

From Labour-Intensive to Knowledge-Driven: Structural Upgrading of the Apparel Industry in Emerging Markets — Evidence from Sri Lanka

Niluka C. Algawatta*, B.E.A. Jayasekara†, L.M.F. Adams‡

Abstract

The rising pressure of digitalization, sustainability governance, and global value chain (GVC) restructuring is increasing the structural change of export-driven apparel sector in the case of emerging markets. The conventional labour-cost competitiveness is no longer a competitive advantage in the world of Industry 4.0 technologies, ESG-based buying expectations, and post-pandemic supply chain restructuring. This paper discusses the shift of the apparel sector of Sri Lanka, a country of labour-intensive cut- make- trim (CMT) manufacturing, to the knowledge-based, technologically enhanced and sustainability-based upgrading in the country. It is premised on structural transformation theory, GVC upgrading frameworks, and endogenous growth views and involves secondary-data review of peer-reviewed articles, institutional reports, and industry reports of 2018-2025. Indicates that four interconnected pathways of upgrading exist: (1) technology upgrading based on automation, digital integration, and data-oriented production system; (2) functional upgrading based on CMT to original design and brand production (ODM/OBM); (3) deepening of human capital through skills modernization and the improvement of absorptive capacity; and (4) upgrading based on sustainability through ESG compliance, green manufacturing, and circular production. These dimensions are value capturing and international competitive dimensions. Nonetheless, obstacles of capital, asymmetric digital preparedness of the SME, instability of infrastructure, and instability in the global demand moderate the velocity and inclusiveness of change. It adds a comprehensive upgrading model that consolidates technological, functional, human capital, and sustainability aspects into one model of structural transformation, also provides policy guidance to medium end emerging markets in the quest to enjoy sustained competitiveness in the more knowledge-based and sustainability regulated world production systems.

Keywords: structural transformation; global value chains; industry 4.0; apparel upgrading; ESG; sustainability; emerging markets; Sri Lanka.

* DBA Candidate, Lincoln University College, Malaysia

† Senior Lecturer, University of Sri Jayewardenepura, Sri Lanka

‡ Vice Chancellor, Institute of Knowledge Academia, Colombo, Sri Lanka

Introduction

Background

Export-oriented garment production has traditionally served as a form of labour-intensive industrialization into the international economic system of emerging economies (Gereffi, 1999; World Bank, 2020). The developing countries under the buyer-driven global value chains became part of the global markets mainly via cut make trim (CMT) assembly processes that took advantage of the low labour costs and preferential access to the market. This model allowed quick creation of jobs, foreign exchange earnings and establishment of industrial bases especially in South and southeast Asia. Nevertheless, labour-cost arbitrage as a long-term strategy of development has remained a subject of growing skepticism regarding the reality of technological disruption and the changing world governance forms.

Digital transformation, geopolitical fragmentation, sustainability regulation, and post-pandemic supply chain reorganization are all factors that are causing global production networks to be structurally reconfigured (World Trade Organization, 2022; UNCTAD, 2023). Technologies of Industry 4.0 automation, artificial intelligence, cloud-based enterprise systems, and predictive analytics are transforming the cost structure, productivity standards and criteria of suppliers. At the same time, emerging pressures of increased environmental, social, and governance (ESG) in developed markets are integrating the concept of sustainability compliance into the very nature of the global sourcing decision process. These changes indicate that cost-based to capability-based competition will happen whereby an increasing value capture depends on the intensity of knowledge, digital integration, and responsible production.

The apparel sector in Sri Lanka is a major example of this dynamic of change. The industry is the biggest contributor to merchant exports in the country and also provides more than 350,000 people with jobs, a significant part of whom are females (Central Bank of Sri Lanka, 2023). In addition to the macroeconomic role, the sector has also been instrumental in industrial dispersion in the region, participation of women in the labour force and also diversification of exports. However, with the decline in wage-based comparative advantage among small scale manufacturers like Bangladesh and Vietnam, the competitive forces have become heightened. Such competitors have the advantage of economies of scale, greater labour pools within the country and wide backward integration in the textile industry.

As a result, Sri Lanka is in a strategic junction. To remain competitive in exports, it is necessary to shift away to technological

modernization, functional differentiation, deepening human capital, and differentiation on sustainability. The conditions of the background, therefore, do not only indicate sectoral change, but rather a more expansive structural change that is necessitated by an ever more knowledge-based global production system.

Research Problem

Although digitalization, sustainability compliance, and export performance were considered individually in previous literature, very little scholarship has combined these forces into a framework of structural transformation, adopted to Sri Lanka. The lack of comprehension of the interaction between technological, functional, human capital and sustainability upgrading remains a theoretical and empirical gap in the context of Industry 4.0 and ESG governance pressure.

Research Objectives

This study aims to:

1. Determine visible monitoring ways in the apparel industry, in Sri Lanka.
2. Research the way Industry 4.0 and ESG pressures transform value capture.
3. Examine structural limitations to change.
4. Establish a coherent upgrading system in the emergent market apparel industries.

Research Questions

To address these objectives, the study is guided by the following research questions:

RQ1: What forms of technological, functional, human capital, and sustainability upgrading are observable in Sri Lanka's apparel industry?

RQ2: How do Industry 4.0 adoption and ESG compliance influence value capture and competitive positioning within global value chains?

RQ3: What structural constraints moderate the depth, speed, and inclusiveness of upgrading in a mid-cost emerging economy?

RQ4: How can these upgrading dimensions be conceptually integrated into a unified structural transformation framework applicable to emerging-market apparel sectors?

Literature Review and Theoretical Framework

Structural Transformation and Productivity

Modern structural transformation theory insists on increasing productivity in sectors by dint of technological deepening, diffusion of innovation, as well as capability accumulation instead of just reallocating sectors between agriculture and manufacturing (McMillan & Rodrik, 2011; World Bank, 2020). Although development economic accounts of classical developmental theory have understood structural transformation as mainly a process through which labour moves across industries with different levels of productivity, more modern scholarship has noted the role of qualitative upgrading in industries as a factor that drives long-term economic growth. The growth of productivity is now seen to be due to the extent of knowledge intensity, absorption of technology, effectiveness of institutions, and able development of firms.

The manufacturing-led development is still applicable in this view, but the competitiveness of manufacturing has changed. The emerging economies are not able to depend only on the advantage of labour costs to justify the growth of exports. Rather, the increased productivity should be based on the improvement of the technology, organizational learning and integration into more valuable components of the world production chains. Structural change therefore entails dynamic capability formation whereby organizations and industries increase absorptive capacity to embrace new technologies, enhance production processes and shift to more complicated work in global value chains.

This change is further supported by the endogenous growth theory that highlights human capital accumulation, innovation systems and knowledge spillovers in the continued growth of productivity. Industrial deepening focuses on investment in research and development, technical skills, digital infrastructure, and institutional coordination. Productivity, in this case, is not solely a matter of capital accumulation but of knowledge creation and diffusion both among firms and industries.

When applied to export-based garment sectors, structural transformation involves the development of low value assembly activities to technologically advanced, design-oriented, sustainability-based production systems. It is no longer seen as labour absorption but value addition, scale-based competitiveness but ability-based differentiation and cost-reduction but innovation-based growth. In turn, structural change in

the modern global economy is a multidimensional process where the productivity, accumulation of knowledge, and institutional upgrading are collectively defining the long-term industrial resilience and international competitiveness.

Global Value Chain Upgrading

The global value chain (GVC) literature offers a critical analytical perspective in the way of how firms and industries of emerging economies are incorporated in and move through global networks of production. GVC scholarship singled out four major types of upgrading that are process upgrading (enhancing production efficiency), product upgrading (producing more complex or of superior quality), functional upgrading (acquiring new and higher-value functions in the chain), and inter-sectoral upgrading (capabilities leveraging to enter new industries) (Gereffi et al., 2005). Such upgrade routes define the way companies may boost value capture in even buyer-led global markets like the apparel market.

Among them, the functional upgrading would be useful especially to the export-oriented apparel industries. The conventional cut make trim (CMT) model restricts the firms to low margin assembly business with low bargaining power since design, branding and market access are held by global customers. By moving towards original design manufacturing (ODM), where the company does product development and design activities, and then even more towards original brand manufacturing (OBM), where the company develops and markets its own brands, producers can capture value-added segments of the chain. Functional upgrading therefore indicates a change of production-based competition into knowledge and capability-based differentiation.

Nevertheless, the transformation within the GVCs is not automatic and predictable. The buyer-driven chains system can also limit the level of accessibility of suppliers to the strategic operations of the company, e.g., branding and retail distribution. The lead firms have ownership of intellectual property, market intelligence, and consumer relationships, and this can deny the possibility of redistributing value as much as possible. Therefore, the upgrading is only possible with the assistance of the firm-level investments, but also with the help of the institutions, the connection of the strategic policy, and the creation of the supporting capabilities, i.e., the logistics coordination, the compliance management, and the sustainability certification.

Recent studies in the GVC also indicate an increasing role of digital integration and sustainability governance in determining upgrading paths. Industry 4.0 technologies provide the opportunity to monitor production in real-time, have a transparent supply chain, and quickly

respond to market demand, which increases the possibilities of process and functional upgrading. At the same time, the ESG compliance is now integrated into the sourcing decisions, which essentially introduces new entry barriers and new differentiation opportunities. Upgrading, in this dynamic setting, is becoming more multidimensional, a combination of technological, organizational and sustainability capabilities.

GVC upgrading is therefore a strategic requirement as well as a structural challenge in the case of the emerging-market apparel industries such as Sri Lanka. The transition to the next level of CMT into more valuable functions needs to be accompanied by the coordinated investments in technology, skills, innovation systems, and institutional frameworks that can help them accumulate their capabilities on the long-term basis in the global controlled production networks.

Digital Manufacturing 4.0 and Industry

Industry 4.0 technologies such as artificial intelligence (AI), Internet of Things (IoT) systems, robotics, enterprise resource planning (ERP) integration, cloud computing, and predictive analytics are changing the competitiveness in the manufacturing industry, making it more responsive, more efficient in operations, and more visible of its supply chains (OECD, 2021; United Nations Industrial Development Organization, 2022). These technologies facilitate real time transmission of data throughout the system of production, automated decision making, forecasting demand and end to end traceability and decreases production lead times and enhances consistency in quality.

In the context of the export-oriented apparel production, digital manufacturing is a transition between the labour-intensive coordination and the data-based optimization. The intelligent production lines are fitted with sensor-based monitoring systems, which enable manufacturers to monitor the utilization of the machines, defect rate and the bottlenecks in the workflow in real time. Predictive maintenance systems also minimize downtimes and increase capital productivity, whereas AI-based demand analytics streamline alignment between production planning and buyer forecasts. ERP implementation and integration with supply chain management systems also enhance the coordination among the suppliers, manufacturers, and world purchasers so that these companies can respond to the fluctuating demand conditions.

Outside of efficiency improvements, Industry 4.0 adoption is associated with upgrading in the form of the improvement of absorptive capacity and organizational learning. Companies which invest in digital capabilities build up greater data management skills, analytic talents, and

cross-functional combination. This and similar capabilities facilitate process upgrading (improved cost and efficiency) and functional upgrading, since digital tools to design, virtual sampling technology, and 3D prototyping platforms make use of less external design intermediaries. Digitalization is, therefore, one of the processes of transitioning to greater knowledge-intensive operations within the value chain, as opposed to pure assembly operations.

Nevertheless, the digital revolution in the apparel industries in emerging markets is skewed. The expensive capital investment, inadequate access to long term finance, deficiency of skills to operate advanced analytics and automation engineering and the lack of stability in infrastructure, especially energy provision and digital connections, all limit its scale of adoption. SMEs are also susceptible to other limitations in terms of scale and lack of technological absorptive power. These limitations drive a two-tiered process of transformation whereby large export-oriented companies implement new sophisticated systems, and those that are smaller fall behind in the process.

Notably, sustainability governance also overlaps with Industry 4.0. Digital traceability tools improve compliance monitoring, carbon accounting, and transparency reporting in line with the technological upgrading in line with the ESG needs. With the growing demand of global buyers to have real-time visibility of the supply chain and verification of its sustainability, the digital capability is not only an instrument of productivity but also a strategic requirement to sustain market access. Therefore, Industry 4.0 adoptions act as a driver and an enabler of more comprehensive structural change in export-driven apparel sectors.

ESG and Sustainability Governance

Sustainability has shifted from voluntary corporate social responsibility initiatives to a strategic market necessity driven by tightening regulatory frameworks, mandatory disclosure regimes, and evolving buyer expectations in advanced economies (United Nations Conference on Trade and Development, 2023). ESG compliance increasingly determines market access, supplier selection, and long-term buyer retention within global value chains. Regulatory developments such as mandatory supply chain due diligence laws, carbon border adjustment mechanisms, and enhanced sustainability reporting standards have embedded environmental and social governance considerations directly into international trade architecture.

Within export-oriented apparel industries, ESG governance encompasses multiple dimensions: carbon footprint reduction, renewable

energy integration, water stewardship, waste minimization, circular production practices, labour standards compliance, gender equity, and transparent reporting. International buyers now require verifiable sustainability certifications, traceability documentation, and science-based emissions targets as preconditions for sourcing contracts. As a result, sustainability performance is no longer peripheral but central to competitive positioning.

From a GVC perspective, ESG requirements function as both barriers and upgrading catalysts. On one hand, compliance costs—investment in cleaner technologies, wastewater treatment systems, renewable energy infrastructure, and auditing mechanisms—raise entry thresholds, particularly for small and medium-sized firms. On the other hand, firms that successfully integrate sustainability practices can differentiate themselves in higher-value market segments, strengthen brand partnerships, and secure long-term contracts. Sustainability upgrading thus contributes to value capture by reinforcing reputation, risk mitigation, and resilience.

Moreover, ESG governance intersects with technological upgrading. Digital traceability systems, blockchain-enabled supply chain transparency, and automated environmental monitoring enhance the credibility and efficiency of compliance reporting. This integration reinforces the multidimensional nature of structural transformation, where technological capability, institutional alignment, and sustainability performance co-evolve.

For mid-cost emerging economies such as Sri Lanka, ESG integration presents both a strategic opportunity and a structural challenge. Firms positioned in ethically branded, sustainability-conscious market niches may leverage strong labour standards and renewable energy adoption as competitive advantages. However, uneven access to green finance, high energy costs, and limited policy coordination can moderate the speed and inclusiveness of sustainability-led upgrading. Consequently, ESG governance has become a decisive axis along which export competitiveness, industrial resilience, and long-term structural transformation are increasingly determined.

Conceptual Framework

The research hypothesizes a four-dimensional model of structural upgrading that theorizes structural transformation as a capability-based process and not a linear change in the production activities. In the first place, technological upgrading is the implementation of Industry 4.0

solutions, such as automation, digital integration, and data analytics that ensure productivity, traceability, and operational agility.

The study proposes a four-pillar upgrading model:

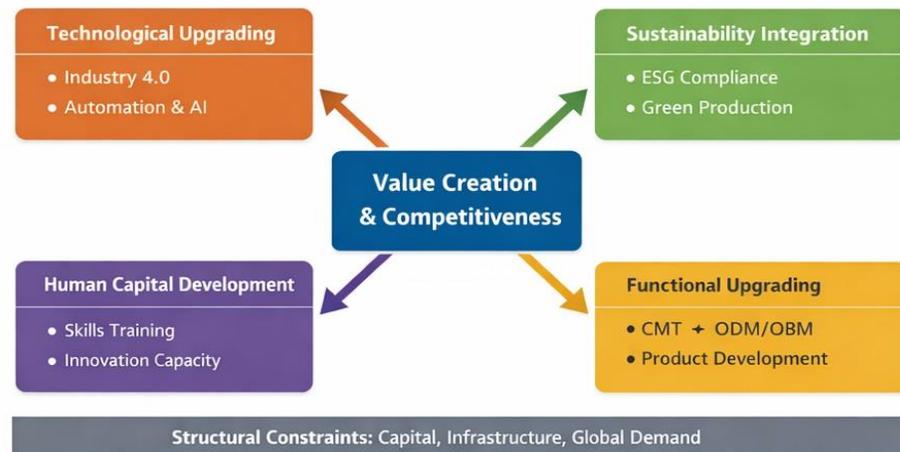
Upgrading Dimension	Mechanism	Value Outcome
Technological	Automation, ERP, AI	Productivity & speed
Functional	CMT → ODM/OBM	Higher margins
Human Capital	Skills & innovation	Absorptive capacity
Sustainability	ESG integration	Market differentiation

Second, functional upgrading depicts the transition between low-value cut make trim (CMT) assembly and original design manufacturing (ODM) and original brand manufacturing (OBM) and allows capturing more value and strategic flexibility of global value chains. Third, human capital deepening underlines skill improvement of the workforce, competence of management, and capacity to innovate as the precursors of technological absorption and functional repositioning. Fourth, the integration of sustainability is an indicator of the institutionalization of ESG compliance, green production systems, and open-minded governance practices that tend to shape access to the market and trust among buyers more and more.

These four dimensions are not independent ways but complementary ones. Such changes as technological adoption, human capital deepening, functional upgrading, and ESG integration strengthen sustainability monitoring and design capabilities, digital readiness and innovation, incentives towards sustainability branding, and long-term competitiveness. The consequences of structural transformation hinge thus on the concerted progression of all the four dimensions of upgrading of

the global value chain in a dynamic global context.

Structural Upgrading in the Apparel Industry



Explanation for Insertion

The framework explains that:

1. Industry 4.0 is a technological upgrading, which improves productivity and responsiveness.
2. Functional upgrading enhances value capture by moving away a stage of assembly (CMT) to design and branding (ODM/OBM).
3. Absorptive capacity and innovation capability is enhanced by human capital development.
4. Integrating sustainability facilitates differentiation in the global governance directed by ESG.

These four upgrading pillars together identify value creation and global competitiveness, and structural restraints moderate the transformation results.

Methodology

Research Design

Secondary empirical and policy evidence applicable in structural transformation in export-oriented apparel industries was synthesized using

a structured narrative review with systematic search characteristics. It has been chosen in order to allow theoretical integration of different sources such as peer-reviewed journal articles, multilateral development reports, industry publications, and policy documents without losing analytical transparency and replicability. The thematic coding protocols and preset search criteria, screening procedures, and thematic coding procedures prevented selection bias and high-level methodological rigor in contrast to a purely descriptive narrative review.

Literature published between 2018 and 2025 was considered in the review to reflect the current trends in the adoption of Industry 4.0, ESG governance reform, and global restructuring of the value chain. Peer-reviewed studies were detected by doing major academic databases (Scopus, Web of Science, and Google Scholar) and institutional sources (reports of multilateral organizations and national policy agencies) were also taken into consideration to supply the necessary context and statistical data. The keywords were the combinations of apparel industry with global value chain upgrading, Industry 4.0, digital manufacturing, ESG compliance, sustainability governance, and Sri Lanka.

Empirical studies, theoretical contributions and policy analysis were favored as inclusion criteria that have direct bearing on upgrading dynamics within emerging-market manufacturing sectors. Articles with insufficient transparency of methods or those that were not directly relevant to the dimensions of upgrading were not considered. The four research questions in Section 1.3 were used as thematic coding and analytical categorization. The evidence was systematized based on the four dimensions of upgrading structure of the study, namely, technological, functional, human capital, and sustainability integration, which provided an opportunity to compare the sources in a systematic way.

This study design will facilitate conceptual synthesis without an analytical coherence, as it will allow developing a comprehensive upgrading framework based on a modern empirical and policy evidence.

Data Collection

The secondary sources were the only sources of data collection to achieve breadth of coverage and analytical triangulation. The review has used several types of evidence to include theoretical, empirical, institutional and industry specific viewpoints used in structural change in the Sri Lankan apparel industry.

To begin with, peer-reviewed journal articles that were included in Scopus and the Web of Science were the main academic base of the research. These articles included the empirical results and theoretical

debates of the global value chain upgrading, Industry 4.0 implementation, ESG compliance, industrial policy and structural change in emerging economies. Preference was put on studies that utilized clear methodologies and were published in well-known journals on development studies, international business, operations management, and sustainability.

Second, there was inclusion of multilateral institutional reports to give macroeconomic and sectoral data. The Asian Development Bank and the International Labour Organization publications have been consulted to get regional productivity profiles, labour market evaluations and industrial upgrading profiles. These sources included comparative information among the emerging Asian manufacturing economies.

Third, both macroeconomic and sectoral indicators at the national level were obtained through the official publications of Central Bank of Sri Lanka. These comprised of the data on export performance, statistical data on employment, trends on investment, and industrial policy developments in the apparel industry.

Lastly, industry publications and sectoral reports between 2018 and 2025 were included to get the firm level trends, digital adoption trends, sustainability certification, and competitive positioning in global markets. This multi-source approach enhanced triangulation of data, the contextual accuracy and ensured that the analysis is based on the academic scholarship and actual industry trends.

Inclusion Criteria

In order to make the analysis relevant and methodologically sound, specific inclusion criteria were drawn down before the literature screening exercise. First, publications were limited to 2018-2025 to reflect the recent changes in the field of Industry 4.0 diffusion, ESG regulatory changes, post-pandemic restructuring of the supply chain and changes in the global value chain governance. This period represents the increased rate of digital transformation and sustainability regulation of export-oriented manufacturing industries.

Second, the chosen references had to reveal substantive coverage of at least one of the thematic areas as follows: (1) apparel or textile global value chains; (2) Industry 4.0 adoption and digital manufacturing in emerging economies; (3) ESG compliance, sustainability governance, or green industrial transformation; or (4) structural transformation dynamics in Sri Lanka or other similar mid-cost emerging markets. The literature that covered manufacturing upgrading on a more general level had to contain transferable conceptual or empirical information that could be applied to the transformation of the apparel sector.

Third, the sources had to be empirically, theoretically or policy relevant. Empirical research had to put forth well-defined methods and evidence-based results. Where they contained conceptual models or underpinning frameworks of upgrading, theoretical contributions were incorporated. Where the policy reports and the institutional publications provided valid statistical information, regulatory analysis, or sectoral performance indicators, they were incorporated.

Articles that were not based on methodological transparency, motivated by opinion but lacked an analytical basis, as well as those that were not related to the upgrading dynamics were discarded. The following criteria were used to make sure that the end evidence base was consistent, timely and directly relevant to the four-dimensional upgrading framework of the study.

Analytical Procedure

The analysis was based on a thematic synthesis stepwise procedure aimed at maintaining transparency and conceptual consistency. After the identification and subsequent screening of sources with the correct eligibility criteria, a deductive-inductive hybrid approach was used to review and code the full texts. The four upgrading pillars of technological upgrading, functional upgrading, human capital deepening, and sustainability integration that were exerted to deductive coding were based on the theoretical framework above in Section 2. Inductive coding also made other subthemes to arise out of the information especially on structural constraints, institutional enablers and external market pressures. The sources were all analyzed according to empirical data, policy-related data, or conceptual arguments that could help the research questions. The results were tabulated and classified in terms of upgrading dimension, evidence type (empirical study, policy report, industry data), and geographical relevance. This allowed making comparisons done systematically across a variety of sources and minimize the possibility of narrative bias.

To increase the strength of the analysis, cross-source triangulation was used. The comparisons of evidence were made between peer-reviewed journal articles and multilateral institutional reports, national statistics, and industries publications to establish common trends and rectify certain imbalances. When there were differences of interpretation, more prominence was attributed to empirically rigorous studies having transparent methodologies.

The Findings and Discussion sections were then prepared based on the synthesized findings, which were then grouped into themes

according to the research questions. This analytical stepwise process made sure that the conclusions were made based on evidences and not on opinion hence enhancing the credibility and replication of the research.

Findings

Technological Upgrading

Adoption of enterprise resource planning (ERP) systems, automated cutting technologies, AI-enabled demand forecasting tools, and digital production monitoring platforms is increasing among leading export-oriented apparel firms. These technologies enable real-time production tracking, inventory optimization, quality control integration, and improved coordination with international buyers. Advanced firms are integrating computer-aided design (CAD), 3D virtual sampling, and product lifecycle management systems to reduce sampling cycles and accelerate time-to-market. Such digital integration enhances responsiveness to volatile fashion demand and shortens lead times—critical factors in buyer-driven global value chains.

Technological upgrading has also strengthened data-driven decision-making capabilities. AI-based analytics support more accurate demand forecasting and production planning, reducing overproduction and excess inventory. Automated cutting and robotics-assisted material handling improve fabric utilization rates and minimize waste, contributing simultaneously to cost efficiency and sustainability goals. Digital production dashboards allow managers to monitor machine performance, defect rates, and workflow bottlenecks in real time, thereby improving operational productivity.

However, technological diffusion remains uneven across the sector. Large, export-oriented firms with established international buyer relationships demonstrate higher levels of digital integration, supported by greater access to capital, foreign partnerships, and managerial expertise. In contrast, small and medium-sized enterprises (SMEs) exhibit slower adoption due to financial constraints, limited economies of scale, and shortages of advanced technical skills. Infrastructure challenges—particularly energy reliability and high technology import costs—further moderate adoption capacity.

This dual-speed digital transformation creates structural differentiation within the industry. While technologically advanced firms move toward data-driven, agile manufacturing systems aligned with Industry 4.0 standards, smaller firms risk remaining confined to lower-productivity operations. Consequently, technological upgrading functions

both as a driver of competitiveness and as a source of intra-sectoral divergence, shaping the broader trajectory of structural transformation within Sri Lanka's apparel industry.

Technological Upgrading

Evidence shows increasing adoption of ERP systems, digital production monitoring, and AI-enabled forecasting (Abeyruwan et al., 2025; OECD, 2021).

Table 1: Digital Adoption Trends

Technology	Adoption Trend	Impact
ERP	High (large firms)	Supply chain visibility
AI forecasting	Moderate	Demand alignment
Robotics	Emerging	Labour productivity
Cloud SCM	Growing in SMEs	Coordination

Functional Upgrading

It has been shown that the apparel value chain is gradually evolving with Cut Make Trim (CMT) operations to Original Design Manufacturing (ODM). Within the CMT model, companies are mainly involved in labour intensive assembly of designs and specifications supplied by buyers which leads to low value capture and over reliance on buyers abroad. The shift to ODM is an extension of its capabilities to product development, sourcing fabric, sampling, and in-house design. This move indicates the improved technical expertise, improved supplier relations and the improved control of production planning and quality management.

Despite the fact that Original Brand Manufacturing (OBM) is in its inclement in the emerging economies, some level of initial development can be seen in individual companies that are investing in brand-building, digital marketing, and direct-to-consumer (DTC) channels. Manufacturers of major apparel producers in countries like Sri Lanka have started to

consider the need to niche brand, sustainability positioning and ethical fashion segments as a way of diversifying their reliance on foreign consumers. Equally, product makers in Bangladesh and Vietnam are slowly exploring the option of own labels and local growth of brands.

Functional upgrading also helps a lot in capturing of the margins as companies cease to engage in low-cost production to more value-added tasks like design innovations, material research, supply chain coordination and compliance management. Through vertical integration, companies augment their portion of aggregate worth in world value chains (GVCs). This boosts profit, builds resistance to price wars, and plays down the resistance to switching buyers.

In addition, renovation increases buyer bargaining. Companies that possess both design and product development resources can be replaced with more difficulty, and thus they are able to bargain prices, and contract terms over a longer period and engage in partnership relationships as opposed to transactional relationships. Strategic alliances with international brands enhance knowledge transfer, technological advances and spillovers of innovation, which lead to long-term competitiveness.

The functional upgrading also promotes:

- Investment into high-tech manufacturing (automation, digital pattern-making, demand forecasting based on AI).
- Design, merchandising and supply chain analytics skills development in the workforce.
- Adherence to environmental and social norms, reinforcing the entry to high quality markets.
- Expansion into performance wear, sustainable fabrics and technical apparel.

Development wise, functional upgrading encourages industrial deepening, improvement of the quality of employment, and diversification of exports in emerging economies. It also fits with the larger structural change agenda of moving firms in the labour-intensive production to knowledge based and capability-based manufacturing systems.

In general, although CMT to ODM change is gradually gaining momentum, the shift towards OBM is the next strategic frontier of the apparel companies aiming to be competitive in the long-term, create brand equity, and have more freedom in the global apparel value chain.

Table 2: Functional Upgrading

Shift observed from CMT toward ODM and limited OBM.

Model	Characteristics	Margin Potential
CMT	Assembly only	Low
ODM	Design + production	Medium–High
OBM	Branding + retail	High

Sustainability Integration

As a manufacturer of ethical products, Sri Lanka has been able to use its positioning based on ethical manufacturing to help distinguish itself in ESG-oriented markets, especially in Europe and North America, where consumers are becoming more focused on environmental, social and governance (ESG) compliance. The narrative of national branding of Garments without Guilt has enhanced the reputation of the nation in regard to responsible labour practices, compliance with the regulations and environmental conscious production systems. This niche allows Sri Lankan companies to enter the high-end market segments and establish long-term relationships with globally oriented sustainable brands.

There is increased investment in the adoption of renewable energy in major facilities in the manufacturing of apparel. Some large companies have built rooftop solar panels, biomass energy generators and energy-saving equipment to minimize the level of carbon intensity per garment made. These programs both reduce operating expenses in the long-term, and are consistent with carbon reduction goals by global buyers both in carbon frameworks like Science-Based Targets (SBTi) and net-zero agreements. Emissions performance is also being monitored more and more using energy management systems and real-time monitoring technologies to improve reporting transparency.

The water stewardship is also a key pillar of integration of sustainability. Clothing processing and especially the dyeing and finishing processes consume significant amounts of water hence the adoption of wastewater treatment facilities and water recycling equipment and zero-

liquid discharge facilities by the firms. There are closed-loop water management practices that are being applied with the intention of lessening freshwater extraction and reducing the impact on the environment. Adherence to international standards like ISO 14001 certifications, OEKO-TEX certifications are also other standards that enhance credibility in the global markets.

Moreover, there are the circular models of production that are slowly appearing. To curb landfill dependence, manufacturers are considering recycling of fabric waste, upcycling of waste, and collaborating with textile recovery organizations. Certain companies are testing take back initiatives and introducing recycled polyester, organic cotton and biodegradable material into their product lines. Passports and traceability technologies for digital products are also under trial to increase the level of supply chain transparency.

In terms of social sustainability, the Sri Lankan clothing companies focus on:

- Fair working conditions and gender.
- Constant skills improvement and leadership education.
- Activities in communities and creation of jobs in the countryside.
- International labour standards (ILO conventions).

Risk management has also been enhanced due to sustainability integration. Companies that take the initiative to implement ESG models are in a better place to resist changes in regulations, carbon border adjustment policies and evolving consumer demands. Compliance has ceased to be optional in ESG-sensitive markets because it is now a precondition to access the market.

However, challenges remain. Smaller firms may be curtailed by the high start-up costs of renewable technologies, lack of access to green funding and the necessity of ongoing technological modernization. These drawbacks notwithstanding, industry-wide cooperation, the government-business relationships, and export-based policy promote sustainability faster.

In sum, sustainability integration in the apparel industry in Sri Lanka is gradually changing to be compliance-oriented practices as opposed to being strategic value-creating practices. Integrating environmental stewardship, social responsibility and governance transparency in the primary activities, enables the sector to improve competitiveness, build brand recognition and help in industrial sustainability over short and long terms in the global apparel value chain.

Human Capital Development

The development of human capital has emerged as a strategic issue in the apparel industry where companies have noticed that long-term competitiveness relies not just on the cost-effectiveness, but also on the intensity of knowledge and the ability to be innovative. Absorptive capacity is being reinforced by corporate academies, vocational reforms and digital literacy programs, which allow firms to internalize new technologies, meet the needs of international buyers, and execute process innovations in a better way.

In Sri Lanka, the main manufacturers of apparel have opened their own training institutions with disciplines in technical skills, lean manufacturing, industrial engineering, compliance management, and leadership. These business schools offer designed career opportunities, and therefore, enhance employee retention and succession planning. Digital skills in training modules are becoming more common, like ERP systems, 3D design software, and real-time monitoring tools of production.

Partnership with national organizations like Sri Lanka institute of Textile and Apparel and Tertiary and Vocational Education Commission have helped in modernizing the curriculum. Vocational reforms focus on competency-based training which is in line with industry standards; and it fills the gap between the academic output and the factory level of skills. Apprenticeship programs have also been extended through activities of public-private partnerships which offer a systematic exposure in a workplace to young people joining the manufacturing industry.

The importance of digital literacy initiatives especially in the industry 4.0 implementation is huge. Data interpretation, digital pattern-making, automated cutting systems, and supply chain analytics training increases the absorptive capacity of firms, or the capacity to identify, absorb, and use new knowledge. As the apparel companies develop automation, robotics, and artificial intelligence-based demand projections, the employees will be required to move away their strictly operational mobilizations to supervisory and analytical one that is technology-enhanced.

Irrespective of these developments, skills gaps are still obvious in high demand segments like:

- Machine learning and artificial intelligence in optimization of production.
- Forecasting and inventory management data analytics.
- High level automation maintenance and robotics programming.

- Digital supply chain and cybersecurity.
- Green materials engineering and environmental analysis.

These loopholes indicate more structural issues of emerging economies such as lack of STEM specialization pipelines and research connections between industry and the university. Increasing the intensity of cooperation between universities, research centers, and manufacturing companies is thus important in promoting innovation environments. Incorporating applied research projects, internships at the industry level and DBA-level practitioner research may also contribute to knowledge transfer and problem-solving ability at the firm level.

There are also enhanced improvements in labour productivity, quality consistency and outcomes of innovation because of the human capital development. Employees with better skills are in a better position to undertake functional upgrading (ODM and later OBM), assist in sustainability reporting demands and in dealing with complicated buyer relationship. In addition, middle management skills needed in strategic decision-making and change management are developed in leadership development programs.

Developmentally, human capital investment fosters inclusive development through the creation of higher wage employment opportunities, and lessening the exposure to cheaper production by other emerging markets. With the gradual transformation of labour demand in a more automated way, constant up and reskill programs will be needed as the means of eliminating structural unemployment and ensuring social stability.

In general, to ensure the long-term sustainability and international competitiveness of the apparel industry in Sri Lanka and similar new-business economies, continuous investment in innovative digital, analytical, and other technological skills will be the key to the success of the sector despite the introduction of corporate academies and vocational reforms that enhanced the absorption capacity of the sector.

Structural Constraints

Although functional upgrading, sustainability integration and human capital development have increased significantly, there are still a number of structural limitations, which tend to fractionalize the rate and extent of change in the apparel industry. These limits determine the strategic decisions of firms and the competitiveness of the industry at large in the emerging economies.

The issue of lack of capital by SMEs is one of the most critical barriers. The small and medium-sized enterprises (SMEs) as a significant part of the apparel value chain (especially in the field of subcontracting and ancillary services) most frequently have poor access to cheap long-term funding. The lack of investments in automation, renewable energy systems and product development capabilities by high interest rates, collateral and currency volatility. In Sri Lanka, monetary tightening after the crisis further restrained credit growth which was disproportionately impacting smaller firms which have no diversified sources of funding. Consequently, the modernization process is highly focused in one big vertically integrated manufacturer, increasing the discrepancy of capabilities in the industry.

The most notable intense infrastructure instability, especially energy fluctuation in the 2022/2023 economic crises greatly affected production continuity. The interruptions in power supply, fuel crises, and rising electricity fees added to uncertainty in operations and production expenses. Processes that consumed a lot of energy like dyeing and finishing were mainly influenced. Even though companies have since hastened their investments on solar and other energy systems, the reliability of infrastructure is a moderating factor affecting productivity and export performance. Inefficiencies in logistics such as port congestions, freight cost volatility and shipping delays have also affected lead times which are important in fast-fashion supply chains.

Sectoral agility is also restricted by regulatory bottlenecks. The complicated customs processes, the latency in acquiring VAT refunds, restrictions on importation of raw materials, and duplication of compliance procedures augment the cost of transactions. The investor confidence can be undermined by the inconsistency of the policy and the impulsive alterations of the regulations that will not stimulate the long-term capital commitment of the investors. Ease of doing business and competitiveness in export trade requires simplification of trade facilitation procedures and digitalization of customs systems, as well as regulatory predictability.

Demand shrink in major export markets at the international level has been an added burden. Sluggish economic growths in the key consumer economies such as the United States and the European Union have minimized orders of apparel resulting into overcapacity and price pressure. The state of inflation and the changing consumer expenditure habits to necessities have further depressed the demand of apparel. This has further led to heightened cost bargaining, decreased order times and diversified sourcing locations that have augmented competitive pressures on the producers located in the emerging economies.

Other structural constraints are:

- Volatility of exchange rate that impacts on the cost of imports of fabrics and accessories.
- Reliance on foreign raw material, backward linkage is not well developed.
- Small scale domestic textile production, decreasing supply chain integration.
- Geopolitical risks such as trade disputes and changing tariff systems.
- Disruptions caused by climate changes, which affect the reliability of the supply chain.

All these moderating factors have an impact on the rate of structural change in the apparel industry. Although diversification, sustainability positioning, and upgrading of technology have proven to be resilience measures by leading firms, systemic constraints demand coordinated policy actions. The key to reducing these limitations of structure is public-private partnerships, better access to green and development finance, modernization of infrastructure and regulatory reform.

In general, it is important to address these limitations to achieve sustainable competitiveness, industry-wide upgrade inclusivity, and industry sustainability through greater resiliency of the apparel industry in the global value chains.

Discussion

The results indicate that transformation in mid-cost economies in terms of structural upgrading necessitates coordinated technological, functional, and institutional change. Single-time enhancements, e.g. automation without skill development, or sustainability compliance without design capability, are not sufficient to generate long-lasting competitive advantage. Rather it will be necessary to upgrade in the form of a synchronized change in the production systems, human capital, governance systems, and the positioning of the market.

The mid-cost economies like Sri Lanka cannot sustain their competition on wage differentials with the lower cost producers like Bangladesh. Bangladesh enjoys a high level of cluster production, lower costs of labour and high level of backward integration in the textile industry, thus allowing economies of scale in the mass-market segments.

Competition based on cost would mainly be a squeegee battle, decline innovation and put the firms in the low value CMT business.

Rather, the alternative channel is provided by differentiation based on digital agility and ESG compliance. The technical approach of digital nimbleness, which is demonstrated by real-time monitoring of production, demand forecasting powered by AI, 3D prototyping, and ERP systems can be used to achieve shorter lead times, customization, and greater responsiveness to the erratic business environment. This feature is especially useful in fast-fashion and near-shoring models in which speed-to-market is paramount.

At the same time, the sustainability leadership and ESG compliance are reputational assets in cash-intensive markets. The European Union and the United States have seen a growing trend of environmental and social performance measures being incorporated in the supplier selection criteria by buyers. Carbon transparency, water stewardship, ethical labour practices and traceability system are no longer optional practices but an absolute necessity. In this regard, sustainability integration does not simply play the role of compliance, but as strategic positioning in the market.

The case of Sri Lanka affirms endogenous growth views, which holds the view that long-term productivity increases are founded on knowledge accumulations, innovation and human capital accumulations other than mere labour expansions. In line with the endogenous growth theory, the enhancement of the productivity of the apparel industry is associated with the investments in the adoption of technologies, development of the skills, the sophistication of the management, and cooperation between the research and the industry. The move away of labour-intensive assembly to knowledge-intensive production is an indication of the shift in structure between a factor-intensive growth and an efficiency and innovation-intensive growth.

Further, the results suggest that path-dependency of structural upgrading exists. The past investments in compliance culture, workforce training, and institutional coordination have established thalassizational capabilities that enable further upgrading. This is in line with the evolutionary economic theory in which learning effects and institutional embeddedness determine future competitive paths.

Nevertheless, modernization still is not even among firms of all sizes. Big vertically integrated companies have more absorptive capacity and financial strength whereas SMEs have capital and technological limitations. The benefits of upgrading can be concentrated without the targeted policy measures, including concessional financing, innovation

grants and cluster-based knowledge diffusion without the benefit extending to inclusive industrial development.

Strategically, the mid-cost economies should thus strive to accomplish:

- a) Greater industry-university partnership to enhance applied research and digital transformation.
- b) Policy consistency to minimize regulatory lineups and trade facilitation.
- c) Both, tax relief incentivized green investments and blended finance.

Diversification of market on a regional level in order to address a decline in demand in the conventional export markets.

To sum up, it is indicated that the sustainable competitiveness of mid-cost apparel economies is not based on the wage suppression but that it is achieved by integrated capacity building. The case of Sri Lanka demonstrates how an organized change in technology, functions, and institutional change can realign an industry in the global value chains. The long-term productivity increase is pegged on knowledge gathering, the level of innovation, and sustainability leadership- the characteristics of the endogenous growth processes in the emerging industrial environments.

Contribution to Knowledge

This paper has a number of theoretical, empirical and policy-oriented contributions to the body of literature on industrial upgrading and competitiveness in emerging markets.

1. An Integrated Framework of Upgrading.

To begin with, the analysis constructs a framework of upgrading synthesizing the Global Value Chain (GVC) theory, industry 4.0 transformation, and ESG governance into an analytical framework. Although conventional GVC literature mainly focuses on functional upgrading (CMT → ODM → OBM), the framework is expanded by this study adding:

Technological upgrading (digitalization, automation, integration of AI),

Sustainability improving (environmental custodianship, social oversight, corporate transparency),

Policies (aligning the institution, regulatory facilitation, skills ecosystems).

The combination of all these dimensions makes the framework go beyond linear upgrading paths and theorizes transformation as a multi-layered, co-evolutionary process. This will help to fill the gap between the traditional GVC literature and the present-day Industry 4.0 discourse in order to position ESG compliance not as an external factor but as a strategically integrated variable of value chain dynamics.

2. Synthetic Empirical Results of Sri Lanka as a Mid-Tier Upgrading Model.

Secondly, the paper offers an empirical synthesis of Sri Lanka as a mid-level upgrading model in the world apparel industry. The literature pays much attention to either a low-cost mass producer like Bangladesh or a high-value fashion economy located in developed markets. The study is a gap in research because it examines a mid-cost economy that can no longer compete simply on wage benefits but has managed to exploit:

- Positioning of ethical manufacturing,
- Digital adoption,
- Institutional coordination,
- Human capital development,
- Functional upgrading in selective fashion.

The case of Sri Lanka shows how smaller emerging economies can re-align themselves in global value chain by differentiation in lieu of scale. It thus adds a subtle paradigm of capability-based competitiveness, which can be used to provide comparative ideas to other middle level-apparel exporters like Vietnam and Indonesia.

3. Theoretical Explanation of sustainability as a Value-Creation Process.

Third, the research takes a step forward in enhancing conceptual clarity, transforming sustainability into a compliance requirement to a value-creation process. The current bodies of research tend to view ESG standards as an expense imposed by either customers or the regulator. On the contrary, this paper illustrates that sustainability integration:

- Increases brand differentiation,
- Increases buyer confidence and long-term contracts,
- Efforts operational efficiency (energy, water, waste reduction),

- Minimizes regulatory and reputational risks,
- Allows the premium ESG sensitive markets.

Sustainability, therefore, is a strategic than a reactive enhancement. The reconceptualization makes a contribution to the industrial policy discussion, as well as strategic management theory, in that it establishes ESG governance as an endogenous growth variable in an export-based manufacturing system.

4. Policy Implications to Apparel Competitiveness in the Emerging Markets.

Policy implications to emergent-market apparel competitiveness are also generated in the study. The results indicate that governments ought to:

- a) Encourage blended finance systems to finance SME technological upgrading.
- b) Tax credit and concessional lending should be used as a way of incentivizing the use of renewable energy.
- c) Intensify industry-university connections to bridge AI and data analytics skills gap.
- d) Automate trade and digitize customs in order to lower the cost of transactions.
- e) Promote the innovation ecosystems at clusters to speed up the knowledge diffusion.

In lieu of wage suppression or currency depreciation to maintain export competitiveness, the policymakers should focus on productivity-enhancing investments and institutional coherence.

Limitations and Future research

In spite of its efforts, this research has various limitations that are worth considering. To start with, the analysis is based mainly on the secondary sources of data such as policy reports, industry publications and previous empirical research. Although these sources offer some valuable information on a macro-level, they might not grant granularity and real-time data of the operations of a firm. Second, the lack of quantitative modelling at the level of the firms prevents the possibility to test the causal relationships between the upgrading strategies and the performance outcomes. This makes the study very analytical and interpretive as opposed to econometrically validated. Third, the study fails to include primary data of industry players; manufacturers, exporters, policymakers

and technology providers, which could limit the contextual depth. Fourth, heterogeneity in sectors in the apparel and manufacturing environment in Sri Lanka is not exhaustively represented, especially differences between large export-oriented and small and medium-sized enterprises (SMEs). Lastly, macroeconomic external shocks, e.g. exchange rate fluctuations, world demand changes and geopolitical reorientation of trade are conceptually discussed though not empirically modelled.

With these shortcomings, there are a number of potential research opportunities in the future.

1. Analysis of Productivity in Panel-Data.

Future research ought to engage longitudinal firm-level panel-data productivity analysis of firm-level data. Using the fixed-effects or random-effects models, the researchers will have the opportunity to study the impact of technological upgrading, use of workforce skills, and compliance with environmental, social, and good governance (ESG) on the total factor productivity (TFP) in the long-term. Causal effects and endogeneity could be further isolated using a dynamic panel estimation (e.g., GMM estimation). This modelling would give statistically significant evidence connecting the strategies of upgrading with the export competitiveness and profitability.

2. ESG Return Elasticity Modelling.

With the shift in environmental, social and governance (ESG) factors to center stage of global supply chains, it is suggested that future studies must quantitatively simulate ESG-return elasticity. This includes determining the effects of marginal changes in the performance of the ESG on the financial performance in the form of the return on assets (ROA), the return on equity (ROE), the export margins, and market valuation. Multi-level regression frameworks or structural equation modelling (SEM) may be useful in establishing whether ESG investments in emerging markets such as Sri Lanka will yield quantifiable economic returns.

3. Comparison of Cross-Country Analysis.

A comparison of Sri Lanka, Vietnam, and Bangladesh would offer some information of regional value. Such studies may test variations in industrial policy models, inward FDI, labour productivity, digital preparedness, and sustainability preparedness. Cross-country

benchmarking model would explain structural benefits and policy weakness to enable Sri Lanka fit better in the global value chains.

4. SME Digital Adoption Determinants.

The factors that determine adoption of digital technology by SMEs should also be investigated in future. The capital access, managerial capability, digital literacy, presence of infrastructure, government incentives and perceived risk are all variables that may have a tremendous impact on decisions to adopt. A mixed methodology, i.e. survey based quantitative modelling as well as qualitative interviews would produce more information on the behavioral, institutional, and financial constraints to digital transformation in SMEs.

5. Policymaking and Policy Review Research.

Future studies may evaluate the usefulness of industrial upgrading policies and export incentives with the help of the impact evaluation methods of difference-in-differences (DiD) or propensity score matching. This would assist it in determining whether there would be productive and sustainable gains through the intervention by the people.

6. Big Data and Real-Time Analytics.

With the increased role of the digital transformation, big data analytics and machine learning methods may be integrated into the future workforce to predict the demand, supply chains optimization, and policy simulations. The predictive modelling would supplement the strategic decisions with the firm-level data sets.

To summarize, future research agenda should go beyond descriptive and thematic analysis to hard empirical modelling and cross-country benchmarking and mixed methods studies. These would enhance the value of theoretical contribution and give a better policy and managerial implication of industrial upgrading and sustainable competitiveness in Sri Lanka and other emerging economies.

Conclusion

The apparel sector in Sri Lanka is experiencing a multi-dimensional and intricate process of structural modernization that is conditioned by the twin forces of transformation in Industry 4.0 and an increasingly demanding ESG compliance mandate in the global value chain. Traditionally laid in the assembly industry, which is an intensive

labour-based industry, the industry increasingly relocates to more value-added, technology-infused and knowledge-based production models. The trend is driven by both a need and a strategic vision since global customers are growing more conscious of speed-to-market, transparency, traceability, ethical sourcing, and carbon responsibility.

The shift between cost-based competitiveness to the capability-based competitiveness is still a lopsided movement among firms. Big export-oriented producers have more acceptance of the ERP integration, automated cutting, artificial intelligence-enhanced demand forecasting, and real-time monitoring of production, but numerous SMEs have limited financial, technological, and management resources. This deviation forms a two-tiered industry where technology leaders co-exist with companies that are unable to keep up. This gap thus becomes the major concern in ensuring inclusive sectoral upgrading as opposed to chosen modernization.

The case of Sri Lanka explains the larger dilemma of the emerging-market producers who want to redefine themselves in the global apparel supply chains dominated by the highly competitive economies like Vietnam and Bangladesh. Although Sri Lanka has reputational advantages in the areas of ethical manufacturing and sustainability branding, the sustainability of that competitive niche and its further growth presuppose the ongoing investment in the innovation ecosystem, the workforce competence and organizational alignment.

There are four pillars of sustained competitiveness. First, the integrated industrial policy support should be able to synchronize trade policy, technology incentives, and sustainability regulation. Second, smart manufacturing requires a well-developed digital infrastructure investment, such as cloud computing, cybersecurity capability, and interoperable manufacturing platforms. Third, the advancement of human capital in terms of technical education, development of digital literacy, and management skills is essential in adopting the advanced technologies. Fourth, alignment of sustainability governance to international ESG standards will guarantee further access to high value markets and compliance-based buyer relations.

The results of this paper highlight the fact that knowledge-intensive change is not just a technological change but a transformative change of the production logic in the structure of the organizational culture and value capture structures. Companies integrating data analytics, design abilities, coordination of the supply chain, and sustainability reporting in their fundamental strategy have a higher chance of attaining long-term resiliency. Conversely, companies stuck in low-value assembly face the

threat of competitive depreciation in a more automated and sustainable global community.

Finally, the future of the apparel industry in Sri Lanka will be determined by how it will incorporate technological upgrading and social responsibility and environmental stewardship. As a middle way between innovation, inclusiveness and institutional coherence, it will be the ability to change efficiently-based development into innovation-driven industrial development that will decide whether the sector will come out as a winner or a loser. Here, knowledge-intensive upgrading is the core tool that will be used to advance productivity, become better positioned globally and capture values at a long-term basis in emerging-market clothing industries.

References

- Abeyruwan, N. Y., Weerasuriya, G. D. H. N., Wijesekara, J. H. T., Amarasekera, M. A. B., Wisenthige, K., & Rajapakse, V. (2025). Digitalization, export market orientation and export performance in Sri Lanka's apparel industry. *Journal of Emerging Market Studies*, 6(1), 45–60.
- ADB. (2021). *Asia SME monitor 2021*. Asian Development Bank.
- ADB. (2023). *South Asia economic focus 2023*. Asian Development Bank.
- Asian Development Bank. (2022). *Asian development outlook 2022: Economic recovery in Asia and the Pacific*. ADB.
- Baldwin, R. (2016). *The great convergence: Information technology and the new globalization*. Harvard University Press.
- Banga, K. (2019). *Digitalization and developing countries*. ODI Working Paper.
- Central Bank of Sri Lanka. (2023). *Annual report 2023*. CBSL.
- European Commission. (2023). *GSP+ monitoring report 2023*. European Union.
- Freeman, C., & Soete, L. (1997). *The economics of industrial innovation*. MIT Press.
- Gereffi, G. (1999). International trade and industrial upgrading in the apparel commodity chain. *Journal of International Economics*, 48(1), 37–70.
- Gereffi, G. (2018). *Global value chains and development*. Cambridge University Press.
- Gereffi, G., Humphrey, J., & Sturgeon, T. (2005). The governance of global value chains. *Review of International Political Economy*, 12(1), 78–104.
- Goonawardena, E. D. M. A. A., Surangi, H. A. K. N. S., & Ranwala, R. (2023). Impact of digital transformation on SMEs performance in

- Sri Lankan apparel sector. *South Asian Business Review*, 5(2), 88–104.
- Hallward-Driemeier, M., & Nayyar, G. (2018). *Trouble in the making? The future of manufacturing-led development*. World Bank.
- Humphrey, J., & Schmitz, H. (2002). How does insertion in global value chains affect upgrading in industrial clusters? *Regional Studies*, 36(9), 1017–1027.
- ILO. (2022). *Skills for a greener future*. International Labour Organization.
- IMF. (2023). *Sri Lanka country report 2023*. International Monetary Fund.
- International Labour Organization. (2021). *The future of work in the textiles, clothing, leather and footwear sector*. ILO.
- Kaplinsky, R., & Morris, M. (2001). *A handbook for value chain research*. IDRC.
- Kudamanna, L. (2025). Supply chain digitalization and performance in Sri Lankan apparel sector. *Journal of Supply Chain Innovation*, 3(1), 22–39.
- Lall, S. (2000). *Technological change and industrialization in Asia*. Palgrave.
- Lee, J., Bagheri, B., & Kao, H. (2015). A cyber-physical systems architecture for Industry 4.0-based manufacturing systems. *Manufacturing Letters*, 3, 18–23.
- McMillan, M., & Rodrik, D. (2011). Globalization, structural change, and productivity growth. *World Development*, 40(2), 267–280.
- OECD. (2021). *Digital transformation and productivity in manufacturing*. OECD Publishing.
- OECD. (2022). *Trade and environmental sustainability*. OECD Publishing.
- OECD. (2023). *Industrial digitalization outlook 2023*. OECD Publishing.
- Pietrobelli, C., & Rabellotti, R. (2011). Global value chains meet innovation systems. *World Development*, 39(7), 1261–1269.
- Ponte, S. (2020). Green capitalism? Sustainable value chains and the uneven transition to sustainability. *Environmental Politics*, 29(3), 519–537.
- Porter, M. E. (1990). *The competitive advantage of nations*. Free Press.
- Rodrik, D. (2016). Premature deindustrialization. *Journal of Economic Growth*, 21(1), 1–33.
- Sachin, K., & Bandara, A. M. A. S. M. (2025). Impact of Industry 4.0 capabilities on supply chain performance in Sri Lanka's apparel industry. *International Journal of Operations Management*, 12(2), 67–84.

- Schwab, K. (2017). *The fourth industrial revolution*. Crown Publishing.
- Sri Lanka Export Development Board. (2024). *Sri Lanka apparel industry overview 2024*. EDB.
- Stiglitz, J. E. (2019). *People, power, and profits*. W.W. Norton.
- Sturgeon, T. J. (2021). Global value chains in the post-pandemic world. *Journal of Industry Studies*, 27(2), 123–142.
- Teece, D. J. (2018). Business models and dynamic capabilities. *Long Range Planning*, 51(1), 40–49.
- UNCTAD. (2023). *Global trade update 2023*. United Nations.
- UNCTAD. (2023). *World investment report 2023: Investing in sustainable recovery*. United Nations.
- UNDP. (2022). *Human development report 2022*. United Nations Development Programme.
- UNEP. (2022). *Sustainability and circular economy in textiles*. UNEP.
- UNIDO. (2022). *Industrial development report 2022: The future of industrialization in a post-pandemic world*. UNIDO.
- WB. (2022). *Manufacturing competitiveness in South Asia*. World Bank.
- World Bank. (2020). *World development report 2020: Trading for development in the age of global value chains*. World Bank.
- World Bank. (2023). *Sri Lanka development update 2023*. World Bank.
- World Economic Forum. (2023). *Global risks report 2023*. WEF.
- World Trade Organization. (2022). *World trade statistical review 2022*. WTO.
- WEF. (2022). *Future of jobs report 2022*. World Economic Forum.