

Technology Adoption, Sustainability and Logistics Challenges in Asian Textile Supply Chains: Empirical Evidence

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ABSTRACT

The study focuses on the mechanisms of international supply chains for textiles, the challenges of multi-level supply chains, the impact of technology advances on the efficiency of logistics and the problems of the sustainability of the textile sector. This study examines logistics practices, technology adoption and sustainability priorities within textile supply chains, drawing on survey evidence from 101 respondents within an Asian textile supply chain. The study aims to identify key logistics challenges, examine technology adoption and assess sustainability priorities within Asian textile supply chains. Results suggest that logistics practices are mostly viewed positively, but inventory management, competition and transportation cost remain problematic for a significant minority of respondents; GPS tracking, IoT sensors and RFID are the dominant shipment tracking technologies, with technology being rated as critical or useful by most respondents; and sustainability is a stated priority for most respondents, but a significant minority still consider it secondary to cost and delivery concerns. This study offers an understanding of variations in the sustainable practice, the usage of digital technology to enhance supply chain visibility. The findings are intended to support academics, industry practitioners and policymakers in making more informed decisions that enhance resilience, sustainability and efficiency of textile supply chains, and to contribute to the current debate on supply chain optimisation strategies in multinational corporations.

Keywords: Supply chain management; Technology adoption; Sustainability: Asian Textile Supply Chain; Logistics Management

INTRODUCTION

A global web of linked firms produces, distributes and consumes textiles and clothing around the world. The proper management of these processes guarantees the smooth flow of raw materials, intermediate products and completed items from manufacturers to customers (Tiwar, 2012; Scarsi and Cepolina, 2016). The dynamics of the global textile supply chain are influenced by localisation, increasing competition, regulation constraints, changing consumer tastes, technological advancement, and globalisation. To remain competitive in a constantly changing market, companies need innovative supply chain and logistics management strategies (Scarsi and Cepolina, 2016; Uddin, 2023). It is important to understand these strategies in full: in a dynamic global economy, companies that focus on innovation, collaboration and continuous improvement are better able to achieve long-term profitability (Kähkönen and Lintukangas, 2012). Globalisation, technological advancement and changing consumer tastes continue to challenge established supply chain processes, driving industry participants to innovate and adapt (QodeNext, 2024; Beyers and Heinrichs, 2020).

Ongoing coordination issues are posed by worldwide textile supply chains, including producers, distributors, retailers and raw-material suppliers. The relevant organisations need to be able to communicate and coordinate seamlessly in an effort to ensure operational effectiveness and responsiveness to market change. The uneven adoption of logistics and supply chain technology across industrial segments adds further complexity and can block cooperation and lower overall competitiveness. Simultaneously, the sustainability demand implies a

careful balance between morally and environmentally sound activities, which is a complicated topic that deserves extensive consideration (Beyers & Heinrichs, 2020).

This research provides an in-depth analysis of logistics and supply chain management practices across the global textile supply chain to identify best practice and innovative solutions to improve resilience, efficiency and sustainability in the midst of globalisation, technological change and changing consumer preferences. The specific aims are to:

- evaluate the effectiveness and efficiency of logistical processes in international textile supply chains;
- identify the key barriers and possibilities for the supply chain management practices in the textile sector;
- compare and contrast the technological and logistical techniques employed throughout textile supply chain segments and geographic regions;
- evaluate the influence of new technology and environmental initiatives on supply chain management and logistics in the textile sector; and
- provide insights and ideas to enhance logistics and supply chain procedures in the global textile industry.

Thus, the study covers the following four research questions: (RQ1) What are the principal logistics challenges experienced within textile supply chains? (RQ2) What technologies are most commonly used for supply-chain visibility and shipment tracking? (RQ3) How do textile supply-chain stakeholders perceive the importance of sustainability and operational efficiency? (RQ4) Which areas of logistics and supply-chain operations are perceived to require the greatest improvement?

The study is motivated by the increasing complexity of the world textile supply chains, which is a consequence of globalisation, technological advancement, changing consumer tastes, and increasing pressure for ethical and sustainable behaviour. It's important in 3 ways. Textiles are economically important to global trade and competitiveness, and discovering cost reductions and efficiency improvements in supply chain procedures help long-term business survival with increasing environmental legislation and consumer consciousness (Uddin, 2023). From a societal point of view, the industry is a core contributor to meeting the worldwide need of clothes and footwear, and the study addresses issues of working conditions and ethical sourcing by focusing on transparency and social responsibility (Lindahl and Özdemir, 2023). From a research perspective, the study contributes to the knowledge of logistics, manufacturing and consumption relationships, best practice and supply chain management issues. It helps firms to succeed in the long term, supports policymaking and promotes more sustainable and equitable practice throughout the global textile sector (Giri and Rai, 2023).

LITERATURE REVIEW

Textiles are one of the most significant and largest sectors in the world economy, with an annual worldwide production capacity of over US\$1.4 trillion for garments, home textiles and industrial materials. Asia, Europe and Latin America are important production areas, with China, India, Bangladesh and Vietnam at the forefront. The sector employs over 60 million people, especially in developing countries, even though extensive value chains and working conditions continue to raise issues related to pay and workers' rights (Scarsi and Cepolina, 2016). Manufacturers of sustainable textiles such as organic cotton, and recyclable materials have an increasing emphasis for sustainability, incentivising reduced waste and reassessed resource use (Qorbani and Groesser, 2020). Textile production is an important part of gross domestic product in emerging countries such as Bangladesh, Vietnam, and Cambodia, with annual exports of over US\$500 billion, and efficiency has increased thru automated and high-performance textiles even as low-wage labour continues to cause social and environmental concerns (Lindahl and Özdemir, 2023). Key changes in the sector include production moving to lower-cost areas because of globalisation (Vidroya, 2020), the rise of fast-fashion retailers with short collection cycles (Singh, 2023), more pressure from consumers and regulators to be more environmentally friendly (Sartal, 2020), and new technologies like automation, robotics, blockchain, RFID, 3D printing, and smart fabrics (Cuc, 2022).

The textile supply chain is a complex and multi-stage process starting with raw materials such as cotton, wool, silk and synthetic fibres. These materials undergo spinning, weaving, knitting, dyeing and finishing before reaching the end consumer. The management of the textile supply chain is complicated by the involvement of numerous manufacturers, suppliers and logistical actors (Tiwary, 2019). The sector faces some unique problems compared to others, such as long lead times because of quality checks, sequential processing, and seasonal reliance on agricultural raw materials (Cuc, 2023) and production that is spread out geographically and needs strong coordination and logistics to keep delivery dates (Vidroya, 2020); material prices that change quickly because of market demand, geopolitics, and weather (Ahmad et al, 2021a); and environmental and ethical problems like waste, chemical use, and labour standards (Daukantienė, 2022). These problems are balanced by clear opportunities: the use of IoT, AI, and automation to improve efficiency and traceability; the growing possibility of environmentally friendly methods like using recycled materials and more energy-efficient methods (Denuwara, Majjala, and Hakovirta, 2019); working together thru collaborative models like supplier alliances and integrated logistics services (Wadhwa, 2023); and flexible supply chain strategies that can adapt more quickly to changing consumer and market needs (Li, Zhou, and Wu, 2017).

The logistics and supply chain management in the textile business is studied based on several well-established theories (Moktadir et al., 2020). Supply chain resilience theory is concerned with the ability of supply networks to forecast, adapt to and recover from disruptions such as pandemics, natural disasters or geopolitical conflict, while sustainable supply chain theory is focused on the integration of social and environmental responsibility within supply chain operations thru the use of eco-friendly materials, reduced carbon footprints and fair labour policies (He et al., 2020). Lean manufacturing theory aims at removing non-value-added activities to minimise cost and lead time, while agile supply chain theory promotes flexibility and response to rapidly changing consumer desires (Li, Zhou and Wu, 2017). The Resource-Based View and Transaction Cost Economics provide contrasting perspectives: the first emphasises the strategic value of a firm's unique resources that are hard to copy, and the latter emphasises lowering the costs of economic transactions and governance (Oelze, 2017). These theories are further contextualised in a Global Value Chain (GVC) perspective. The textile industry is conceptualised as a complex network of interrelated processes from acquiring raw materials to production, shipping, retailing and interaction with customers. Producers, manufacturers, logistics providers, retailers and consumers all have different roles and different degrees of negotiating power in the chain (Cornell, Häyhä and Palm, 2024).

Logistics optimisation continues to be a key research area with focus on distribution and transportation, inventory management and the application of information technology including RFID, GPS, cloud platforms and big-data analytics in order to enhance coordination, routing and disruption forecasting (Wang et al., 2020). Research into supply chain management practices includes sourcing and procurement (increasingly focusing on ethical and near-sourcing strategies), Industry 4.0-driven automation in production and operations (Ghobakhloo, 2018), and supply chain risk management thru diversified sourcing and contingency planning. Sustainability and ethical considerations have become especially important: research on social responsibility focuses on worker safety and fair labour standards, particularly thru certification schemes (Köksal et al., 2017), and research on the circular economy examines recycling, reuse, and upcycling as ways to extend product lifespans and reduce waste (Koszevska, 2018).

Previous studies have addressed sustainability, technology adoption, logistics and supply chain management in the textile and clothing industry, but these characteristics are often explored separately (Singh, 2023; Ahmad et al., 2021a; Moktadir et al., 2020; Denuwara, Majjala and Hakovirta, 2019).

There is little empirical research that has explored these concerns within a single textile supply-chain setting from a logistics and operational decision-making perspective (Nguyen, Doan, and Hoang, 2020; Cornell, Häyhä, and Palm, 2024; Giri and Rai 2013). So, this paper addresses this gap by empirically exploring logistical efficiency, technology adoption, sustainability priorities, supplier relationships and possibilities for operational improvement, based on survey results from 101 textile supply-chain stakeholders across Asia. In particular, the analysis highlights a potential gap between the strategic importance of sustainability and its priority in operations.

RESEARCH METHODOLOGY

The present study employed a quantitative, cross-sectional research approach to analyse logistics, technology adoption, sustainability practices and supply chain management within the Asian textile industry. A quantitative methodology was chosen because it allows for the systematic assessment of industry practices and the identification of patterns in logistics, technology adoption, sustainability and supply-chain management. The study identifies that textile supply chains consist of physical elements like resources, products and logistical infrastructure, and intangible factors like information flows, stakeholder interactions and regulatory impacts (Rayyaan et al., 2014; Sadowski et al., 2021).

The study employed a purposive sampling approach, targeting individuals with current, active engagement in the Asian textile supply chain across producer, manufacturer, supplier, distributor, logistics-provider, and retailer roles. Eligibility was defined solely by current, active involvement in the industry; firm-level characteristics such as company size, revenue, or years in operation were not collected as part of the screening criteria or survey instrument. Approximately 200 eligible individuals were identified and invited to participate via LinkedIn and the authors' personal and professional contacts within the industry, of whom 101 completed the survey, yielding a response rate of approximately 50.5%. The survey was administered entirely online over a period of data collection in 2024, was self-completed by respondents in English, and no incentives were offered for participation.

Survey items were newly developed for this study, drawing on constructs identified in the literature review, including supply chain resilience theory, sustainable supply chain theory, the resource-based view, transaction cost economics, lean manufacturing theory, and agile supply chain theory (see Table 1 for the full mapping of research questions, theoretical constructs, and survey items). As existing validated scales specific to this combination of constructs within the Asian textile supply-chain context were not available, new items were developed based on the reviewed literature. Prior to full administration, the instrument was piloted with a panel of nine reviewers (seven academics and two industry practitioners) to assess item clarity, relevance, and content validity; minor wording revisions were made to the instrument based on this feedback before the survey was distributed to the full sample.

Table 1 makes explicit how each research question (as stated in full in the Introduction) was operationalised in the survey instrument, and which theoretical construct(s) from the literature review each item draws on.

RQ	Theoretical Construct(s)	Survey Item(s) / Measure
RQ1	Supply chain resilience theory (capacity to forecast, adapt to and recover from disruption); Transaction cost economics (cost and complexity of coordinating across firms); Resource-based view (relational, hard-to-replicate value of supplier/manufacturer ties)	Perceived logistics efficiency (Excellent/Good/Fair/Poor); ranked logistics challenges (transport costs, competition, inventory management, regulatory compliance); quality of supplier and manufacturer relationships
RQ2	Resource-based view (technology as a valuable, firm-specific capability); Agile supply chain theory (flexibility and responsiveness enabled by real-time visibility)	Self-rated importance of technology for logistics/supply chain management (critical, useful, limited, insignificant); primary shipment-tracking technology used (GPS tracking, IoT sensors, manual tracking, RFID)
RQ3	Sustainable supply chain theory (integration of social and environmental responsibility into operations); Lean manufacturing theory (minimising cost and non-value-added activity,	Stated priority given to sustainability (top/high/minimal priority, not a priority); ranked importance of logistics considerations, including sustainability

	which can compete with sustainability investment)	practices, relative to cost efficiency, timely delivery and supplier relationships
RQ4	Supply chain resilience theory (identifying vulnerabilities for targeted improvement); Global Value Chain perspective (coordination demands across dispersed, multi-tier networks)	Factors driving customer satisfaction (product quality, on-time delivery, supply chain transparency, customer service); frequency of evaluating/adapting practices; self-identified areas most requiring improvement (distribution, production, procurement, retail operations)

Table 1 Theoretical Framework: Research Questions, Constructs and Survey Items

Beyond ensuring respondent anonymity and obtaining informed consent, no additional procedural remedies (e.g., temporal or psychological separation of predictor and criterion items, reverse-coded items) were built into the survey design, and no post hoc statistical test for common method variance (e.g., Harman's single-factor test or the marker-variable technique) was conducted. This is acknowledged as a limitation of the study and is revisited in the Conclusion.

The respondents comprised producers, manufacturers, suppliers, distributors, logistics providers and retailers. Descriptive statistics such as frequencies and percentages were employed to provide an overview of the respondent characteristics and trends related to logistics efficiency, technology adoption, sustainability and supply chain practices.

FINDINGS

The findings provide insights into logistics efficiency, supplier relationships, sustainability, technology adoption, customer satisfaction, and operational challenges within the textile supply chain. Overall, respondents reported relatively positive perceptions of logistics performance and technology use, although inventory management, distribution, production, and cost efficiency remain important areas for improvement.

Variable	Category	N	%
Gender	Male	54	53.5
	Female	37	36.6
	Prefer not to Say	10	9.9
Age	18–24 years	42	41.6
	25–30 years	31	30.7
	31–35 years	15	14.9
	Above 36 years	13	12.9
Country	India	36	35.6
	Pakistan	20	19.8
	Bangladesh	15	14.9

Supply Chain Role	Malaysia	8	7.9
	Thailand	5	5.0
	China	13	12.9
	Indonesia	4	4.0
	Producer	0	0.0
	Manufacturer	35	34.7
	Supplier	25	24.8
	Distributor	7	6.9
	Logistics Provider	5	5.0
	Retailer	29	28.7

Table 2 Respondent Profile (N = 101)

Table 2 presents the consolidated demographic and geographic profile of the 101 respondents. The sample comprised 53.5% male and 36.6% female respondents, while 9.9% preferred not to disclose their gender. In terms of age, respondents were predominantly younger, with 41.6% aged 18–24 and 30.7% aged 25–30; those aged 31–35 represented 14.9%, while 12.9% were above 36 years. Respondents were drawn from seven Asian countries, with India (35.6%) and Pakistan (19.8%) most heavily represented, followed by China (12.9%), Bangladesh (14.9%), Malaysia (7.9%), Thailand (5.0%) and Indonesia (4.0%). By supply chain role, manufacturers (34.7%) and retailers (28.7%) accounted for the largest share of respondents, followed by suppliers (24.8%), distributors (6.9%) and logistics providers (5.0%); no respondents identified as producers. Overall, the sample was concentrated among younger respondents aged 18–30, working predominantly as manufacturers, retailers and suppliers, and based mainly in South Asia (India and Pakistan).

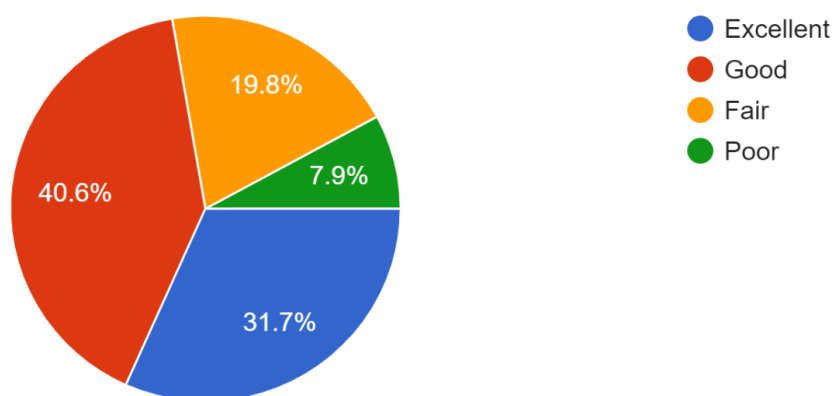


Figure 1 Logistics Efficiency

Perceptions of logistics efficiency were generally positive. 40.6% of respondents rated logistics practices as good and 31.7% as excellent, indicating that 72.3% viewed logistics performance favourably. However, 19.8% rated performance as fair and 7.9% as poor, suggesting that approximately 28% of respondents identified scope for improvement.

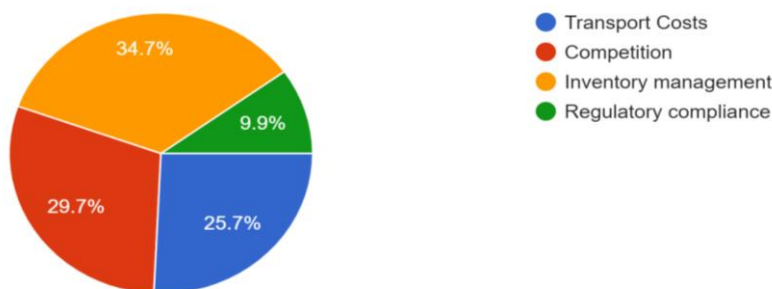


Figure 2 Logistics Challenges

Inventory management was the most frequently reported logistics challenge (34.7%), followed by competition (29.7%), transportation costs (25.7%), and regulatory compliance (9.9%). These findings indicate that inventory control and cost pressures are particularly important operational concerns within the textile supply chain.

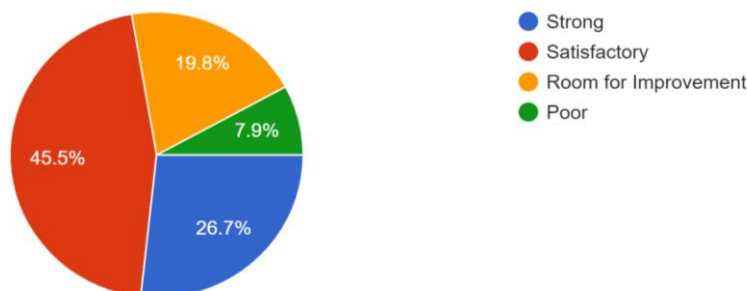


Figure 3 Supplier Relationships

Supplier and manufacturer relationships were generally viewed positively, with 45.5% rating them as adequate and 26.7% as strong. Nevertheless, 19.8% considered these relationships in need of improvement and 7.9% rated them poorly. This suggests that although most respondents maintain satisfactory relationships, opportunities remain for stronger collaboration and coordination.

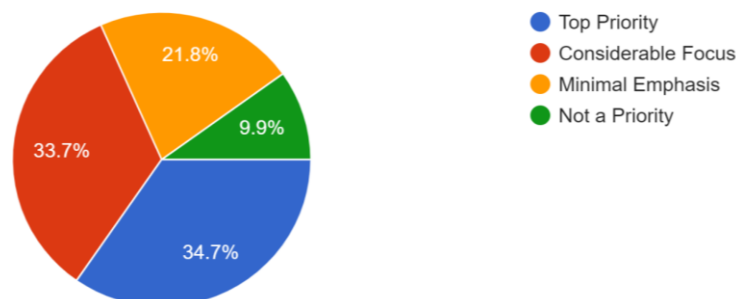


Figure 4 Sustainability in Textile Industry

Sustainability was also identified as an important consideration. 34.7% regarded sustainability as a top priority and 33.7% as a high priority, meaning that 68.4% placed substantial importance on sustainability. However, 21.8% considered it only occasionally important and 9.9% did not regard it as a priority.

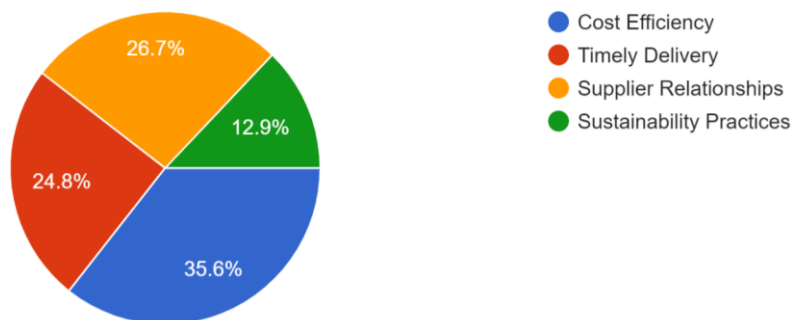


Figure 5 Logistics Issues in Textile Industry

An important finding emerges when sustainability is compared with operational priorities. Although 68.4% reported sustainability as a high or top priority, only 12.9% identified sustainable practices as the most critical logistics consideration. In contrast, cost effectiveness (35.6%), supplier relationships (26.7%), and timely delivery (24.8%) were prioritised. This indicates a potential gap between stated sustainability priorities and operational decision-making.

Technology Adoption

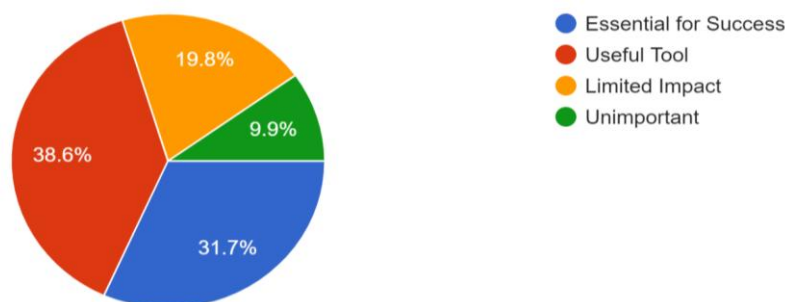


Figure 6 Technology Prioritization

Technology was generally perceived as beneficial to textile supply chain management. 31.7% of respondents considered technology essential and 38.6% considered it useful, indicating that 70.3% recognised its positive contribution. Nevertheless, 19.8% considered its impact limited and 9.9% viewed it as insignificant.

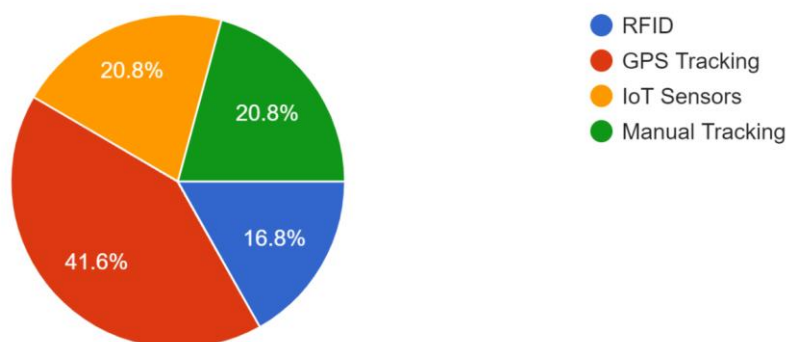


Figure 7 Technological Application

Shipment tracking and monitoring was most commonly done by GPS tracking (41.6%), followed by IoT devices (20.8%), manual tracking (20.8%) and RFID (16.8%). The results indicate that organisations are still combining old tracking technology with newer digital solutions, and manual tracking is still suitable for some firms.

The results show that product quality was the most important element affecting customer satisfaction (34.7%) followed by on-time delivery (25.7%) and supply chain transparency (23.8%). Customer Service was 15.8% of responses. Regarding continuous improvement, 43.6% of the respondents said they periodically evaluate and adapt their logistics and supply chain procedures and 28.7% do it consistently. However, 18.8% examined their methods now and then and 8.9% never did. As per the improvement priorities, distribution (31.7%) and production (30.7%) were the sectors that required the most improvement, followed by procurement and retail operations (19.8% each). The results indicate that improvements in operational processes, especially in distribution and production, could lead to improved efficiency and satisfaction among customers.

Dimension	Category	Frequency (%)
Factors influencing customer satisfaction	Product quality	34.7
	On-time delivery	25.7
	Supply chain transparency	23.8
	Customer service	15.8
Frequency of evaluating and adjusting practices	Periodically	43.6
	Routinely	28.7
	Sporadically	18.8
	Never	8.9
Areas requiring improvement	Distribution	31.7
	Production	30.7
	Procurement	19.8
	Retail operations	19.8

Table 3 Customer Satisfaction, Continuous Improvement and Areas Requiring Improvement

Table 3 indicates that product quality and on-time delivery are the dominant customer-satisfaction factors, while distribution and production represent the primary areas requiring operational improvement. The result shows that the most important element affecting customer satisfaction is product quality (34.7%), followed by on-time delivery (25.7%) and supply chain transparency (23.8%). Customer service was 15.8 percent. Regarding continuous improvement, 43.6% of the respondents said they periodically evaluate and adapt their logistics and supply chain procedures and 28.7% do it consistently. However, 18.8% examined their methods now and then and 8.9% never did. Distribution (31.7%) and production (30.7%) were the sectors that needed the most development, followed by procurement and retail operations (19.8% each) as opportunities for improvement. These data show that upgrading operational processes including distribution and production may help to achieve efficiency and customer satisfaction. Most often mentioned was operational improvement in distribution (31.7%), while production wasn't far behind (30.7%). 19.8% of the respondents identified both

procurement and retail operations. These results show that the biggest potential to make the supply chain more efficient and effective are in distribution and production.

Overall, the data point to a somewhat favourable logistical performance in the textile supply chains, along with a growing recognition of technology and sustainability. Still, a number of operational issues persist. The topics to focus on include inventory management, competition, transportation costs, distribution and production. Technology such as GPS and IoT is being utilised more and more to increase visibility of shipments and supplier relationships continue to be a key predictor of effectiveness in the supply chain. One particularly interesting conclusion is the discrepancy between the strategic significance ascribed to sustainability and its operational prioritising. 68.4% of respondents said sustainability was a high or top priority, with only 12.9% rating environmentally friendly procedures as the most important logistics issue. Thus, cost, supplier relationships and delivery performance continue to drive day-to-day logistics decisions, indicating an essential subject for further exploration.

Inferential Statistical Analysis

The descriptive patterns reported above — including the gap between stated sustainability priority (68.4% rating it high or top priority) and operational prioritisation (12.9% rating it the single most important logistics consideration) — are suggestive of a meaningful divergence between attitude and practice. However, we did not conduct inferential statistical tests (e.g., chi-square tests of association between respondent category and technology adoption, sustainability prioritisation, or logistics challenges; paired-sample comparisons of stated versus operational sustainability priority; or correlation analysis between technology adoption and perceived logistics efficiency) because the individual-level response data required to construct the necessary contingency tables and matched pairs were not retained beyond the initial descriptive analysis. As a result, the patterns reported in this Findings section, including the sustainability gap, should be interpreted as descriptive rather than statistically confirmed differences or associations; we do not claim statistical significance for these patterns. This constraint is acknowledged as a limitation in the Conclusion, and we recommend that future studies on this topic retain raw, individual-level response data specifically to enable chi-square testing across respondent categories (e.g., supply chain role, geographic location), paired-sample or Wilcoxon signed-rank comparisons of stated versus operational sustainability priority, and correlation analysis between technology adoption and logistics efficiency measures.

DISCUSSION

Globalisation and Supply Chain Dispersion

Over the last 30 years, the textile industry has undergone a transformation due to globalisation, with production shifting from high cost manufacturing centers in Europe and North America, to low cost regions centred in Asia, including China, Bangladesh, Vietnam and Cambodia (Vidrova, 2020). This migration has reduced unit costs of production and increased access to low-cost labour but has also dispersed supply chains across multiple regulatory, political and economic environments, each with their own compliance requirements, currency exposure and infrastructure constraints (McCarthy, 2016). From a Global Value Chain perspective, this dispersion increases the number of intermediaries that have to coordinate across jurisdictions and time zones, namely raw-material suppliers, fabric mills, garment manufacturers, freight forwarders and retailers, each with differing degrees of bargaining power within the chain (Cornell, Häyhä and Palm, 2024). The result is longer and less predictable lead times, more complex multimodal logistics and greater susceptibility to trade restrictions, tariff changes and geopolitical uncertainty, all of which increase the coordinating load on supply chain managers.

The survey data supports this theoretical picture: inventory management (34.7%), competitive pressure (29.7%) and transportation cost (25.7%) were the three leading logistics challenges, all plausible downstream consequences of a dispersed, multi-tiered production footprint (Tang, 2022). For companies that source raw materials in one place, manufacture in another and ship to a third, larger safety-stock buffers are required to smooth variability in transit time, increasing the cost of holding inventory and making demand forecasting

more difficult, particularly for fashion-oriented product lines with short selling seasons. Fast fashion merchants further strain this system by shortening design-to-shelf cycles, which squeeze the lead-time tolerance of an already globally stretched supply chain (Singh, 2023). Overall, the findings suggest that the logistics challenges reported by the surveyed Asian textile-supply-chain stakeholders shows that the result of operational inefficiencies at any one node, and more the structural consequence of globalisation itself. Thus, regionalisation, nearshoring and multi-sourcing are potential mitigating strategies that are worth further empirical investigation.

Technology Integration

Automation, data analytics and real-time tracking are changing the logistics management of textile companies, making transportation networks more efficient, improving production schedules and enabling inventories to be monitored in real-time (Duan 2020). Technologies such as radio-frequency identification (RFID), the Internet of Things (IoT), blockchain, and cloud-based logistics platforms are increasingly seen as enablers of end-to-end supply chain visibility, allowing companies to track shipments, verify provenance, and detect disruption earlier in the process (Wang et al., 2020). Specifically, the use of blockchain has been identified as a tool to address operational and reputational risk concurrently by increasing the traceability and fighting counterfeiting in fashion and textile value chains (Cuc, 2023). In a broader context, these technologies are part of the larger Industry 4.0 transformation, in which automation and data driven decision making are changing production and logistics operations across the manufacturing sectors, not only in textiles (Ghobakhloo, 2018).

Our survey results reaffirm this trend with the most popular shipment-monitoring technology being GPS tracking (41.6%) followed by IoT sensors and manual tracking (20.8%) and RFID (16.8%) with 70.3% of respondents saying the technology was either important or useful to their operations. It implies that the actors in the textile supply chain in the sample have gone considerably beyond a purely manual, paper-based approach to shipment tracking, even if the use of more sophisticated techniques such as RFID and blockchain is still relatively restricted compared to GPS. This pattern is consistent with broader literature showing that the adoption of frontier digital technologies in the textile industry tends to be slower than in other industries, partly because RFID tagging and blockchain integration require upfront capital investment, cooperation from suppliers and technical capacity that may not be possible for smaller firms or firms in less digitally mature markets (Gardetti and Muthu, 2023). Some 30% of respondents rated technology as having little or no impact on their operations, suggesting that the issue is not so much a question of scepticism about the value of digital instruments in principle, but rather the practical barriers – cost, integration complexity and workforce knowledge of technology – that limit their adoption in practice.

Sustainability and Ethical Considerations

The textile sector faces significant environmental impacts, from water- and chemical-intensive raw material extraction, to energy-intensive manufacturing and dyeing processes, to carbon-intensive global transportation (Patti, Cicala and Acierno, 2020), making sustainability a central concern. Firms are being encouraged to utilise more environmentally friendly materials such as organic cotton and recycled fibres. Circular economy methods such as reusing, recycling and upcycling are also being used. These practices are aimed at extending product lifespans and reducing landfill trash (Koszewska, 2018). The sustainability agenda also intersects with digital technologies: RFID tagging has been found to enable more efficient material tracking and waste reduction throughout the apparel supply chain, indicating that the technology and sustainability themes revealed in this study are not separate but reinforcing (Denuwara, Maijala and Hakovirta, 2019). The subject also has a parallel strand of ethical concerns regarding labour standards, with increasing consumer demand for transparency on sourcing and fair-labour certification that can be verified across the supplier networks (Köksal et al., 2017).

The poll statistics show a more complex picture than one of blanket industry commitment to sustainability. While 68.4% of respondents stated sustainability was a top or high priority, 21.8% said it received only passing mention and 9.9% said it was not a priority at all, indicating a meaningful minority of firms in the sample have yet to embed sustainability into core operational decision-making. This is further supported by the result that when asked to choose the single most significant logistics consideration, just 12.9% of respondents selected

environmentally friendly practices compared to 35.6% for cost effectiveness, 26.7% for supplier connections, and 24.8% for timely delivery. This discrepancy between stated and real priority is consistent with the wider circular economy literature, which has observed that the advancement of more sustainable textile supply chains is constrained not so much by ignorance or intent, but by the practical cost of recycling technology, the increased complexity of reverse-logistics infrastructure and the challenge of balancing sustainability investment with short-term cost and delivery pressures (Lawrence et al, 2023). Thus, sustainability seems to act in this sample as an aspirational priority, often taking a back seat to more immediate operational and commercial concerns – a tension that parallels debates in the wider sustainable supply chain management literature about the difficulty of operationalising sustainability commitments under competitive cost pressure (Kim, Colicchia and Menochof, 2016).

Supply Chain Resilience and Risk Management

The COVID-19 pandemic has demonstrated the need for resilient supply networks that can endure unexpected disruption. It revealed the vulnerability of firms that relied excessively on one manufacturing location, a small number of suppliers, or just-in-time inventory models with little buffer capacity (Su et al., 2022). Here, resilience consists of two related capabilities: short-term mitigation of risk, the ability to absorb and recover from acute shocks such as pandemics, port closures or geopolitical conflict and longer-term structural adaptation to slower-moving pressures such as the increasing frequency of climate-related disruption to agricultural raw-material supply and manufacturing infrastructure (Giannakis and Papadopoulos, 2015). The development of such a dual capability usually involves supplier diversification across multiple regions, stronger cross-network communication and information sharing, and more sophisticated risk assessment tools that can model the propagation of disruption thru a multi-tiered supply chain (Moktadir et al., 2020). Emerging analytical methodologies like as machine-learning-based decision-support systems for production and logistics optimisation are increasingly advocated as instruments to help enterprises in anticipating and responding to these risks in near real-time (He et al., 2020).

Although direct measures of firms' resilience strategies or disruption history were not captured in this study, survey findings provide indirect evidence of where vulnerabilities associated with resilience may be concentrated. The most frequently cited logistics challenge was inventory management, with distribution (31.7%) and production (30.7%) as the two areas most often cited as needing improvement — both functions closely tied to a firm's ability to absorb demand or supply shocks without service failure. From a resilience perspective, it is also worth noting that sustainable methods are given relatively low priority as a key logistics consideration (12.9%). Environmental risk, including the physical risk of climate-related disruption to raw-material-growing regions, is increasingly being considered in the literature as a resilience issue, rather than a purely ethical or reputational one. This may mean that enterprises in the sample are choosing near-term operational resilience (maintaining inventory flow and distribution capacity) above the longer-horizon structural resilience that sustainability-linked risk management is meant to give.

Logistics Optimisation

The industry is highly dependent on the timely transportation and distribution of goods within geographically dispersed production networks, and as such, logistics optimisation continues to be a priority, as transportation cost constitutes a significant and often volatile proportion of total supply chain expenditure (Majercak, 2020). Consistent with the survey results, the literature widely identifies improved route planning, real-time shipment tracking and optimised warehousing (including automated storage systems and just-in-time inventory management) as key levers for reducing cost and improving delivery reliability (Phupattarakit and Chutima, 2019). Collaborative logistics models that allow firms to share transportation capacity, warehousing infrastructure, or distribution networks with supply chain partners have also been put forward as a way to achieve economies of scale that individual firms, particularly smaller ones, would not be able to access on their own (Wadha, 2023).

Survey respondents identified inventory management as the single leading logistics challenge (34.7%), outranking competitive pressure and transportation cost. This reflects the practical difficulty of balancing supply and demand amid volatile fashion trends, seasonal demand swings, and price volatility in raw-material

markets such as cotton and synthetic fibres (Ahmed, 2021b). This finding is consistent with the broader literature that highlights the need for using sophisticated demand-forecasting tools and more detailed, SKU-level inventory analytics in logistics planning versus aggregate or historical demand trends that might not fully capture the volatility characteristic of fashion-driven product categories (Nucamendi-Guillén, Moreno and Mendoza, 2018). Nearly a third of the respondents (31.7%) also cited the distribution function as the area of the supply chain that most needs improvement, which, when considered together with the inventory management finding, implies that the real bottleneck for many of the firms surveyed is not so much in production capacity per se but rather in the downstream coordination of inventory, warehousing, and last-mile distribution once goods are ready to ship.

Collaboration and Stakeholder Engagement

The textile supply chain is fragmented and globally dispersed, and disruption at any single point – a delayed shipment, a quality failure, a missed production deadline – can cascade thru the entire network and impact downstream partners who had no direct role in causing it (Mahmood and Kess, 2023). Therefore, effective communication and coordination among manufacturers, suppliers, retailers, and logistics providers are crucial for the smooth functioning of the supply chain. The literature suggests a mechanism for improving quality control, shortening lead times and increasing the transparency required to support both technology adoption and sustainability initiatives throughout the supply chain in the form of strategic alliances and longer-term partnership models as opposed to purely transactional, price-driven supplier relationships (Dmitriev and Plastunyak, 2019). Such collaborative agreements also fit with the resource-based view's emphasis on the strategic importance of relationships and competencies that are difficult for competitors to reproduce rapidly (Oelze, 2017).

The survey statistics offer some qualified support for this position. Most respondents assessed supplier and manufacturer relationships as strong (26.7%) or adequate (45.5%), indicating that most organisations in the sample have functional, although not always spectacular, working ties throughout their supply chain. However, just under 28% assessed these partnerships as needing improvement or poor, suggesting collaboration gaps continue to be sufficiently common to be a substantial limitation on overall supply chain performance, rather than an isolated problem affecting a small minority of organisations. 26.7% of respondents cited supplier relationships as the most important logistics consideration (after cost effectiveness). This implies that working together and relationship management is an area where incremental improvement can plausibly lead to disproportionate gains in overall supply chain performance, especially given its interdependency with the inventory, technology and sustainability challenges also identified elsewhere in the findings.

Synthesis: Interdependence of the Six Themes

Read together, these six themes are not independent of one another but form an interlocking system in which globalisation creates the structural conditions — geographic dispersion, longer lead times, more intermediaries — that generate the coordination and inventory challenges reported by respondents; technology adoption offers a partial remedy to these coordination challenges but requires investment that not all firms can readily make; sustainability commitments compete for the same limited managerial and financial resources as cost and delivery priorities, and consequently tend to be subordinated to them under competitive pressure; resilience-building depends on the same supplier diversification and information-sharing capabilities that underpin effective collaboration; logistics optimisation is most effective when built on accurate, technology-enabled visibility into inventory and demand; and collaboration functions as the connective tissue that determines how effectively firms can translate technology investment and resilience planning into practical operational improvement. This interdependence suggests that piecemeal interventions that address a single theme in isolation – such as technology investment without a corresponding improvement in supplier collaboration, or sustainability commitments without integration into core cost and delivery planning – are less likely to deliver durable performance improvement than a more integrated strategy.

Implications for Practitioners and Policymakers

The findings suggest to industry practitioners the importance of a comprehensive strategy that combines technology investment, resilience building, sustainable sourcing and logistics optimisation as complementary rather than competing priorities. Firms that see these as separate, siloed initiatives are at risk of under-investing in the interdependencies identified above and falling behind competitors that adopt a more integrated approach in an increasingly competitive global market (Qorbani and Groesser, 2020). The survey's finding that inventory management and distribution are the most pressing operational challenges suggests that, for small and medium-sized firms with constrained technology budgets, practitioners may find the greatest near-term return on investment in demand-forecasting and inventory-visibility technology, rather than in more capital-intensive frontier technologies such as blockchain. Another relatively low cost lever that seems to have the ability to simultaneously increase operational performance and resilience is the strengthening of supplier and manufacturer relationships thru longer term partnership models in preference to merely transactional sourcing agreements.

For policymakers, the findings add support to the case for regulatory and incentive frameworks that promote ethical business conduct, sustainable environmental practice and investment in digital infrastructure, as well as international cooperation to tackle cross-border challenges such as labour exploitation and environmental degradation that no single firm or country can solve unilaterally (Ajila, 2021). But, considering that this gap exists between the stated importance of sustainability and its relatively low ranking as a critical day-to-day logistics consideration, policy interventions that reduce the practical cost of sustainable practice (e.g., subsidies for recycling infrastructure, tax incentives for verified sustainable sourcing, or shared regional investment in reverse-logistics networks) may be more effective in addressing this gap than awareness-based interventions alone. Likewise, the survey results suggest differences in technology adoption; policy support for shared digital infrastructure or technology platforms across a sector could help smaller firms access the visibility and traceability benefits associated with more advanced tracking technologies without incurring the full capital costs themselves (Humphreys et al., 2021).

Practical Implications by Stakeholder Group

While the preceding discussion addresses practitioners and policymakers broadly, the challenges and opportunities identified in this study differ by position in the supply chain. Table 4 disaggregates the key findings and their practical implications for five stakeholder groups represented in the sample: manufacturers, suppliers, distributors and logistics providers, retailers, and policymakers.

Stakeholder Group	Relevant Findings	Practical Implications
Manufacturers	Inventory management (34.7%) and distribution (31.7%) were the leading logistics challenges; GPS and IoT were the dominant tracking technologies; 68.4% rated sustainability a high/top priority, but only 12.9% treated it as the top operational consideration.	Prioritise demand-forecasting and inventory-visibility technology over more capital-intensive frontier technologies (e.g., blockchain) for near-term returns; integrate sustainability targets into cost and delivery planning rather than treating them as a separate initiative.
Suppliers	Supplier and manufacturer relationships were rated strong or adequate by most respondents, though just under 28% rated them as needing improvement or poor; supplier relationships were the second-most cited logistics priority (26.7%).	Move toward longer-term, collaborative partnership models rather than purely transactional sourcing agreements to strengthen both resilience and day-to-day coordination.

Distributors & Logistics Providers	Transport costs (25.7%) and competition (29.7%) were among the top-ranked logistics issues; GPS/IoT-based tracking was the most widely used visibility technology.	Continue investment in shipment-tracking technology to improve visibility; explore shared or regional investment in reverse-logistics infrastructure to ease the cost burden of sustainable practice.
Retailers	Product quality (34.7%) and on-time delivery (25.7%) were the dominant drivers of customer satisfaction; retail operations were identified by 19.8% of respondents as an area needing improvement.	Treat supply chain transparency and delivery reliability as retailer-facing differentiators; use the retailer's consumer-facing position to signal demand for sustainable sourcing further upstream in the chain.
Policymakers	A substantial gap was observed between stated sustainability priority (68.4%) and its operational ranking (12.9%), suggesting the constraint may be practical/financial rather than a lack of awareness.	Favour interventions that reduce the practical cost of sustainable practice (e.g., subsidies for recycling infrastructure, tax incentives for verified sustainable sourcing, shared regional reverse-logistics investment) over awareness-based campaigns alone; support shared digital infrastructure so smaller firms can access visibility/traceability technology; pursue cross-border cooperation on labour and environmental standards.

Table 4 Practical Implications by Stakeholder Group

CONCLUSION

The study sought to analyse the dynamics of Asian textile supply networks, with particular emphasis on logistics and supply chain management strategies. On multi-tiered coordination, results indicate that while many firms are working on optimised operations, lead-time management and storage and transportation inefficiencies remain important hurdles. This is in line with the survey's identification of inventory management and transportation cost as the main challenges (Sartal et al., 2020). The results show that there is a growing use of GPS tracking, IoT and RFID to increase shipment visibility, with varying degrees of technological acceptance among the respondents. Sustainability is also seen as vital yet operational concerns such as cost effectiveness, supplier relationships and timely delivery remain more dominant in logistics decision making.

These results have consequences for research and practice. From an academic perspective, the study provides an in-depth picture of the relationship between globalisation, technology and sustainability in textile supply chains and informs future research on supply chain innovation and resilience. In practice, the findings encourage the prioritisation of digitalisation, integrating sustainability into operational efficiency goals rather than alongside them, and building resilience thru supplier diversification and better supplier relationships (Majumdar, Shaw and Sinha, 2020).

Addressing the Study's Aims

This study set out to pursue five specific aims. First, in evaluating the effectiveness and efficiency of logistical processes in international textile supply chains, the findings show a generally favourable picture: 72.3% of respondents rated logistics performance as good or excellent, though inventory management, distribution and transportation cost remain persistent sources of inefficiency for a substantial minority. Second, in identifying key barriers and possibilities for supply chain management practice, the study highlights inventory management (34.7%), competitive pressure (29.7%) and transportation cost (25.7%) as the principal barriers, alongside supplier-relationship quality as a recurring enabler of better performance. Third, in comparing technological and logistical techniques across supply-chain segments, the findings show GPS tracking (41.6%) as the dominant shipment-visibility technology, followed by IoT sensors and manual tracking (20.8% each), with adoption patterns that plausibly vary by role and resource base, though this study's data do not

permit a statistically confirmed comparison across segments or regions (see Limitations). Fourth, in evaluating the influence of new technology and environmental initiatives on supply chain management, the study finds that most respondents consider technology critical or useful to their operations, and that sustainability is a stated priority for 68.4% of respondents — yet this same group ranks sustainable practice well behind cost, delivery and supplier relationships in day-to-day operational decisions, pointing to a gap between environmental intent and operational execution. Fifth, in providing insights to enhance logistics and supply chain procedures, the study's stakeholder-specific implications (Table 4) translate these findings into concrete priorities for manufacturers, suppliers, distributors and logistics providers, retailers, and policymakers.

Addressing the Research Questions

RQ1 asked what the principal logistics challenges are within textile supply chains. The evidence points to inventory management, competitive pressure and transportation cost as the three most commonly cited challenges, consistent with a globally dispersed, multi-tiered production footprint in which longer and less predictable lead times increase the burden of demand forecasting and safety-stock management. Theoretically, this supports the relevance of supply chain resilience theory and transaction cost economics to the Asian textile context: coordination costs rise, and the capacity to forecast and absorb disruption becomes more consequential, as supply chains lengthen and disperse.

RQ2 asked which technologies are most commonly used for supply-chain visibility and shipment tracking. GPS tracking was the most widely used technology, followed by IoT sensors and manual tracking in equal measure, with RFID least common. Most respondents rated technology as critical or useful to their operations. This is consistent with the resource-based view, in which visibility technology functions as a firm-specific capability that supports more agile, responsive operations, though the continued reliance on manual tracking by a fifth of respondents suggests that technology adoption remains uneven rather than universal across this sample.

RQ3 asked how textile supply-chain stakeholders perceive the importance of sustainability relative to operational efficiency. The study's central finding here is the gap between stated priority (68.4% rating sustainability a high or top priority) and operational prioritisation (only 12.9% rating it their most important logistics consideration, well behind cost efficiency, timely delivery and supplier relationships). Interpreted through sustainable supply chain theory and lean manufacturing theory, this gap is consistent with sustainability commitments that have not yet been fully integrated into day-to-day operational decision-making, where cost- and lead-time-minimising pressures continue to dominate.

RQ4 enquired about the areas of logistics and supply-chain operations that are seen as most in need of improvement. The most common issues were distribution and manufacturing, followed by procurement and retail operations, roughly corresponding to the challenges mentioned under RQ1. From a Global Value Chain viewpoint this means that the coordination load of a dispersed, multi-tier textile supply chain is most painfully felt at the downstream points when commodities physically travel between enterprises, rather than in manufacturing capacity itself.

Directions for Future Research

Building on these findings, future research could test several specific, falsifiable hypotheses that this study's cross-sectional, non-probability sample was not designed to evaluate:

H1: The gap between stated sustainability priority and operational prioritisation is larger for smaller firms than for larger firms, reflecting more limited slack resources to absorb the cost of sustainable practice.

H2: The sustainability–operational gap varies by geographic location within Asia, reflecting differences in regulatory pressure, infrastructure maturity, and market demand for sustainable products across countries.

H3: Technology adoption mediates the relationship between sustainability commitment and logistics performance — that is, firms with a stated sustainability commitment achieve better logistics outcomes only to the extent that this commitment is paired with investment in supporting technology.

H4: The strength of collaborative supply chain relationships (e.g., longer-term partnership models versus purely transactional sourcing) moderates the effect of technology investment on operational efficiency, such that technology investment yields larger efficiency gains in more collaborative relationships.

Testing H1 and H2 would require a probability sample stratified by firm size and country; testing H3 and H4 would require paired, firm-level measures of sustainability commitment, technology investment, relationship quality and logistics performance, collected and retained for inferential analysis. Beyond these hypotheses, longitudinal research tracking the impact of automation, blockchain and AI on supply chain resilience over time, comparative studies across geographic regions beyond Asia, and sectoral comparisons beyond textiles would each extend the generalisability of the patterns reported here.

An important constraint is the geographical concentration of the sample in Asia. The study examines topics pertinent to the Asian textile supply chains, however the conclusions cannot be taken for granted as representative of textile supply chain activities in other countries. Future study should use larger and regionally diverse samples including Europe, North America, Africa and Latin America. The technology focus may be more reflective of the practices of more digitally mature firms than those that are smaller or less technologically advanced. Future research should include longitudinal study of impact of automation, blockchain and AI on supply chain resilience, particularly in developing markets; further empirical evaluation of the real-world effectiveness of sustainability measures in various geographic and economic contexts; and comparative study of logistics and supply chain best practice in sectors beyond textiles. Several additional limitations should be noted. The study used a purposive, non-probability sample recruited primarily through LinkedIn and the author's professional network; while this approach was appropriate for reaching an internationally dispersed, specialised population, it means the sample is not statistically representative of the Asian textile supply-chain workforce as a whole, and findings should be interpreted as indicative rather than generalisable. The cross-sectional design captures attitudes and practices at a single point in time and cannot establish causality or capture how technology adoption, sustainability prioritisation, or logistics challenges evolve over time. All data were collected via self-report, which is subject to social desirability and recall bias, and no procedural or statistical remedies for common method variance were applied during survey design or analysis. The individual-level response data were not retained beyond the analysis period, which precluded inferential statistical testing (e.g., chi-square tests of association across respondent categories, paired comparisons of stated versus operational sustainability priority, or correlation analysis between technology adoption and perceived logistics efficiency) and prevents independent re-analysis or verification of the reported findings; future studies should retain raw response data to enable such analyses. Finally, firm-level characteristics such as company size and years in operation were not collected, limiting the ability to examine whether the patterns observed differ by organisational scale.

This study therefore offers an in-depth evidence-based discussion of the logistical, technological and sustainability-related issues facing the Asian textile supply chain and provides a foundation for those firms and policymakers seeking to develop more efficient, resilient and sustainable textile supply chains.

ETHICAL APPROVAL, CONFLICT OF INTEREST, AND DATA AVAILABILITY

Ethical Approval: This research obtained the informed consent of all survey participants, and confidentiality and anonymisation procedures were applied throughout data collection and analysis.

Conflict of Interest: The authors declare no conflict of interest.

Data Availability: The individual-level survey response data supporting this study were not retained beyond the analysis period and are therefore not available for external re-analysis or verification. This is acknowledged as a limitation of the study (see Conclusion).

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