

FROM MANUAL TO SMART: HOW LEVELS OF TECHNOLOGICAL ADOPTION INFLUENCE SUSTAINABLE OUTCOMES; THE CASE OF TEXTILE SMES

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ABSTRACT

This study investigates how sustainability standardisation impacts small and medium-scale textile manufacturers in Sri Lanka's export sector, with specific attention to the mediating role of technology in achieving social, environmental, and economic sustainability outcomes. In global textile supply chains, compliance with sustainability frameworks such as SMETA, SEDEX, and the Higg Index has become essential, yet SMEs frequently face compliance challenges due to resource limitations. Using a qualitative multiple-case study approach, three SMEs with different levels of technological adoption were examined through interviews and observations. The findings indicate a strong positive relationship between technology adoption and social as well as environmental sustainability, reflected in improvements in worker wellbeing, occupational safety, and waste reduction. Economic sustainability, however, demonstrated a plateau effect, where returns diminished beyond a certain point of technological investment. While technology was widely perceived as a transformative enabler, barriers such as capital constraints, limited leadership vision, and insufficient awareness restricted uptake. The study contributes to sustainability scholarship by extending prior research on large-scale manufacturers to SMEs in a developing economy context, providing nuanced insights into the dimension-specific effects of technology. Practically, the findings highlight the need for strategic and context-sensitive technological adoption, as well as leadership and policy support, to bridge the technology gap and help SMEs meet global sustainability expectations. Despite the study's limited number of cases, it offers an original perspective on the non-linear relationship between technology and sustainability in export-oriented SMEs.

Keywords: Sustainability Standardization, Technology Adoption, SME Textile Manufacturers, Sri Lankan Export Industry

Introduction

The textile and apparel industry is a cornerstone of Sri Lanka's export economy, contributing significantly to employment, foreign exchange earnings, and industrial growth (Fernando & Wah, 2021). With global buyers and consumers increasingly prioritising sustainable and ethical sourcing, compliance with environmental, social, and governance (ESG) standards has become indispensable. Frameworks such as SMETA, SEDEX, and the Higg Index have gained global recognition as benchmarks for sustainability (Muthu, 2014; Niinimäki et al., 2020), making them critical prerequisites for export competitiveness. However, the integration of these standards is particularly challenging for Small and Medium-scale Enterprises (SMEs). Requirements such as eco-friendly technologies, compliance audits, extensive documentation, and expanded staffing often create disproportionate financial and administrative burdens compared to larger firms (Ghadimi et al., 2020; Amran et al., 2019). For SMEs in developing economies, this can threaten operational viability.

At the same time, literature demonstrates that sustainability practices, when strategically adopted, can generate competitive advantages, enhance long-term resilience, reduce waste, and attract environmentally conscious buyers (Rodríguez-García et al., 2022; Jermstittiparsert, 2019). Moreover,

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investments in sustainability are shown to foster employee wellbeing and innovation, though the scaling of such practices is uneven across firm sizes (Abubakar et al., 2022; Chowdhury et al., 2021).

Existing research disproportionately focuses on large-scale manufacturers, with limited attention to SMEs, particularly in South Asian contexts where structural constraints are acute. More importantly, the question of how technology influences the ability of SMEs to meet global sustainability demands remains underexplored. Addressing this gap, this study investigates how varying levels of technological adoption shape SMEs' sustainability performance across social, environmental, and economic dimensions. Specifically, it asks; How does the level of technological adoption influence the sustainability standardisation performance of textile SMEs in Sri Lanka's export sector? By situating the analysis within sustainability and technology adoption literatures, the study contributes to a deeper understanding of how SMEs can strategically navigate compliance pressures while remaining competitive.

Methodology

This study employed a qualitative multiple-case study approach to explore the influence of technological adoption on sustainability standardisation among SMEs in Sri Lanka's textile sector. The case study design was selected for its strength in generating in-depth, context-rich insights and capturing the complexity of organisational change processes involving sustainability compliance (Yin, 2018; Baxter & Jack, 2008).

Case selection

Three SMEs were purposively selected to reflect distinct levels of technological maturity: one with minimal adoption, one with moderate integration, and one with advanced technological systems. Within each firm, three key informants were chosen through purposive sampling, based on their active involvement in sustainability-related decision-making and implementation (Patton, 2015).

Data collection

Data were collected between April and June 2025 via semi-structured interviews lasting 40–45 minutes. Interviews were conducted in English, either face-to-face or via secure online platforms, depending on availability. Informed consent was obtained, and all interviews were audio-recorded and transcribed verbatim to ensure authenticity (Kvale & Brinkmann, 2009).

The interview protocol was designed around five central themes: (1) perceived benefits of sustainability standardisation, (2) impacts on profitability, employee wellbeing, and continuity, (3) technologies adopted for sustainability, (4) role of technology in compliance, and (5) benefits and drawbacks of technology adoption across social, environmental, and economic domains. These themes were derived from existing literature linking sustainability compliance with organisational performance (Ghadimi et al., 2020; Rodríguez-García et al., 2022; Niimäki et al., 2020) and aligned with common sustainability reporting dimensions (Elkington, 1997; Global Reporting Initiative, 2016).

Data analysis

A thematic analysis framework was applied (Braun & Clarke, 2006). Inductive coding enabled the identification of patterns and emergent themes, which were refined through iterative cross-case comparison. Triangulation of perspectives across cases enhanced credibility (Creswell & Poth, 2018). Findings were then mapped against the technological maturity of each SME, enabling comparative analysis of sustainability outcomes.

Results and Discussion

The findings reveal a clear association between technological maturity and sustainability performance, particularly in the social and environmental domains.

Social and environmental sustainability

The high-tech SME demonstrated strong integration of automation, monitoring systems, and digital tools for safety, occupational health, and waste management. For example, IoT-enabled monitoring and digital health tracking reduced compliance risks, enabling smoother audit preparation. Participants emphasised that “the system is built for sustainability,” reflecting an embedded approach. The moderate-tech SME demonstrated partial progress, with semi-automation (e.g., digital attendance, energy-efficient machines) improving outcomes, yet human error and inconsistent application remained barriers. The low-tech SME was aware of sustainability needs but struggled with manual, resource-constrained processes, leading to gaps in compliance documentation and monitoring. These findings align with Rodríguez-García et al. (2022), who highlight that technological enablers reduce operational inconsistencies and enhance transparency, confirming that higher technological adoption creates structured and reliable sustainability performance.

Economic sustainability

The relationship between technology and economic sustainability was more complex. While cost savings and efficiency gains were observed across cases, returns diminished at higher levels of investment. The high-tech SME, despite advanced systems, reported ROI flattening, consistent with the diminishing returns theory (Brynjolfsson & Hitt, 2000). In contrast, the moderate-tech SME reported the highest perceived economic gains, as incremental investments yielded balanced benefits without excessive cost. The low-tech SME faced exclusion from sustainability-oriented markets, directly affecting profitability. Similar patterns have been noted by Chowdhury et al. (2021), who argue that SMEs often experience barriers to initial investment despite recognising long-term benefits.

Barriers and perceptions

Leadership attitudes and awareness emerged as pivotal in shaping adoption. While technology was unanimously regarded as a “game changer,” barriers included high capital costs, lack of vision, and uncertainty regarding suitable technologies. These challenges echo prior findings (Amran et al., 2019; Ghadimi et al., 2020), reinforcing the need for leadership and policy-level interventions.

Table 1: Comparative summary of sustainability outcomes across SMEs

SME	Technology Adoption Level	Social Sustainability	Environmental Sustainability	Economic Sustainability	Key Observations
SME A	Minimal	Limited, mostly manual	Low, unstructured	Low	Lacks systems for monitoring; aware but resource-constrained
SME B	Moderate	Improving through semi-automation	Moderate, partly digitized	Moderate to high	Best balance of cost vs. benefit; high motivation
SME C	High	Strong, system-integrated	High, digitally monitored	High (with plateau)	Strong compliance, but ROI flattening; high tech maintenance cost

Conclusion

This study demonstrates that technological adoption is a critical enabler of sustainability compliance among textile SMEs in Sri Lanka, particularly in social and environmental domains. Higher
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technological maturity ensured structured, transparent, and reliable compliance processes, while low adoption limited SMEs' ability to meet global sustainability expectations. Economically, however, the study highlights a saturation point where additional technological investments generated limited returns, supporting existing literature on diminishing returns (Brynjolfsson & Hitt, 2000).

The findings are consistent with Rodríguez-García et al. (2022) and Niinimäki et al. (2020), who highlight the transformative role of technology in sustainability, but also extend this knowledge by showing how SMEs in a developing economy experience dimension-specific outcome. The study's originality lies in its focus on SMEs, a sector often underrepresented in sustainability research, and its exploration of how different technological maturity levels affect compliance performance.

Limitations include the small number of cases, which constrains generalisability. Nonetheless, the in-depth insights provide valuable academic and practical contributions, particularly for policymakers and industry stakeholders aiming to bridge the technology gap. Implications suggest that while advanced technologies drive compliance, SMEs may achieve optimal outcomes by adopting targeted, cost-effective solutions rather than pursuing continuous technological escalation. Leadership engagement, capacity-building, and supportive policy frameworks remain essential for enabling SMEs to meet the increasingly stringent sustainability demands of global markets.

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