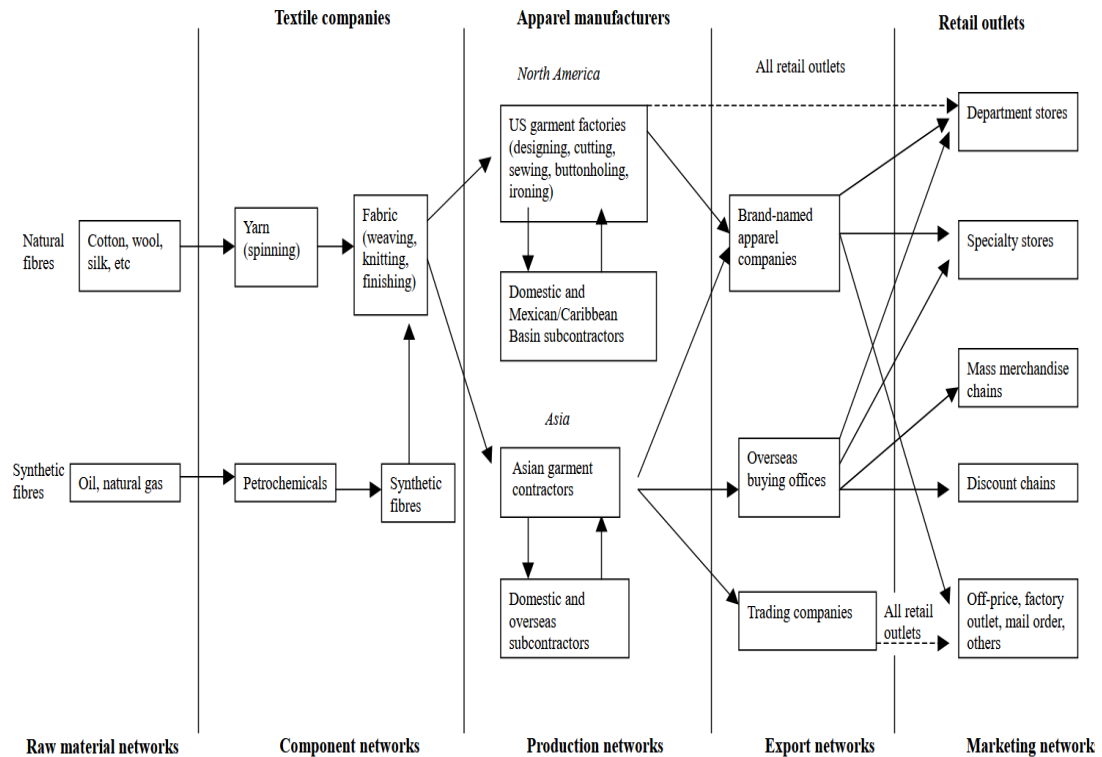


Figure 1. Global textile and garment supply chain diagram.

Source:[29]

The global textile supply chain consists of five key links (Figure 1), specifically: the raw material network; the auxiliary material network; the production network; and the export network, with the final link being the marketing network.

The raw material network is closely related to the extraction of natural petroleum and the cultivation of cotton, wool, etc., which serve as inputs for yarn manufacturing plants to produce synthetic fibers (from petrochemicals) or natural fibers (from weaving). These raw materials are then processed in the auxiliary material network, where textile organizations purchase and produce goods according to specific designs. This network includes garment factories and subcontractors, with finished products distributed to the export network, which includes branded garment companies, domestic and international trading companies, and traders dealing in renowned brands such as Mast Industries, Nike, and Reebok. These suppliers also play a key intermediary role, holding significant value within the chain, even though they do not own any manufacturing plants [4]. Furthermore, the marketing network helps distribute textile products to retail outlets.

In the global textile supply chain, Vietnamese textile enterprises are currently positioned in the production link, primarily as subcontractors, specifically in the garmenting process (Table 1). This phase is considered labor-intensive, as it does not require high technological investment. Therefore, developed textile-producing countries often outsource this step to emerging nations with cheap labor and underdeveloped input raw material production, such as Bangladesh, Pakistan, and Vietnam [4]. However, compared to other emerging garment exporting economies such as Bangladesh and Cambodia, according to [30], up to 2022, Vietnamese textile exports have a low domestic value content, heavily dependent on imported raw materials such as cotton from the United States, India, and Brazil, or synthetic fibers from China and Taiwan. Compared to Bangladesh and Cambodia in the same Southeast Asian region, Vietnam's import rate of 64.2% is still higher than Bangladesh (33.5%) and Cambodia (57.5%). Thus, Vietnam is a huge processing link but has the weakest self-sufficiency in raw materials within this group. Furthermore, in terms of input import growth, Vietnam recorded a 16.3% increase compared to Bangladesh (20.7%) and Cambodia (19.6%). This indicates that the two rival countries are experiencing a strong surge in export order volume, leading to increased demand for imported raw materials to meet production needs. Simultaneously, it reflects the direct competitive pressure on Vietnam in maintaining its global textile market share.

Table 1. Countries Participating in the Global Textile Value Chain. Source: [31]

Form of Production		Form of Production
OBM	OBM (Original Brand Manufacturer)	Led by Italy, France, the UK, and the US; followed by Germany, Japan, South Korea
ODM	ODM (Original Design Manufacturer)	Led by Hong Kong, South Korea; followed by Taiwan, Thailand
OEM	OEM (Original Equipment Manufacturer)	China, Taiwan, South Korea, India, Thailand, Malaysia, Indonesia
CMT	CMT (Cut, Make, Trim or Processing)	Bangladesh, Vietnam, Cambodia, Myanmar

According to [31], Original Brand Manufacturer (OBM) refers to companies that are responsible for the entire process, from building their own brand, sourcing raw materials, design, production, and product completion to marketing and distribution. This is the highest profit-generating model.

Original Design Manufacturer (ODM) refers to companies that manage all stages, from raw materials, design, production, to completion and delivery to customers. This model generates the second highest profit.

Original Equipment Manufacturer (OEM) refers to companies that operate on an order basis, handling raw materials, production, completion, and delivery. This model ranks third in terms of profitability.

Processing, or Cut, Make, Trim (CMT), refers to companies that receive pre-designed fabric from partners, then perform cutting (Cut), sewing and stitching into products (Make), and finishing adjustments (Trim). This model generates the lowest profit.

Thus, in the value chain, Vietnamese textile enterprises are still "held back" in the contract manufacturing position, also known as CMT, where all fabric materials are provided by partners. Currently, 70% of textile companies operate under this model, while only 25% of companies participating in the OEM method are foreign direct investment (FDI) companies [27]. Simultaneously, Vietnamese textile companies are also involved in spinning and weaving, such as Century Fiber Joint Stock Company (STK), Damsan Joint Stock Company (ADS), and Vietnam Textile and Garment Group (Vinatex). The results indicate

that, although Vietnam ranks second after China in textile export value among the top 10 largest exporting countries worldwide, most textile products are in the low and mid-range segments. Meanwhile, countries such as Germany, Italy, Spain, and the United States focus on high-end segments, generating higher value-added profits.

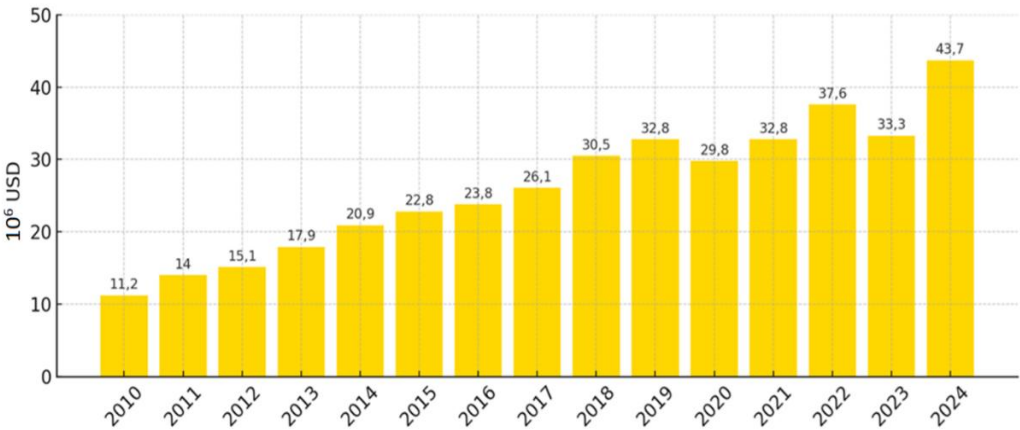


Figure 2. Export value of textiles and garments from 2010 to 2024.

Source: General Department of Customs

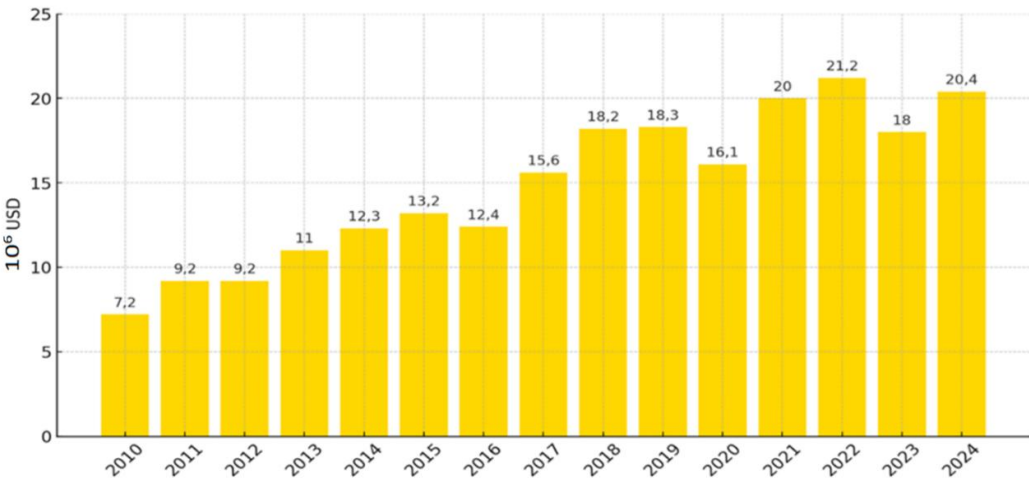


Figure 3. Value of textile and garment imports (cotton, yarn, fabrics, etc.) (2010 – 2024).

Source: General Department of Customs

During the period from 2010 to 2024, it is observed that the value of imports and exports has generally shown an upward trend (Figures 2-3). Although there was a reduction during the Covid-19 pandemic, the overall growth rate has been steady, with an average annual growth rate of 20.7% for exports and 13.1% for imports. Despite the fact that textile exports rank among the top commodities generating the highest revenue, the import of textile goods (cotton, fiber, fabrics, etc.) consistently accounts for about 50% of total export value, reaching a value of USD 20.4 billion in 2024, an increase of USD 13.3 billion compared to 2010. This indicates that the dependency on foreign raw material supply has significantly reduced the trade surplus of the textile industry.

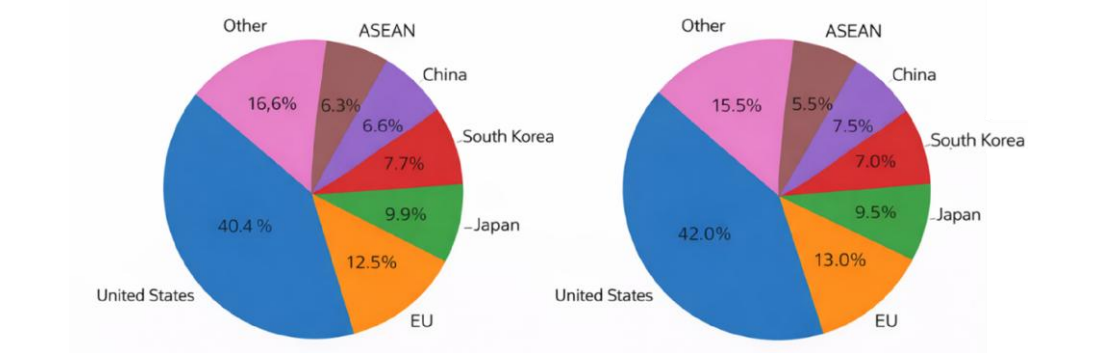


Figure 4. Structure of Vietnam's textile and garment export market in 2015 (left) and 2024 (right).
Source: Vietnam Textile and Garment Association (VITAS)

An overview of the textile export market for Vietnamese enterprises over the past nine years shows little significant change (Figure 4). The leading export markets remain the EU and the United States (13% - 42%), followed by smaller markets such as Japan and South Korea (7% - 9.5%), and finally ASEAN and China (5.5% - 7.5%). These can be considered traditional markets, and the textile supply chain should diversify its export markets, focusing on potential markets such as Canada, Russia, and the UK. This approach helps Vietnamese enterprises avoid dependence on a few markets and increases the sustainability of the supply chain in the face of economic shocks when large markets undergo unfavorable policy changes, such as the imposition of high tariffs by the US in 2025, which is a typical example

4.2. Current status of supply chain collaboration in Vietnam's textile and garment industry

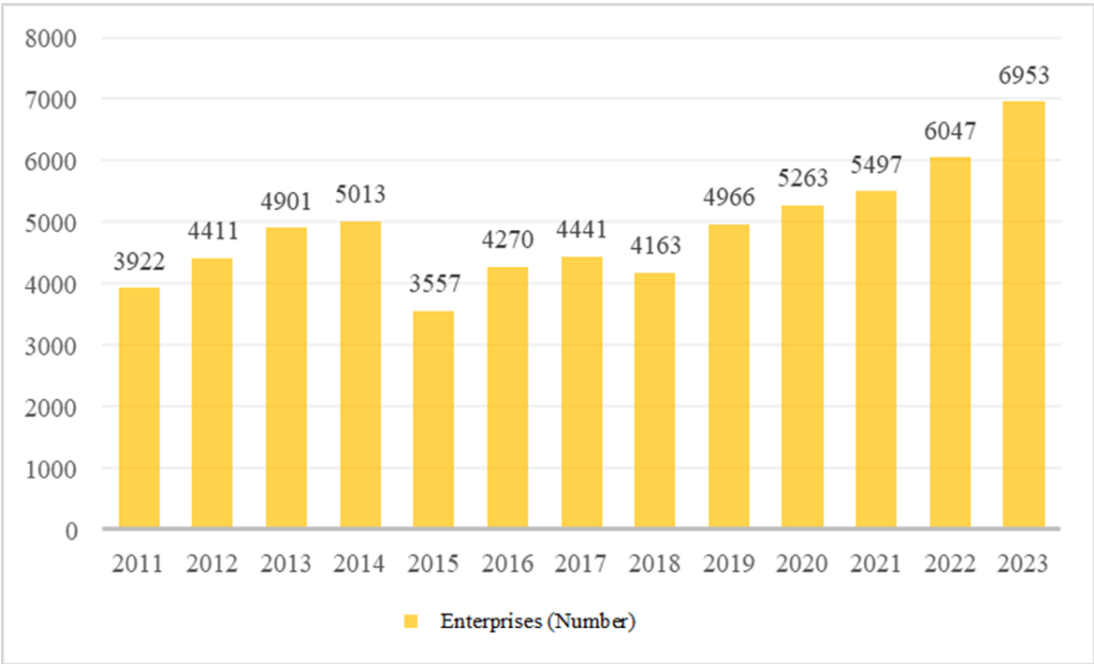


Figure 5. Number of Textile Enterprises in Vietnam (2011 – 2023).
Source: General Statistics Office and Vitas

Currently, the number of enterprises participating in the Vietnamese textile supply chain has been steadily increasing. Between 2011 and 2023, the number of companies rose from 3,922 to 6,953 (Figure 5), with 80% of them being small and medium-sized enterprises, 40% foreign direct investment (FDI) companies, and 70% of the industry's capacity

dedicated to production. Although the number of textile enterprises has increased by an average of 4.3% annually, the structure of the Vietnamese textile industry within the supply chain remains largely focused on contract manufacturing. Despite involvement in yarn production, domestic production meets only 10% of local demand, with the rest being imported from foreign suppliers [32]. This growth in the number of enterprises highlights the need for deeper and more proactive collaboration within the supply chain, aiming to take control of other segments and move beyond the contract manufacturing position, towards higher levels of production such as ODM and OEM.

Table 2. Structure of Organizations in the Vietnamese Textile Supply Chain [33].

Type of Enterprise	Structure (%)	Function
Garment Companies	70%	Manufacture and export clothing, exemplified by the Vietnam National Textile and Garment Group (Vinatex), TNG Investment and Trading Joint Stock Company (TNG), Thanh Cong Textile - Investment - Trading Joint Stock Company (TCM), etc.
Spinning Companies	6%	Produce yarn and supply yarn for the textile and garment industry (polyester yarn, knitted yarn, etc.).
Weaving Companies	17%	Weave fabrics and textile products (cotton fabric, polyester fabric, knitted fabrics, etc.).
Dyeing and Finishing Companies	4%	Provide dyeing and finishing services for textile products and other textile industries.
Auxiliary Companies	3%	Supply machinery and equipment for the textile industry, from weaving machines to finishing equipment, accessories, and maintenance services.

The collaboration status within the textile supply chain is reflected through vertical linkages between companies in the value chain, including material suppliers, manufacturers, and retailers, where the parent company holds the technology chain and overall development orientation. Specifically, the textile industry in Vietnam consists of 70% garment companies and 17% weaving companies, which make up the highest proportion in the sector (Table 2). However, the relationships among parties in the chain are still quite fragmented and unsynchronized in the face of major market changes, as shown by the following:

The green manufacturing trend, driven by the regulations of the Paris Agreement with the goal of limiting global temperature rise to below 2°C and achieving Net Zero by mid-century, includes encouraging the reduction of CO₂ emissions and promoting the use of renewable energy instead of fossil fuels. In this context, the EU market has implemented measures such as the Carbon Border Adjustment Mechanism (CBAM) and the Corporate Sustainability Due Diligence Directive (CSDDD). Despite these high requirements, collaboration faces many challenges, particularly since textile companies lack the investment capital to carry out green transformation. Currently, only a few large companies have successfully made the transition, such as the Vietnam National Textile and Garment Group (Vinatex) and the May 10 Corporation, which have converted fossil fuel boilers to electric boilers, reducing greenhouse gas emissions, meeting ESG standards, and transitioning to solar panel systems to produce products from solar energy [33].

The trend toward transitioning to a circular supply chain contrasts with traditional supply chain models, where raw materials and finished products are discarded at the end of the product lifecycle. Collaboration among parties primarily focuses on push or pull distribution to quickly meet consumer demand. However, the circular supply chain aims at recovering and recycling waste through waste management and turning it into products that can be re-

marketed, thus reintegrating into the economy. This helps reduce the extraction of new natural resources. Specifically, the EU market has set standards for exported garments, which must meet three main criteria: durability, reusability, and recyclability of fibers, and prohibit companies from discarding unsold clothes or requiring reporting of discarded quantities. Analyses show that in the textile industry, the fiber production phase creates significant pollution because producing 1 kg of fiber requires 200 liters of water, including washing, bleaching, dyeing, and final product cleaning. Therefore, for garments produced at garment companies to meet green and circular criteria, participants in the upstream stages must ensure synchronized transformation in production processes. Notably, fiber, weaving, and dyeing companies must proactively reduce water consumption, harmful chemicals, and emissions to meet the requirements of the EVFTA agreement. Thus, without strong commitment and clear goals among partners, synchronized transformation is challenging, inadvertently creating significant barriers such as increased competition, high investment costs, and difficulties in maintaining environmental compliance and carbon emission reporting across participants.

The trend of connecting information technology is also a major barrier to collaboration among supply chain participants. Collaboration requires quick and accurate electronic network connections, but 70% of textile companies are small- and medium-sized enterprises, which face difficulties in investing and applying new technologies. Only 30% of companies, including foreign-invested enterprises and large domestic firms, have implemented automation in their production stages. Moreover, fewer than 5% have plans to implement connected automation technology (according to the Vietnam Textile Industry Outlook Report 2025). A survey conducted by the author on factors affecting collaboration in the Vietnamese textile supply chain, involving 257 textile companies across the country, showed that most textile organizations are highly concerned about "the ability to connect and exchange emails within the supply chain," "the ability to directly link computer-to-computer between partners," and "the ability to use IT to support transaction processing." Thus, organizations recognize the urgency of digital technology in transaction activities and information exchange within the chain.

The trend of mastering textile raw material sources is also noteworthy. Currently, only about 10% of the raw materials used in the Vietnamese textile industry are domestically sourced. Vietnam uses approximately 400,000 tons of cotton annually; however, only 3,000 tons of this material are supplied by domestic supply chains, with the remainder being imported, particularly from China, which accounts for nearly 50% [32]. The demand for creating local production areas to control raw material inputs is significant, but collaboration remains insufficient, lacking specific planning to connect textile companies for investment in cultivating raw material areas for the future. The lack of collaboration in controlling raw material inputs is a barrier not only affecting the sustainability of the supply chain in case of adverse fluctuations from large suppliers but also impacting the value of the supply chain, as high-value-added processes such as fiber, chemicals, dyes, and finishing still rely on imports. At this point, digital technology plays a crucial role as an investment analysis tool, solving big data issues among participants to assess optimal approaches for collaboration in raw material cultivation projects for the textile industry.

5. SEVERAL SOLUTIONS TO ENHANCE COLLABORATION IN THE TEXTILE SUPPLY CHAIN ON THE DIGITAL TECHNOLOGY PLATFORM

Extensively exploiting decision-making applications and receiving strong support from AI to ensure the decision-making process of organizations and supply chains will further strengthen the robustness of market analysis and evaluation. In reality, some organizations have boldly invested to take on the role of a supporting manufacturer for certain textile

companies; however, textile companies are unable to forecast long-term product consumption. Due to difficulties in finding business partners, the supporting companies face numerous challenges. This situation highlights that the key issue is that textile companies lack the confidence to collaborate in large-scale projects because they lack analytical tools to assess long-term investment plans amidst market risks, coupled with the overwhelming amounts of big data from market demand and the uncertainty of surrounding information, which causes collaboration decisions to stagnate and miss opportunities. Therefore, AI's contribution will solve complex issues in the collaboration between participants as AI not only supports decision-making but also optimizes transportation routes and material allocation, improving coordination, reducing inventory and transportation costs.

Increasing the use of digital technology for data analysis and accurate forecasting from real-time supply chain data will create feasible and practical forecast figures, which will drive partners to cooperate and adjust production processes, aiming for large and long-term contracts when trust is strengthened. However, forecasting cannot be effective without transparency in the linkage of information between participants in the chain. To ensure accurate and timely information sharing, partners must proactively use digital technology to digitize data, and the disclosure of this data must come from reputable company leaders who ensure open access systems with chain partners. Specifically, management based on a cloud platform to improve the process of sharing data and information among all stakeholders is a fundamental requirement to enhance cooperation across the entire supply chain.

Strengthening efforts based on digital technology to harness robots, or more broadly, moving towards an automated system in garment production processes with the goal of increasing accuracy in sewing and weaving steps, will help minimize waste and accelerate production speed. Specifically, increasing the use of robots for fabric spreading and cutting helps reduce labor by up to 80% and saves 3% of material costs [33]. The automated system enables production activities to be controlled in real-time. By integrating AI and IoT, smart production lines are capable of adjusting speed and operating time optimally, minimizing energy and raw material costs, while also promoting collaboration as partners can proactively monitor the quality of production among participants by updating the real-time production status, thus reducing supply chain disruption risks.

Furthermore, digital technology also facilitates collaboration through digital finance for the Vietnamese textile industry, a method that enhances transparency and enables better control of cash flow in payment transactions. It allows individuals and organizations to access payment, savings, and credit services through the internet, without needing to visit a branch or a service provider's point of contact. When transparency is ensured, it will drive stronger collaboration within the supply chain. Thus, collaboration in the supply chain cannot exclude partnerships with Fintech service providers, as the potential benefits that Fintech brings are substantial compared to other countries and regions. In Vietnam, the Fintech sector has primarily focused on the payment segment (which accounts for nearly 60%) [34]. Banks can collaborate with Fintech companies in other areas such as savings, investment, and credit, creating opportunities for SMEs within the textile supply chain to access investment capital.

The digital solutions proposed in this study should not be understood as isolated technological options, but rather as an integrated, collaborative architecture, derived from previously identified barriers in the Vietnamese textile and garment supply chain and systematic integration from the micro to the macro level. Specifically, at the micro level, businesses in the supply chain will leverage AI as a suitable tool to address barriers related to weak forecasting capabilities, uncertain market signals, and limitations in overall planning for long-term investment and the development of domestic raw materials. Simultaneously, businesses will combine AI and IoT to automate production, processing, and packaging operations at various links in the textile and garment supply chain, ensuring quality

synchronization, traceability, and environmental compliance among businesses, a process that takes place internally within each company. When implemented synchronously at the micro level, cloud platforms deployed across the entire supply chain help address fragmented information sharing and low transparency among stakeholders by enabling timely data exchange and creating shared information visibility. Simultaneously, digital financial tools help overcome capital constraints that limit the participation of small and medium-sized enterprises (SMEs) in green, circular, and digital transformation.

From this perspective, these technologies are systematically linked across material, information, and financial flows to improve the cooperation barriers explored earlier. While each technology addresses a distinct coordination issue, they collectively contribute to enhancing transparency, trust, responsiveness, and long-term integration within the supply chain.

6. CONCLUSION

Strengthening cooperation in the textile and garment supply chain is an urgent issue requiring comprehensive innovation to achieve sustainable development. This research shows that the challenges of cooperation in Vietnam's textile and garment supply chain are closely linked to structural issues such as dependence on imported raw materials, fragmented linkages, limited digital capabilities of small and medium-sized enterprises (SMEs), and increasing pressure from green transformation and the circular economy.

The main scientific contribution of this paper is connecting the perspective of supply chain cooperation with digital transformation to explain these constraints within the specific context of Vietnam's textile and garment industry. In practice, the research suggests that businesses need to move beyond individual digitization to prioritize shared data systems, integrating real-time forecasting and coordination among actors in the chain to facilitate green production, circular supply chains, stable raw material supply, and timely information sharing. Regarding policy, the article shows the need to strengthen support for digital infrastructure, upgrade SMEs, train human resources, and develop linkages between upstream and downstream sectors.

Although exploratory in nature and primarily based on secondary data, the study still provides a useful analytical foundation for further research on digital technology and supply chain cooperation in the Vietnamese textile and garment industry from an empirical perspective.

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