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**Sustainability initiatives in supply chain
management in garment manufacturing companies
in Sri Lanka**

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ABSTRACT:

The study investigates sustainability initiatives implemented in supply chain of Sri Lankan apparel companies, evaluating its effects on efficiency. Since sustainability has become more important globally, due in part to regulations, consumer demand and concerns about the environment, the Sri Lankan garment industry is a significant example of investigating how supply chain management can be sustainable. The apparel industry supports Sri Lanka's economy greatly, but research into the impact of sustainability initiatives on its supply chain is not widely available. The research is focused on finding prevalent sustainability practices, evaluating the KPIs used to assess supply chain efficiency and evaluate the challenges manufacturers encountered when moving towards sustainability.

Using this qualitative exploratory design, we obtained data from two main Sri Lankan garment manufacturers by surveys and interviewing managers and executives. Companies are reportedly working on many sustainability operations, including lean manufacturing, energy efficiency, ethical sourcing, waste reduction, recycling, carbon negativity and zero emissions. This set of initiatives is in line with the Triple Bottom Line framework, making sure there is concern for environment, people and the business at the same time. Typical supply chain performance measures, frequently checked, operational cost, lead time, supplier performance, customer satisfaction and reduction of waste and emissions. Analysis reveals that initiatives related to sustainability are effective in decreasing operating costs, increasing efficiency and meeting customer requirements, but still face some challenges managing supplier performance and lead time.

Nevertheless, some major challenges including high initial costs, company reluctance to change and shortage of technology experts keep sustainable practices from being adopted more broadly. According to the study, addressing these problems depends on effective leadership, training people and integrating efforts among several organizations. Moreover, it stresses that better sustainability practices and clear reporting are key to keeping the industry improving and making everyone accountable. This study adds important research findings to the SSC literature by investigating sustainability in the Sri Lankan garment industry and suggesting practical guidance for industry leaders and policy creators to advance sustainable and successful supply chains in the country.

KEYWORDS: Sustainability practices, supply chain efficiency, manufacturing companies, key performance indicators, apparel industry

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Abbreviations

SSCM	: Sustainable supply chain management
TBL	: Triple bottom line
CE	: Circular economy
KPI	: Key performance indicators
SSC	: Sustainable supply chain
LCA	: life cycle assessment
OBM	: Original brand manufacturer
RL	: Reverse logistic
SCM	: Supply chain management
SDG	: Sustainable development goals

1 Introduction

A comprehensive overview of the research is presented in this chapter that, includes background information includes purpose definition and limitations together with the research process description. This section reveals the research motivation together with a demonstration of why sustainability matters within supply chain management. The research objectives along with key questions and specific goals appear in the purpose section. Furthermore, key terms and study limitations are also highlighted. This study defines key terms through the definitions and limitations section which also specifies its scope. Finally, the research process details the methodological approach undertaken to achieve the study objectives.

1.1 Background of the study

The manufacturing industry now places sustainability as their key priority in supply chain management due to increasing regulatory pressures, consumer demands and environmental concerns. Contemporary business operations must reach maximum profitability and efficiency while demonstrating ethical practice and social responsibility as well as environmental sustainability (Seuring & Müller, 2008). Garment industry, as one of the largest contributors to global commercial products which significantly impact sustainability initiatives. The current market trend features sustainable supply chain practices including green logistics operations with ethical procurement strategies and energy-efficient production techniques which help manufacturers maintain financial performance together with environmental accountability (Govindan et al., 2021).

The growth of societal and environmental concerns has empowered supply chain sustainability to become a prominent topic in recent years. Consumers together with governments and non-governmental organizations currently inspect supply chains operating in the garment manufacturing sector (Carter & Rogers, 2008). The market change has encouraged organizations to adopt waste reduction methods and circular economy approaches along with green logistics systems which protect the environment and keep operations running efficiently (Geissdoerfer et al., 2017).

Sri Lanka represents a growing economy in south Asia, with a unique geographic position, skilled labor force, and commitment to ethical business practices. It is one of the main export industries in the country, with a share of more than 40% of total exports and an employment of more than 300,000 (Board of Investment of Sri Lanka, 2023). Sri Lankan garment sector also renowned for its sustainability efforts, and many organizations are leading the way in environmental initiatives, including zero-waste, ethical work processes, and carbon-neutral manufacture. Innovative sustainability practices such as factories powered by solar energy, water preserving systems, and circular economy practices have been adopted by major garment manufacturing companies e.g. Brandix Pvt Ltd, MAS Holdings Pvt Ltd, and Hirdaramani International exports (Rathnayaka et al., 2014).

The apparel industry of Sri Lanka plays an important role in providing the economy sustainability through sustainable practices which contribute to overall international market competitiveness (Jayaratne & Wickramasinghe, 2020). The manufacturing industry faces ongoing complications linked to high expenses, technological barriers, and shareholder reluctance to adopt new practices despite their efforts according to Chkanikova & Mont (2015). Companies need to understand sustainability program impacts on supply chain operations to achieve their objectives of enhance long-term profitability while meeting sustainability goals.

With the increasing research on sustainable supply chain management, researches have primarily focused on extensive global marketplaces or developed economies, with limited empirical studies related to Sri Lanka's garment manufacturing sector (Fernando & Rupasinghe, 2022). Current research frequently highlights environmental advantages while adequately assessing the effects of sustainability activities on supply chain efficiency (Gunasekara et al., 2021). Furthermore, the key performance indicators (KPIs) employed by Sri Lankan manufactures to assess supply chain efficiency regarding sustainability are largely unexplored. There is a lack of study regarding the particular challenges encountered by local garment manufactures in adopting sustainable practices.

Examining the common sustainability initiatives in Sri Lanka's apparel manufacturing industry and assessing their impact on supply chain efficiency would help to address the research gap. The study will:

- List main sustainability practices followed by Sri Lankan clothing manufactures.
- In considering sustainability, review the KPIs used to evaluate supply chain effectiveness.
- Discover the difficulties in implementing sustainability initiatives into action.

This study aims to provide useful insights on how Sri Lankan garment manufacturers might improve operational efficiency and environmental sustainability while keeping their competitiveness in the worldwide market by means of qualitative research comprising surveys and interviews with industry professionals.

1.2 Purpose of the study

The main research objective investigates sustainable practices of Sri Lankan garment manufacturers while evaluating their supply chain performance efficiency. The study aims to:

- Examine what are the prevalent sustainable activities in the Sri Lankan garment industry.
- Assess which key performance indicators (KPIs) are important for Sri Lankan garment manufacturing companies to assess supply chain performance.
- Assess how the sustainability activities from garment manufacturing firms in Sri Lanka involve in a role in making the supply chain more efficient, using the identified key performance indicators (KPIs) as reference.
- Examine the challenges manufacturing companies experience when implementing sustainability practices.

The research is guided by these key questions:

1. Which sustainability approaches are most frequently seen among garment companies in Sri Lanka?

2. What effects do sustainability initiatives have on the effectiveness of the supply chain?
3. What KPIs does a Sri Lankan garment manufacturer use to measure supply chain efficiency?
4. What is the influence of sustainability initiatives taken by garment industries on how efficient their supply chains are, as measured by KPIs?

1.3 Definitions and limitations

The following terms are explained to ensure readers clarity:

Sustainability practices: According to Elkington (1997), sustainability practices are used to inspire environmental responsibility and minimize the effect of corporate activities on the environment. Some of these techniques are minimizing waste, the effect of corporate actions on the environment. To ensure long-term environmental and economic positive effects in supply chains, sustainability needs ethical employee rules, open relationships with suppliers and compliance to worldwide environmental regulations.

Supply Chain Efficiency: Supply chain efficiency is a way in which a company makes use of resources to optimize production, reduce costs, maintain high standards of quality, as well as reduce environmental impact. A very effective supply chain improves lead times, waste control, and market demand response. Incorporating sustainability measures evaluates efficiency not only in financial performance but also in resource conservation, carbon footprint reduction, and long-term supply chain resilience (Carter & Rogers, 2008).

Green Logistics: Green logistics is the implementation of environmentally friendly distribution, storage facility, and transportation methods implied for minimizing carbon emissions and energy consumption. Key strategies include using biodegradable or recyclable packing materials, streamlining delivery routes to save fuel consumption, and fuel-efficient or electric cars. Companies which include green logistics improve corporate social responsibility and cost effectiveness in addition to complying with sustainability rules (Srivastava 2007).

Ethical Sourcing: As per Pedersen and Andersen (2015), Being ethical in sourcing goods ensures that fair labor practices, environment protection and the supplier responsibility. It needs choosing vendors who observe strict ethical rules, meaning they prohibit child labor, ensure employees are paid fairly and strive to decrease harm to the environment. Ethical sourcing positions businesses as conscientious corporate citizens in worldwide markets by enhancing brand reputation, risk management, and consumer confidence.

The circular economy: By means of recycling, remanufacturing, and sustainable design, the circular economy is a sustainable economic model meant to maximize resource utilization and minimize waste. Whereas the conventional linear economy ("take, make, dispose") the circular economy promotes reusing materials, extending product life cycles, and combining closed-loop supply chains. By reusing waste into new products, companies accepting circular economy ideas lessen ecological impact, minimize raw material reliance, and cost savings (Geissdoerfer et al., 2017).

Key performance indicators (KPI) : As per Gunasekaran and Patel (2001), A key performance indicator (KPI) is a measurable amount used by companies to evaluate their development towards particular goals and objectives. KPIs are applied in supply chain management to assess performance in fields including efficiency, sustainability, cost-effectiveness, and customer satisfaction. KPIs linked to sustainability might be waste recycling rates, energy consumption per unit, carbon footprint reducing, and supplier sustainability compliance. Well defined KPIs allow businesses monitor developments, identify areas of weakness, and streamline their supply chain operations and environmental performance.

1.4 Scope of the study

The sustainability practices in the supply chain management of Sri Lanka's apparel manufacturing industry are the main emphasis of this paper. It especially looks at the most frequently adopted sustainability initiatives, how they affect supply chain efficiency, and the key performance indicators (KPIs) applied to measure these consequences. The study focusses on Sri Lankan textile manufacturers since the sector significantly contributes to the nation's economy and has been strongly including sustainable practices.

Using surveys and interviews with business leaders, the study uses a qualitative research methodology to provide insights. Although the results will offer insightful advice for researchers, manufacturers, and legislators, they might not be totally applicable to other sectors or geographical areas. The report also notes time restrictions, small sample size, limited access to private data, and so forth. Despite these constraints, the study seeks to advance knowledge of how sustainability could help the Sri Lankan clothing industry's operational effectiveness and supply chain performance.

1.5 Research process

The research method implements qualitative methods by distributing open-ended surveys which lead to subsequent follow-up interviews with Sri Lankan garment manufacturers. The research process follows these steps:

Step 1

Literature review: Academic literature review in regarding supply chain sustainability practices leads to the development of fundamental theoretical grounding.

Step 2

Data collection: Conducting open ended survey and follow up interviews with industry professionals to gather information on sustainability programs and performance KPIs.

Step 3

Data analysis: Using thematic analysis to recognize patterns, themes, and relationships between sustainability practices and supply chain efficiency.

Step 4

Findings & discussion: Results demonstrate comparison with existing literature to identify the key takeaways, challenges, and best practices.

Step 5

Conclusion & recommendations: This study concludes by summarizing its key outcomes and providing actionable commendations for both industry professionals along with governance representatives.

By adopting an inductive research method, this study goals to examine emerging trends in sustainable supply chain management and contribute to the ongoing discourse on sustainability in the manufacturing sector.

This chapter has provided an overview of the research study, together with its background, purpose, key definitions, limitations, and research process. The next unit will present a comprehensive literature review, discussing key theoretical frameworks, sustainability practices, and their impact on supply chain efficiency.

2 Literature review

Prior to examining how apparel companies integrate sustainability into their supply chain management strategies, several existing scholars have addressed this topic in various ways. It is essential to comprehensively comprehend the impact of the apparel business. Subsequently, understanding the operational dynamics of the supply chain within the apparel industry is essential as a practical component of the sector. Ultimately, sustainability in the apparel industry pertains to its theoretical foundation and the integration of sustainable practices inside its supply chain operations.

2.1 Environmental effect of apparel industry

The apparel business operates through a complicated system, encompassing the production and supply of raw materials, manufacturing, packaging, shipping, and sales of products, each contributing significantly to pollution. Cotton is the predominant raw material utilized. Despite its ease of cultivation, its growth must be thoroughly regulated to prevent its potential role as a course for diseases or pests that could endanger humans and other crops (Spurrier, 2013). The 2017 report by the waste and resources action Programme (WRAP) indicated that the textile and dyeing processes contributed around 20% to water pollution. Transportation is a significant contribution to greenhouse gas emissions.

The widespread nature of fast fashion has exacerbated a significant issue in the apparel industry: the accumulation of textile waste from discarded garments. 73% of garments are disposed of in landfills, with fewer than 1% undergoing recycling, resulting in significant waste of non-recyclable materials and considerable economic loss (Moorhouse, 2020). The two methods for disposing of this trendy waste are landfill and incineration. Certain garments, composed of non-biodegradable synthetic materials, may require extended periods for degradation, and the chemical emissions generated post-degradation can contaminate the environment (Saicheua et al., 2012).

These include a range from textile manufacturing to the more widely-known fast fashion industry, which are among the most damaging industries to the environment continent

wide based on resource consumption indicators, chemicals used in production and the linear model of production measures. As insinuated in the article by Moazzem (2021), the environmental impacts of the apparel supply chain extend throughout the entire lifecycle of the product from fibers through to end-of-life disposal. One of the most important problems is water consumption in excess, in particular, in cotton and denim production. For example, the production of the simplest jeans can take no less than 7,000 liters of water which puts enormous pressure on already scarce areas like many textile producing nations. Moreover, the dyeing and finishing process will pollute the freshwater system by massing hazardous chemicals and contribute to severe environmental pollution and public health threat. More than 2000 chemical compounds, as many as toxic or carcinogenic, are used in textile treatment (Moazzem, Wang, Daver, & Crossin, 2021). According to Moazzem (2021), Carbon emissions are another serious problem. The global apparel sector contributes about 10% of all collectively produced greenhouse gas emissions; more than international aviation and maritime shipping together. These emissions are mostly the result of the electricity used in textile mills and for international logistics being based on fossil fuels. Besides, global fast fashion leads to unprecedented volumes of solid textile waste, including more than 11 million tons per year in the United States alone. Synthetic fibers, including polyester, release microplastics during washing, which produce marine pollution and cause ecological damage. The author demands attention to the absence of environmental regulation and enforcement in developing countries at which the majority of apparel production takes place. Countries such as Bangladesh and Sri Lanka are frequently sunk into the environmental cost of the global supply chains because of weak legal frameworks, and limited technological infrastructure.

The significant consequences have reduced sustainability in the apparel business a focal point of considerable interest. This study intends to apply apparel companies as narrators to analyze their sustainable initiatives among the supply chain.

2.2 The supply chain in apparel industry

The phrase "supply chain" denotes the activities associated with the drive and conversion of goods from their origin to the end customers, together with the accompanying data flows (Seuring and Müller, 2008). It serves as a conduit connecting suppliers, manufacturers, distributors, and end customers. The apparel industry's supply chain comprises three primary entities: the manufacturer, responsible for design, production, packaging, and transportation; the distributor, a critical channel for product sales; and the brand owner, who outlines the distinctive attributes of various brands. The supply chain comprises additional components. The agriculture sector, as the initial component of the supply chain, supplies raw materials like fiber and yarn for clothing production, while certain small and medium enterprises convert these raw materials into fabric through textile processing (Şen, 2008).

Apparel companies use diverse business strategies; hence, an apparel company may include two or all three major roles due to considerations of financial expenditures, such as labor expenses, and available resources, resulting in varied supply chain topologies. Fung et al. (2021) classified the apparel supply chain into three primary categories. A vertically-integrated structure denotes that the corporation maintains complete control over the entire supply chain, encompassing raw material production to product launch. This framework enables organizations to enhance their oversight of product sales and suppliers, acquire comprehensive marketplace and supplier evidence, and expand profitability. ZARA workouts control over various phases of its supply chain through wide vertical combination and a just-in-time approach, hence minimizing time and financial expenditures (Berbiche et al., 2020).

Simultaneously, certain brands, for example Nike, Puma and Hugo Boss employ a production outsourcing framework. Through this structure, corporations outsourced certain manufacturing activities to external professionals to optimize resource utilization, hence reducing costs and enhancing their attractiveness in the international market. The formation of this structure is driven by organizational changes within the fashion industry, prompted by shifts in the marketplace environment, including globalization and alterations in client socioeconomic class. The conventional method in the fashion business has

historically followed a predetermined timetable of trade exhibitions and displays to highlight the forthcoming season's trends, so influencing consumer choices (Birtwistle et al., 2003).

As the market grew increasingly competitive and consumer desire for attractive and personalized clothing styles intensified, the conventional model was interrupted and substituted by fast fashion. Fast fashion is a commercial approach that provides fashionable designs at affordable prices, frequent updates to inventory, and rapid market responsiveness (Caro and Martínez-Albéniz, 2015). This model's popularity has contested the vertically-integrated structure due to its stringent time requirements within the supply chain. The original brand manufacturer (OBM) consistently completes design, production, and marketing independently, resulting in a longer timeframe than customers require. In this context, they must assume greater risks of market elimination. Consequently, in the contemporary apparel sector, this agile, low-cost supply chain model is progressively becoming prevalent. A reorganized structure is employed by a corporation that introduces many product categories under its brand, including apparel, accessories, and travel goods. In this framework, retail brands will delegate design and manufacture to trading firms like Li and Fung and original design manufacturers (ODM). The interchange companies will initially create the design independently and thereafter engage suppliers and original equipment manufacturers (OEM) to complete the entire process. However, as the revenues generated by the OEM are contingent upon trading firms, this incentivizes certain OEMs to establish their own design teams and transition into ODMs. As the supply chain grows more intricate and the number of members expands, the significant environmental threat posed by present supply chain structures has generated discussions among academics. Saicheua et al. (2012) methodically detailed the environmental effect of supply chain procedures over subordinate studies that examine energy usage and petrol emissions associated with raw materials, procedures, and trade. Niinimäki et al. (2020) defined and created the environmental impacts associated with the apparel value chain and advocated for "slow" fashion. Bailey et al. (2022) identified harmful environmental influences of the fast fashion business, including heightened carbon and energy footprints, using a methodical literature analysis. Consequently, to

enhance climate action, it is essential to evaluate the advancements of measures undertaken by the apparel industry.

The apparel industry has an extremely fragmented global supply chain with participants ranging from raw material producers to final retailers. As Harper & Pal (2025) note, supply networks in apparel are characterized by intricate interdependencies and strategic sourcing choices with special emphasis on high-cost situations where small series production is being promoted through digitalization and nearshoring strategies. On this topic, Hassan (2025) indicates why supply chain disruptions, including the disruption caused by world events like the COVID-19 pandemic can prevent sustainability goals in the textile industry, especially in developing nations.

The authors of Ferrazzi et al., 2025 also further explore the alignment of supply chain strategy with the goals of the environment and provide proof that phenomenon of lean manufacturing practices allows one to increase efficiency and sustainability in textile operations as the following is reduced through implementation – waste and process flow. Moreover, Rahaman et al. (2024) highlight the fact that such practices of circular economy as closed-loop systems and life cycle assessment (LCA) are changing waste management and resource efficiency in apparel supply chains.

Transparency and ethical sourcing have been thrown up as integral themes. Comparing U.S. and Italian fashion brands, Camiciottoli (2024) observes that clear communication of sustainability practices – ethical use of labor and carbon disclosure, plays a critical part in a consumer's trust and a stakeholder's engagement. Meanwhile, Mollel-Matodzi et al (2025) report that a realization of supply chain sustainability among African fashion entrepreneurs is growing, but they lack knowledge and infrastructure.

2.3 The supply chain management

We will first give quick background of the SCM concept in order to present the theoretical thoughts on the research phenomenon before we then use this concept as the study groundwork towards the adoption of the idea of SSCM. The SCM field is a comprehensive and interdisciplinary subject which has grown, and continues to grow until becoming a discipline in its individual right and not a pure expressive subject (Ahbodi, 2016) gives a

definition; a Supply chain involves means of obtaining data, goods and services from producers or sellers to end customers in the best and most effective way possible, a Logistic chain. This refers to the operations inside organizations which are either directly or indirectly connected so that goods and services can be distributed to the end customers (Harrison, 2001).

In essence it is possible to define SCM as the concurrent supervision and management of a complex web of processes that are utilized in delivering products or services to the end user in the most effective and profitable method probable (Storey et al, 2006). Among the procedures may be obtained and the maintenance of raw ingredients and portions, work in procedure, manufacturing and assemblage of products, order entry and following, transport and delivery, and lastly the distribution of finished goods to end customers (Ahbodi, 2016).

The above explanation of SCM was implemented since it allows this research to focus on major sustainable creativities in the supply chain and explain how these are established and implemented within the SCM environment. SCM's inclusive vocabulary is utilized in this study as an umbrella term for the various set of methods and ethics of SSCM to be discussed in the succeeding sections.

In general, SCM aims to control contacts and commercial activities between three primary associates of the supply chain, that is, the central firm, supplier and buyer with the aim of being effective and price efficient across the whole supply chain (Ahbodi, 2016). From the literature, there are four main SCM events namely; 1) Strategic partnership and external relationship development; 2) Procurement; 3) Operations (manufacturing, warehousing), and 4) logistics (distribution). Purchase, manufacture, delivery and financial administration (see Figure 1). These core events have either direct or indirect connections to the vital associates of the supply chain, therefore it is required that there should be good relationships between these parties, which can eventually result to a win-win circumstance between all (Ahbodi, 2016). How the management of these key events between the central firm, traders and clients is achieved has a bearing on how efficient the supply chain is as well as coming up with the overall success (Storey et al; 2006).

It should be renowned that the primary events of SCM as illustrated in Figure 1 were modeled with the view of a manufacturing company straddling the supply-chain's center stage (Croxtton et al., 2001). Furthermore, unlike the present works, the central firm in the framework of SCM will be stated to as the producer this study (Taylor and Taylor, 2013).

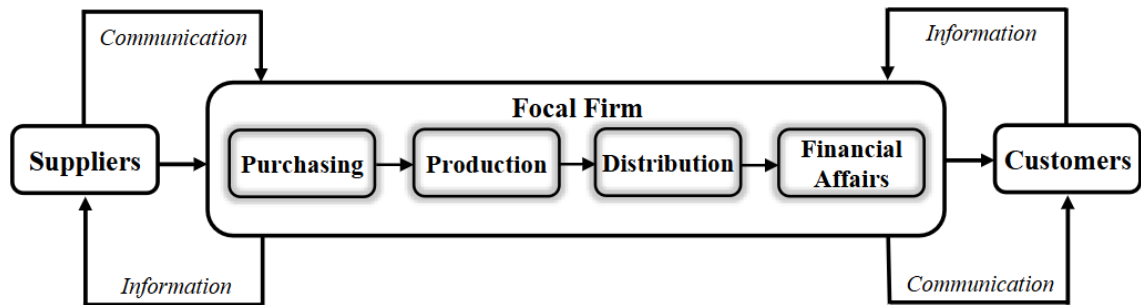


Figure 1. Key actions related in SCM (Ahbodi, 2016).

The apparel industry has a heavily fragmented supply chain all over the globe involving a wide number of players from raw material suppliers to end retail outlets. Supply networks in apparel get determined by the intricacies of interdependencies and strategic sourcing choices especially in high-cost environments where small series production is increasing with the help of digitalization and nearshoring strategies (Harper & Pal 2025). According to Hassan, (2025), sustainability goals within the textile industry can be undermined by supply chain disruptions, for example, occurrences of global events such as COVID-19 pandemic, SCM is a significant strategic function in manufacturing industries that combines logistics, production, procurement and customer service in a combined system. SCM has grown beyond its operational efficiency boundaries to include risk mitigation, sustainability, and digital innovation in the last few years. Research in academic literature indicates increasing concurrence over the direct impact of both effective SCM on an organization's agility, resilience, and long-term competitiveness especially in sectors such as apparel manufacturing where the integration of cost and quality and sustainability does not exclude others.

Musa (2025) examines the decision process in choosing the best plant locations in supply chain networks. His study uses quantitative techniques to establish the effect of geographical placement on the level of logistics efficiency and production cost. He stresses the fact that such components as proximity to raw materials, transportation routes, and market demand zones play a huge role in influencing overall responsiveness in the supply chain and overall environmental imprint. According to the research, strategic location planning is a fundamental part of SCM, especially in manufacturing where the distribution networks are closely coupled with production cycles and expectations of customer deliveries.

According to Singh et al. (2024), blockchain technology plays a revolutionary tendency of increasing transparency and food security in the Indian dairy supply chain. While focus is on agriculture, the implications have very important relevance to manufacturing. The study describes how the practice of using blockchain can be applied in tracking material provenance, monitoring compliance with environmental standards and managing automation of documentation thereby making the supply chain not only more efficient but also more secure and ethically traceable. The authors' conclusion is that the decentralized character of blockchain facilitates real-time confirmation of supplier practices, which is becoming more critical in globalized manufacturing world, including the apparel and textile industries.

Gummadi (2025) gives a case study of a practical application of Artificial Intelligence (AI) in optimizing supply chain workflows. His research explains how AI algorithms such as machine learning and predictive analytics, enhance inventory forecasting, order accuracy, and production scheduling. Through the automation of iterating tasks and permitting data driven decision making, AI improves both velocity and accuracy in the manufacturing supply chains. This research is of special interest in the post COVID-time when volatility and uncertainty require an adaptive, intelligent SCM system that is capable of anticipating disruptions and reconfiguring operations on the fly.

Abdelilah et al (2025) discuss the integration of lean manufacturing concepts to agile supply chain strategies. Their comparative research of their use in several manufacturing companies indicates the following: lean techniques (just-in-time production, waste

reduction and continuous improvement) not only serve to reduce cost; but to generate more adaptable/customer-responsive supply networks. The authors argue that the combination of lean practices and supply chain agility are timely for manufacturers as when they apply them, they can easily adapt to changes in the demand for the products and remain: efficient in terms of environment and quality —something very important in a dynamic industry such as fashion apparel.

Yokoi et al. (2025) are concerned with sustainability and risk in global supply chains and develop a consumption-based model that studies a specific environmental impact. They use multi-regional input-output analysis to trace the abiotic resource use contained in product life cycles. This is very important for manufacturers who purchase raw materials or components from cannabis sensitive locations. Their results indicate that the knowledge of country-specific risks and environmental externalities is crucial for developing effective and sustainable supply chain strategies that are able to withstand the environmental regulations and carbon accounting on the world market. Gusmerotti et al. (2025), as an example, analyze the role of structural abilities (absorptive capacity and strategic sensitivity), in facilitating the implementation of collaboration and circular economy practices in supply chains. They discover that firms that practice strong knowledge integration and inter-organizational communication tend to be more effective in the application of sustainable initiatives such as recycling, closed-loop logistics, and eco-design.

Many literature evaluations have observed optimal policies for certain apparel products to enhance their supply chain management within the framework of SSCM. Seuring and Müller (2008) performed a literature assessment of prior research on SSCM to identify significant themes for the expansion of a theoretical framework. A comprehensive approach to sustainable supply chain management (SSCM) must consider ecological, societal, and financial implications all over the entire supply chain, since raw material manufacture to customer disposal. It is imperative to utilize sustainable resources and renewable energy in the production process to mitigate the environmental impact caused by brands. Ultimately, sustainability information generated by brands are crucial for organizations to enhance their practices in sustainable supply chain management (SSCM).

Wren (2022) analyzed H&M and Everlane to highlight their deficiencies in the current sustainable supply chain management (SSCM) and proposed novel SSCM methodologies. He categorized supply chain management into two segments: upstream and downstream activities. The author outlined many tactics for fashion companies to explore in upstream operations. For instance, collaborating with partners to enhance investments in sustainable equipment aimed at decarbonizing material manufacturing and processing to mitigate ecological impacts. In downstream actions, brands can engage customers in developing successful Sustainable Supply Chain Management (SSCM) by promoting adherence to the four R principles: recycling, rental, repair, and resale. This strategy lowers fashion waste. Furthermore, the choice of materials and the conceptualization of products must prioritize environmental sustainability.

This insight is very much in-line with thesis objectives; it demonstrates that it is potential for internal competencies held within a manufacturing company to shape a range of broader supply chain sustainability initiatives.

2.4 Sustainability and sustainable practices in supply chain

Having elaborated over the theoretic contextual of SCM as required to lay the groundwork of the study phenomenon, this part proceeds on discussing how this thought has changed its emphasis to sustainability in order to prepare the ground for the introduction of the SSCM topic. As a concept, traditional SCM has slowly moved from serving as a mere theory for dealing with only commercial and operative issues to being a full-blown theory of the issues surrounding a firm's supply chain in greater social, economic and environmental sense (Sarkis, 1999, Emmett and Sood 2010; Carter and Easton 2011). This is supported by many isomorphous drivers and weights that force firms' old-style supply chains to be further accountable in regard to societal and ecological matters (Ahbodi, 2016). Figure 2 shows the development of SCM to sustainability and development of SSCM.

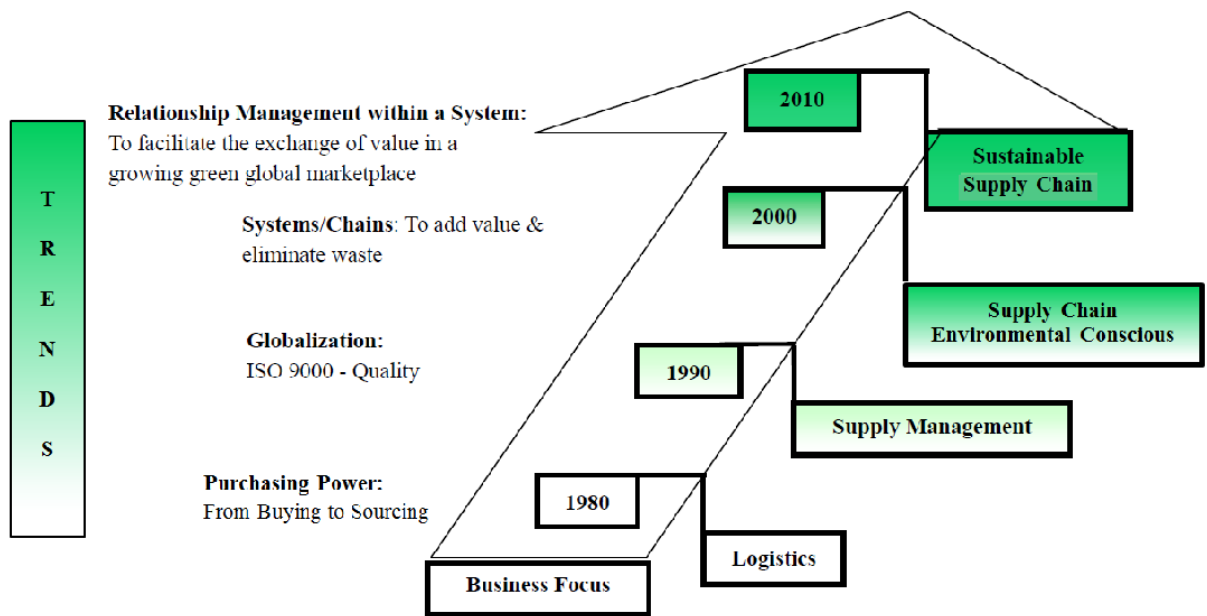


Figure 2 Sustainability rebellion in supply chain (Ahbodi, 2016)

Business enterprises slowly began to convert ecological friendly since the late 1980s once the emergence of the excellence and supply chain revolts happened (Srivastava 2007). The high-volume production during this era was built according to the applied command and resistor sense into technology and assemblage lines (Nahm & Vonderembse, 2002; Though, such high-volume manufacture ended in an equivalent increase in serious ecological difficulties originating from the supply chain such as pollution, rock-hard /sewage waste, emissions etc. (Ahbodi, 2016). These environmental issues emanating from the old-style supply chain contributed more to wider adverse consequences on the environment such as acid rain and global warming specifically (Ahbodi, 2016). These dire environmental challenges have seen strategy makers and business initiatives adopt a post- manufacturing method to steadiness among ecological challenges and financial performance (Ahbodi, 2016).

Also, exiting the era of the 1980s and entering the 1990s, societies began slowly developing greater modernization and affluence (Skinner, 1985), and this resulted in increased expectations by customers of products, who would require improved quality, diversity, obtainability, and lately, ecologically friendlier goods (Ahbodi, 2016). Such fluctuating marketplace situations driven by multiple shareholder groups such as end-customer,

controllers and entrants led to a standard shift in the industry from manufacturing structures that looked at only large-scale production and financial goals to postindustrial structures which look at environment responsive goods and societal ecological aims (Ahbodi, 2016). These significant changes laid the basis for the transformation phase from old-style SCM to SSCM. It is then that traditional SCM has changed and lifted its concentration from outdated monetary purposes to a full-fledged method which aims to consider societal, commercial and ecological matters (Sarkis, 2012)

The incorporation of sustainability into supply chain management has convert a serious extent of interest for manufacturing industries looking to reduce their environmental impact, and maximize resource usage as well as improve social responsibilities. Sustainable supply chain management (SSCM) is about integrating the traditional operations of the supply chain to environmental stewardship, social equity, and the economic viability tenets.

As per Sarkis (2012), Sustainability began to get attention as a crucial objective for attaining sustainable development. The term evolved alongside the changing meaning of sustainable progress, particularly after 1987. The notion was initially introduced by environmentalists in 1972. They proposed the idea of environmental sustainability, which seeks to reconcile the equilibrium among natural resources and their utilization. In 1987, the United Nations Brundtland commission defined sustainability as the fulfilment of present demands without bargaining the capability of forthcoming generations to satisfy their own needs (United Nations, n.d.). At that time, sustainability was not a definitive phrase to denote environmental contemplation. It was considered a guideline for societal advancement that harmonizes economic, environmental, and social equity factors, similar to the concept of the "Triple Bottom Line" (TBL) (Elkington, 2013). Three aspects of TBL were elucidated comprehensively. The financial measurement pertains to the influence of business performs on the expansion of the financial system; the social measurement signifies that practices should produce advantages for society, including labor and community; the environmental dimension involves embracing actions that safeguard the environment for future generations (Elkington, 1999).

Ferrazzi et al. (2025) aggregate lean manufacturing with environmental sustainability through a fuzzy DEMATEL model. Their research highlights the fact that lean principles – originally created in order to eliminate waste and to increase efficiency could be refashioned, in order to support sustainable practices throughout the supply chains. Integrating lean and green approaches into a firm's production process would decrease the emissions when the company pays more attention to the consumption, resources, and eco-efficiency, which would bring not only cost savings, but also compliance with the environmental requirements. This dual approach is highly applicable in businesses such as textiles where environment is part of the production process.

Mbago et al. (2025) take the interest in reverse logistics (RL) and its contribution in making sustainable supply chain. From the case study report, they show that firms that have introduced the RL practices (product returns, recycling and waste minimization) report better performance in the aspect of environmental conservation and compliance with regulations. The research implies that RL can promote circularity, decrease dependency on raw materials, and provide a basis for competitive advantage in markets oriented to sustainability. Asante-Darko et al. (2025) determine the impact of sustainable practices such as green sourcing; sustainable production, and environmental compliance on firm performance when reviewed against supply chain integration. They claim that the sustainability is incorporated to sourcing and production decisions that produce higher operational resilience and better financial outcomes. Their empirical data demonstrate that proper balance of internal and external supply chain coordination is essential to maximizing the positive impact of sustainability.

The apparel industry's unique characteristics necessitate a complicated and extensive supply chain that demands significant labor, and its production processes have environmental implications, which are wisely linked to the Triple Bottom Line (TBL). The connection among sustainability and apparel indicates that apparel is directly connected to the nature (Ulasewicz and Hethorn, 2008). Several researchers have examined the behaviors of fashion corporations in improving environmental pressure from two perspectives: inspirations and existing sustainable performs.

Liu (2025) uses a resource-based view (RBV) to study how sustainable supply chain practices help increase the firms' long-term competitiveness. According to the study findings, green management, particularly in the form of circular input adoption and innovation with sustainability objectives, increases firm reputation, market share and stakeholder satisfaction. This shows that SSCM is not merely compliance, but rather a source of durable strategic advantage. De Brito et al. (2008) highlighted a beneficial change in business attitudes towards sustainability following the establishment of the sustainable development goals (SDGs) and the increase in nationwide principles. Yang et al. (2010) discovered that businesses can collaborate with suppliers to refine their practices, thereby augmenting their competitive advantage in the market through their constructed mediational regression analysis. Paras et al. (2018) performed a case analysis, concluding that business considerations, produce factors, and customer attitudes are pivotal drivers for businesses or governments to address ecological concerns within their current commercial models.

Several studies are investigating the company's sustainable activities in relation to contemporary sustainable practices. The public perceives sustainability in the apparel sector as the utilization of eco-friendly materials in clothing. However, sustainability becomes more intricate for the supply chain.

The apparel industry's supply chain has experienced a structural transition in answer to societal developments. This transition has influenced society and the environment, promoting sustainable practices within the supply chain. Several experts have conducted studies to understand that. Masunaga (2019) noted that companies like Adidas and Ralph Lauren are concentrating on minimizing inventory to avoid waste and utilizing sustainable materials. Moretto et al. (2018) examined the sustainability of the focus company. The company prioritized the collection of sustainable resources in the initial phase and subsequently restructured the manufacturing procedure with a focus on sustainability.

Turker and Altuntas (2014) examined the interaction among retail brands and their providers. Upon analyzing nine organizations, they found that when the components of the

supply chain are remote, the company will employ distant monitoring and restrictions to enhance supplier compliance with the code of conduct.

Despite efforts by apparel companies to demonstrate proactive engagement in addressing sustainability issues, several investigators and associates of the public continue to express doubt regarding the effectiveness of current initiatives, advocating for more sophisticated strategies. Bhandari et al. (2022) recognized barriers to reaching sustainability in the apparel industry, including insufficient sustainable raw material supply and lack of responsiveness. Hur and Cassidy (2019) examined two categories of obstacles faced by companies in the fashion design process: internal and external factors. From an internal view, creators often lack information of sustainable strategy and find it challenging to make trade-offs with fashion design criteria. The complication of sustainability issues presents challenges for companies in implementing sustainable strategies. The rapid evolution of fashion trends, coupled with the pollution and waste generated during production, presents significant challenges to achieving sustainability.

Combined, these studies confirm the multidimensional nature of supply chain sustainability, including green operation, supplier strategy, technology, circular economy principles. They collectively advocate that SSCM is no longer optional, but essential for the long-term competitiveness, regulatory compliance and stakeholders' trust in the manufacturing and apparel industries.

3 Theoretical framework

Market reflexivity with an increased concern of the environment and social responsibility, sustainability has become a focus point for supply chain management (SCM). In the wake of mounting pressure from customers, nations and other stake holders to practice environmentally and socially responsible behaviors, sustainability has become more than an optional business strategy and has evolved into what is a core business imperative. The difficulties of running effective and profitable supply chains while reducing the environmental impact have resulted in the emergence of a number of theoretical frameworks, each of which provides a specific perspective on how business operation could be sustainable.

One of those is Sustainable Supply Chain Management (SSCM), which combines sustainability considerations in supply chain management practices in order to reduce the impact on the environment, enhance resource utilization and achieve positive social effects. Adoption of environmental and social consideration into the traditional supply chain practices is intended to ensure efficiency as well as supporting positive societal impact (Carter & Rogers, 2008).

The Triple Bottom Line (TBL) framework introduced by Elkington (1997) broadens the established indicator of business performance from financial performance to include two other dimensions. social (People) and environmental (Planet). This approach requires organizations to strike a balance on the issue of profit with the need for society and the environment. The TBL concept motivates businesses to measure their performance using a wider picture in that it considers environmental and social impact apart from making financial gains (Slaper & Hall, 2011).

The idea of Circular Economy (CE) offers a model that is diametrically opposed to the conventional “Linear” “take-make-dispose’ model. Circumstances in a circular economy are in pursuit of waste reduction, maximizing reuse of resources and recycling of wasted materials (Geissdoerfer et al, 2017). This strategy promotes development of the sustainable business models by incorporating the practices of closed-loop systems within which products and materials are to be reused and regenerated in a

continuous flow thus contributing to all-round environmental sustainability (Lewandowski, 2016).

Included in these three frameworks are SSCM, TBL and CE, which serve as fundamental tools for manufacturing firms operating towards aligning their processes with the sustainability agenda without compromising the sustainable aspects of efficiency and competitiveness in a global economy. This literature review therefore examines these theories in much more depth and seeks insight into their application in optimum supply chain management and the implication for the initiatives for sustainability.

3.1 Sustainable supply chain management (SSCM)

The phenomenon of SSCM has emerged as an progressively popular subject matter between practitioners as well as researchers because a number of arguments proposed and factors affecting this acceptance and influencing this adoption include shareholder requests, emerging customer prospects, administrative provisions, societal pressures over corporate image and reputation, competitor pressure, environmental issues surrounding pollution and the revival of natural resources, and so forth (Ahbodi, 2016). Companies have been attempting to develop a strategy over the past several decades that addresses the financial, societal and ecological issues of their supply chains concurrently (Ahbodi, 2016).

The SSCM approach may be used to arm all firms of any size or category with the advantage of the successful incorporation of societal, financial and environment ideals, considered to be today a critical strategic issue in the continued competition in the expanding international markets (Seuring and Muller, 2008a)

SSCM that is founded on the sustainable progress dimensions is conceptualized and shown in Figure 3.

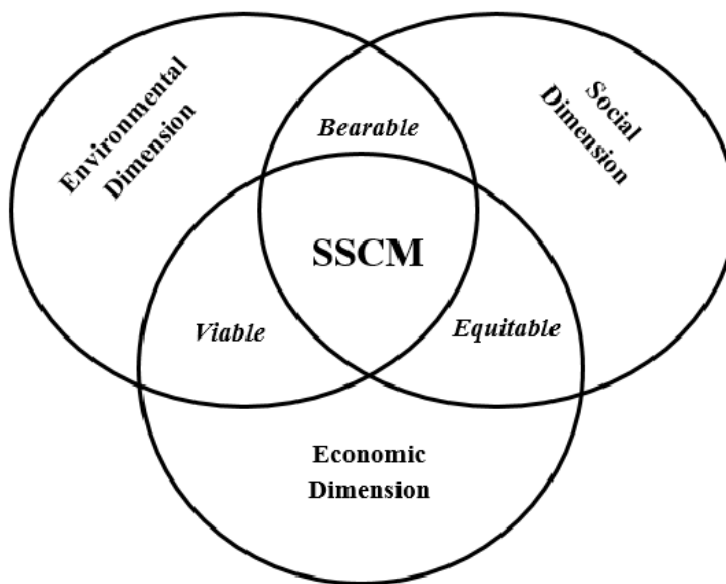


Figure 3 Conceptualization of SSCM (Ahbodi, 2016)

This idea of the SSCM guided the approach in this work, as it helps connect all elements of supply chain sustainability. It is through this incorporation of social, environmental and economic aspects that you can best show what being sustainable in general and for a supply chain means for an organization. SSCM hopes to carry out social and environmental tasks in the supply chain, but with a focus on the company's larger economic objectives. It focuses firms on things they can do in society and nature that fit into the described intersection, supporting or at the very least not compromising their economic results (Carter and Easton, 2011).

With the aid of Figure 3, the area connecting the environmental and social fields is marked as 'bearable,' while the economic sector is set aside. Ahbodi (2016) thinks that it would be very easy for factories to cut energy use by turning off all the lights, but stopping production would also be unrealistic. Firms join in these initiatives to keep the firm's economy on track for the ultimate goal set by management (Rogers et al., 2007). It was commonly said that addressing environmental and social-environmental concerns is both costly and difficult (Walley and Whitehead, 1994). It is not justifiable to use significant resources on energy efficiency or renewable energy if the overall cost to a firm becomes larger. As a result, businesses should make sure their environmental activities

are balanced and won't affect the economic targets set for the business. Porter and van der Linde (1995) believe that long-term improvement in economic terms might occur if the company's environmental and/or social initiatives are sustained by the firm.

Sustainable supply chain management (SSCM) is the identification of environmental, social and economic elements which can be incorporated into supply chain processes in a way that the outcome is sustainable. This framework is now central in supply chain strategy; as companies seek a balance between cost efficiency and environmental/social aspects (Carter & Rogers, 2008). The following practices are included in SSCM: green procurement, energy-efficient transportation, ethical sourcing which are meant to reduce the environmental footprint of supply chain operations (Ahi & Searcy, 2013).

The research has actually pointed out some of the important drivers and barriers to SSCM. Seuring & Müller (2008) note the importance of cooperation between the companies and suppliers in the implementation of sustainable practices which in their opinion will require investment in new technologies as well as redesigns of processes.

Mangan et al. (2016) examine how the regulation of the environment and the need to the cells of the consumer to practicing in ethical manner guide businesses towards embracing SSCM policies. Other than that, environmental impact, SSCM also has the social true dimension, which deals with fair labor practices and enhancing the wellbeing of communities suffering from supply chains (Gold et al 2010). Companies like Unilever and Nike are doing well in incorporating sustainable practices into their supply chains which have seen them to improve on both environmental and social outcomes (Vachon & Klassen, 2006).

However, issues like high implementation costs, lack of knowledge by the adopters and unwillingness to apply change, among others, results to failure of successful adoption of SSCM practices (Pagell & Wu, 2009). In spite of these, firms that have successfully adopted the SSCM experience an improved brand reputation, cost savings, and increased operational efficiency (Ahi & Searcy, 2013).

3.2 Triple bottom line framework (TBL)

It was Elkington (1997) who first presented and advanced the idea of triple bottom line (TBL), sometimes called the three Ps: people; planet; profit. Elkington argues that in general, firm performance can be summarized by three key themes: social, environmental and financial. The idea of TBL has been used through a system that tries to solve social, economic and environmental problems, all from a small-scale, microeconomic perspective (Ahbodi, 2016).

In essence, the main elements of sustainable development have guided the Three-Party framework which worked toward environmental, social and economic aims within a business setting (Ahbodi, 2016). According to TBL, what matters most for an organization's overall welfare is how it impacts the environment, society and ethics, in addition to its conventional financial (economic) results. Any business that only focuses on financial issues will not last in the long term, according to Elkington (1997).

The TBL consists of areas where business practices can meet the needs of society and the environment, as well as improve a firm's economy in the long term (Carter and Easton, 2011). Completed research serves to establish a basis for linking SSCM outcomes to the TBL performance pillars. A diagram of the TBL framework with its essential performance areas can be seen in Figure 4.

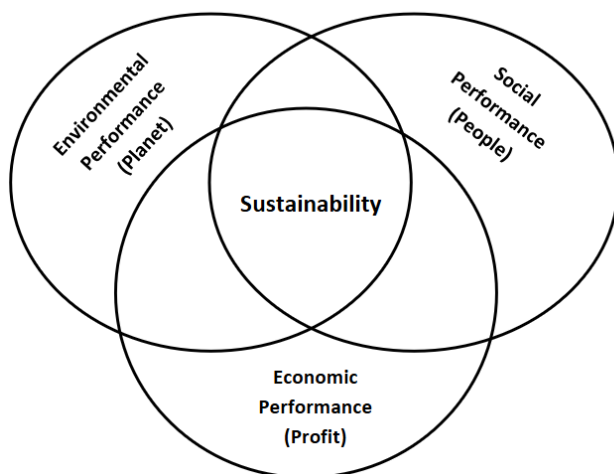


Figure 4 Triple bottom line (TBL) framework (Carter and Rogers, 2008)

A number of manufacturing companies now use TBL-based approaches to evaluate their performance at an elevated level as a way to boost their value and continue succeeding (Hollos et al., 2012). Required by the environmental pillar of TBL is that firms improve their environment and use environmental reasons and criteria in their business operations. It helps organizations create activities that can minimize their adverse effects on the environment. TBL focuses on a company's conduct towards society. Such organizations should plan their activities so that they are both fair and financially rewarding for the people and groups they interact with (Carter and Easton, 2011).

Lines of economic success are linked within TBL to society and the environment so that it brings together social impact and environmental impact with traditional economic growth (Elkington, 1997). This means the value leftover when all the inputs, including environmental and social costs, are removed from a firm's accounting. In short, the economic pillar in TBL adds traditional profit to the costs linked to pollution and losing workers (Lai et al., 2013). For this reason, it is different from the basic accounting meaning of profit issue which measures success only economically.

The Sustainable business approach, Triple Bottom Line (TBL), framework formulated by Elkington (1997) is a bedrock of sustainability theory and calls for a holistic peer of business success measurement. TBL extends traditional performance measurement beyond a single measure of profits, taking into consideration social and environmental aspects. People (social) is labor practices, community engagement, and human rights, while planet (environmental) is reducing ecological implications such as carbon emissions, and waste. Profit (economic) continues to be one of the major priorities that must now be accomplished with positive social and environmental results.

Widely adopted by industries, especially in supply chain management where organizations are advised to exploit environmental responsibility in pursuit of profitability, TBL has been embraced across the board. Gimenez et al. (2012) emphasize the importance of implementing TBL principles in supply chain management because business firms which integrate the social and environmental metrics into their business models are likely to record better long run financial returns. However, according to Hubbard (2009), implementing TBL continually presents challenges such as difficulty in measuring the

firm's social and environmental performance, and paying too much attention to financial performance.

One of the essential problems with implementing TBL is to strike a balance between the three dimensions. As stated by Slaper & Hall (2011), most of the businesses face difficulty in incorporating social and environmental considerations in the main strategy, and tend to consider it as secondary to make profits. However, some companies have adopted this with ease such as Unilever and Ben & Jerry's who are beginning to integrate sustainable sourcing and community engagement into their chains of supply indicating how profitable sustainability initiatives can be (Epstein & Buhovac 2010).

3.3 Circular economy

The Circular Economy model, (CE), operates under the following core principles, among others: design for durability, restorative materials, sharing economy practices and systems thinking (Geissdoerfer et al 2017). In the framework of supply chain management, the adopted CE practices would include closed loop recycling, product take-back schemes and remanufacturing. Through the implementation of CE principles, businesses are able to make a huge cut of their environmental footprint, enhance the degree of efficiency for using resources, and create new business opportunities (Lewandowski, 2016). A major principle of CE is product's design for disassembly so that products can be easily dismantled and recycled at the end of their life cycle (Bocken et al., 2016).

This strategy has been adopted on a rising scale by companies in different industries, especially electronics, and automotive manufacturing. Furthermore, industrial symbiosis, where waste from one process becomes the resource of another, is a key practice in circular supply chains, supporting companies in reaching zero waste goals (Murray et al 2017). However, the general use of CE is hampered by a number of issues. These include great starting costs when implementing circular business models, technical barriers, and consumers changing behavior (Kirchherr et al., 2018).

In addition, regulatory platforms are often lacking or ambiguous meaning companies have a hard time implementing circular practices comprehensively. Despite these issues, many countries are directly incorporating CE principles in their industries. Such

companies include Patagonia, Interface, Nike, which have made tremendous leap in the adoption of the circular approach in their operations such as adopting products manufactured using recycled materials and closed-loop supply chains (Lieder & Rashid, 2016). Multiple researches have clarified the environmental and economic benefits of circular approaches; companies have reported with reduced resource costs and increased competitiveness in the market (Lieder & Rashid, 2016; Ghisellini et al., 2016). Moreover, the notion of circular business models, which build CE into business strategy, has entered into the consciousness of different industries. Such models include extension of product lifetimes, the encouragement of service-based business forms, and the generation of synergies between businesses to increase the efficiency of material use (Bocken et al., 2016).

To conclude, even with the challenges experienced due to circular economy practices, the advantages proven. CE has the potential of accelerating the establishment of a sustainable society through promoting the effective use of resources and generation of waste and innovation in the management of supply chains.

4 Research methodology

The empirical component is implemented subsequent to the theoretical examination of sustainable supply chain management and its associated components. The investigation is conducted using the methods presented in this chapter. The research methodology that was employed and the method by which the data was collected will be discussed. In addition, the chapter will provide a more complete discussion of the survey respondents, interviews, and interviewees, as well as the method of data analysis. Lastly, the study's validity and reliability are examined.

4.1 Research approach

This study uses a qualitative study approach that is best to obtain detailed information regarding perceptions, experiences, and behaviors of study participants. Qualitative research is especially effective in those domains, where the aim is to explore underlying meanings of social phenomena, and the experiences of individuals (Creswell, 2014). Whereas quantitative approaches fail to allow a rich exploration of the complexities involved in topics under study, qualitative research offers the opportunity to analyze the complexity of the issue of study, which in this case is implementation and impact of sustainability practices on the Sri Lankan garment manufacturing industry. Considering the type of questions formulated; in order to find out what factors influence sustainability practices, qualitative research method enables the researcher to investigate the factors holistically and contextually (Denzin & Lincoln, 2011).

The qualitative approach applied to this study is also properly appropriate in an exploratory study. As a field of sustainability practices in Sri Lankan garment manufacturing remains highly under-researched, the use of qualitative methods gives room for flexible data collection with the possibility of capturing emerging themes and ideas (Stebbins, 2001). This type of thinking is different from more rigid deductive sounding models and much more flexible in the face of the complexity and the unexpected that so frequently surface in new areas of study. In addition, the flexibility of qualitative methods allows

the researcher to look for deeper into emerging issues and areas which might otherwise be missed (Patton, 2015).

Moreover, qualitative research allows for the exploration of phenomena in terms of the participants themselves, allowing them opportunity to say their pieces in their own words. This is particularly important in the case of a dynamic and multidimensional topic such as sustainability, where experience and perception may diverge greatly from one context to the next from the stakeholders (Silverman, 2016). The research will aim to collect as much insight as possible from all the involved stakeholders in the garment manufacturing industry, from the owners' managers and supply chain elements, in order to form a full picture of the practices, and their effects.

4.2 Data Collection

Collection of data will incorporate a mix of open-ended and closed-ended surveys supplemented by later on interviews. To collect in-depth descriptive data that represents the view of participants on the sustainability of business practices in their supply chains, the use of open-ended & closed-ended surveys is employed. Surveys provide a complete view of trends and practices and can also allow the necessary flexibility of work in qualitative research to explore the outstanding experiences and interpretations of the participants surrounding the pertinent issues (Bryman 2016). The survey questions are formulated in the open-ended & closed-ended questions to enable the respondents to make detailed and structured responses. Such an approach will provide beneficial insights into the issues of adoption and perception of sustainability initiatives.

Follow up interviews will also be held to dig deeper into the survey responses in order to explore specific themes and issues going deeper. Interviews allow for a better understanding of survey answers and a chance to ask questions which drive deeper specified by the amount of data collected. Rubin and Rubin (2012) highlighted the use of interviews as one of the most important qualitative research techniques in order to acquire valuable insights from a context. Using surveys and interviews together one can obtain a better overview of the subject, making sure that data acquired from disparate sources will be triangulated to make it more reliable (Patton, 2015).

In addition, the following interviews would allow for further research of sensitive or delicate problems that may not be adequately described in the answers to a survey. Interviews give also a possibility to clarify any ambiguities and help to confirm the reliability and completeness of data (Kvale & Brinkmann, 2009). The two-phase approach that combines both surveys and interviews have great advantages over qualitative studies. This methodology enables a complete as well as exhaustive insight into the topic and addresses the limitations of each method used without reliance (Maxwell, 2013).

4.3 Research approach: Inductive

This study is appropriate for exploratory qualitative research and will be directed by an inductive research approach. Inductive reasoning refers to generating theories and patterns from data unlike testing preconceived hypothesis hence it fits for use in this study to allow the researcher understand what influence sustainability practices have in supply chain efficiency in Sri Lanka's garment manufacturing sector (Thomas, 2006). Inductive research is based on the idea that the theory should evolve from the data, rather than being imposed on the data, which creates a more genuine players for the matter in hand (Braun & Clarke 2006). This will let the researcher to construct theory using the reaction and experience of industry stakeholders.

The inductive approach, in particular, is very helpful in such fields in which the existing theoretical frameworks are restricted or in which the phenomena being studied are complex and one does not understand them well (Eisenhardt, 1989). In this research, the use of the inductive approach helps the researcher to overcome the limitations of established theories and instead new insights on how the sustainability practices are implemented and their impact on the supply chain efficiency are developed. Approaches which will allow themes and patterns to emerge from the data in a natural way make for a more refined and flexible understanding of the research questions (Silverman, 2016). Furthermore, in a context where one is interested in subjective meanings of their sustainability practice, the inductive approach of inquiry makes it possible to explore why they are done and how they are perceived and not only what they are. This provides an opportunity for generating profound insights both for theory development and practical

recommendations for the garment manufacturing sector. In pursuit of the primary objective to determine the most popular sustainability practices and test their practicality, an inductive approach offers the opportunity to explore emerging points of view that could have not been touched upon previously (Guba & Lincoln, 1985).

4.4 Research purpose: Exploratory

This study is of an exploratory nature because it aims to explore the adoption of the Stebbins sustainability practices and the effects of the practices on supply chain efficiency in the Sri Lankan garment manufacturers. Exploratory research is also especially useful in case of reduced prior research, or in cases where the prior research conducted on the phenomenon under question had not explored the issue well (Stebbins, 2001). As the matter of the adoption of sustainability initiatives within Sri Lanka's garment manufacturing sector has not yet been properly studied, this research will investigate this literature gap, highlighting the most important sustainability initiatives and their impacts on operational performance and supply chain development.

This kind of research also provides more flexibility in data collection and analysis facilitating applicability for research on developing trends and issues (Creswell, 2014). By examining sustainability practices, the research will identify common strategies, challenges and outcome regarding their implementation. This will create a foundation upon which further study can be based and which will serve as a foundation for the future more focused research. The purpose of exploratory research is not to test hypotheses but to arrive at a set of insights and questions that will lead on to further research (Robson, 2011).

Moreover, the exploratory nature of the study opens a wider discussion of factors that may affect sustainability activities including pressure from regulations, consumers, and organizational concerns. It will also allow for the researcher to study how these factors overlap, and affect the decision-making process of manufacturing companies. By being of the exploratory approach, the study not only meets the specific study questions, but also substantially adds towards the understanding of the sustainable practices within the

developing countries, particularly in the case of Srilankan' s garments manufacturing industry (Patton, 2015).

4.5 Data analysis: Thematic & descriptive analysis

Thematic Analysis, an extensively researched technique in qualitative research that entails identifying, analyzing, and reporting any patterns in the data will be used to analyze the data collected. Thematic analysis provides for an incisive analysis of qualitative data categorizing it in meaningful groups, and identifying recurring themes that summarize important elements of the data (Braun & Clarke, 2006).

Descriptive analysis refers to a statistical technique that is employed in the summary and interpretation of data in order to make it meaningful to the insight of the characteristics of a dataset. It entails the application of the measures such as a mean, median, mode, standard deviation, and range to provide description of the central tendency, variability, and distribution of data (Field, 2013). Descriptive analysis is typically the first step in the analysis of data, providing the basis for understanding the data, before moving on to the more elaborate inferential procedures. By imparting miniature versions, just of the important features of data like trends, patterns, and outliers, it allows researchers to report data in a more consumable way thus helping to communicate findings towards non-technical audience (Hair et al., 2010).

Thematic & descriptive methods especially amenable to this study because it enables the structured observation of responses to survey questions and transcripts from interviews in order to discover common sustainability practices and their impacts on the efficiency of a supply chain.

Thematic analysis is especially useful in exploratory research where one is trying to establish the perception/experience of participants with regard to certain phenomena to be subject of the study (Fereday & Muir-Cochrane, 2006). In this case, thematic analysis will assist to identify those themes as far as the types of sustainability initiatives pursued, challenges that encountered while implementing and what impact has been perceived in terms of the key supply chain performance indicators. Arranging the data into themes, the researcher will make it possible to develop insights that could be both specific and

applicable to the wider context of sustainability practices in the Sri Lankan garment manufacturing industry.

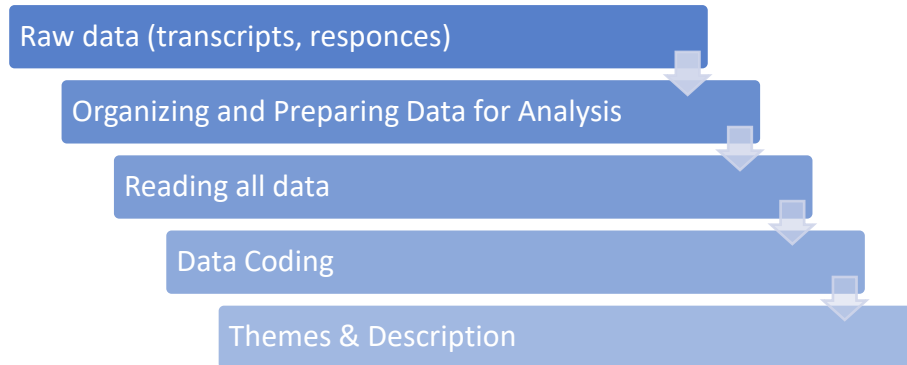


Figure 5 Data analysing process (As per the Creswell 2009)

Additionally, thematic analysis gives rise to flexibility and an iterative approach to data analysis so that themes and patterns can change as data continues to be collected and analyzed. This approach keeps this data analysis anchored in the perceptions of the participants, enabling one to understand in full how the sustainability practices affect the efficiency of supply chain. Further, the use of thematic analysis will also give the researcher an opportunity to identify what are not only the common sustainability initiatives but also the factors behind their adoption, and the factors that shape their effectiveness (Braun & Clarke, 2006).

4.6 Reliability and validity

Reliability and validity are the classic criteria of the evaluation of research in the social sciences and in the business research (Eriksson & Kovalainen 2008). Proposal developers have to communicate the actions that they will take in the study to check the accuracy and credibility of their findings (Creswell 2009). Reliability gives indication on how much you are certain on something. measure, procedure or instrument is used several times and leads to the same result (Eriksson & Kovalainen 2008). Besides, qualitative reliability shows that the researcher's approach is even to different researchers in different projects (Eriksson & Kovalainen 2008). Qualitative validity on the other hand expresses that

the writer applies certain procedures to make that the findings are accurate (Creswell 2009). It is in theory to say that research findings are valid if they are true and certain. It is an indication of the fact that the results are reflecting the phenomenon discussed correctly are supported by evidence (Eriksson & Kovalainen 2008).

Due to the qualitative nature of this study and the data was gathered using survey and follow up interviews, there are minimal chances of getting similar results. The study was carried out in the form of survey and follow-up interview in 2 companies and all the interviewees were in various positions. Details of the survey and interview questions are provided in Appendix 1 and Appendix 2, respectively. This makes studying reliable. However, 8 interviews seem to be a rather small number of interviews, and all case companies are large global firms. Therefore, the outcomes may change depending on the nature of companies.

5 Results and findings

This chapter presents the findings of the conducted survey and interviews among two Sri Lankan leading apparel companies. The results of the findings are presented as per the themes identified as per the theoretical background. This chapter ends with a summary of key findings of the survey and interviews.

5.1 Overview of the conducted survey and interview data

The data for this research was collected using a survey and follow up interviews with key personnel from two major Sri Lankan garment manufacturing companies. 15 people responded per each organization giving a total of 30 respondents on the survey together with 8 interviewees. This has provided quite an opportunity for a good number of insights on sustainability practice that is in the garment manufacturing industry.

A comparison of companies of varied operational tenures is an expedition to learn about the journey of sustainability practices and their adaptation in the course of different periods of organizational maturity. The survey required respondents to provide descriptive accounts of sustainability initiatives of their company, challenges they face and the most important KPIs that they use in measuring the successes of the initiatives in improving efficiency of supply chain. The interviews which were used as follow-ups aimed to increase better understanding of the context and implementation challenges.

By utilizing a mix of open-end & closed ended questionnaire survey and semi structured interviews, this research ensured that qualitative data was descriptive of the real-life complex challenges faced by companies in embracing sustainability initiatives. As the analysis was carried out based on their findings, thematic analysis was used to identify the patterns, responses classification and conclusions drawn regarding the common practices and barriers in the apparel industry.

Survey and interview questions

Created survey contains 15 questions under 4 sections to align with research objectives to get better understanding of the respondents. All 30 respondents answered each

question so the total number of answers for each question is 30. Similarly, the survey was complemented with follow-up interviews with participants at various organizational levels. These interviews involved eight people, four from each case company. Appendixes 1 and 2 contain details on the survey and interview questions, respectively.

Company profile

Responses from the survey were gathered from two leading garment manufacturing companies in Sri Lanka. One company is a long-standing company of operations with over 100 years operations (Company A), while the other has an operating history of 38 years (Company B). This mix of old and comparatively more youthful companies offers a balanced insight into the ways that both legacies, as well as new actors in the industry, are grappling with sustainability challenges in this sector. The survey was sent out to individuals who hold managerial roles and executive roles such as mid-level executives, department heads and managers who are straight involved in decision creation procedures concerning sustainability in their companies. Out of total respondents, 56.6% are managers/department heads, 33.3% are mid senior level employees and 11.1% are Junior associate level employees.

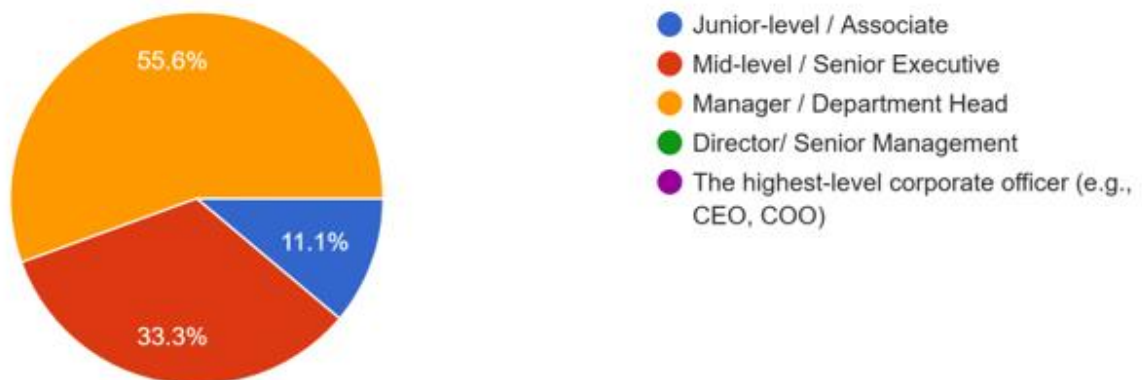


Figure 6 Distribution of current position of the respondents

As the last question of this section A, 100% respondents mentioned that their company is following sustainability initiatives in their company.

Key sustainability initiatives

Among the 30 respondents, 17 identified carbon neutrality as significant, 15 highlighted the importance of zero emissions, 21 emphasized recycling, and 23 pointed to waste reduction as essential sustainable practices. All 30 respondents identified lean manufacturing as the primary sustainable initiative of their companies, while 28 acknowledged energy efficiency, 27 referred to ethical sourcing, and 29 also noted ethical sourcing. According to the responses obtained, both companies are fully implementing lean manufacturing, while ethical sourcing is also employed by both entities 97%.

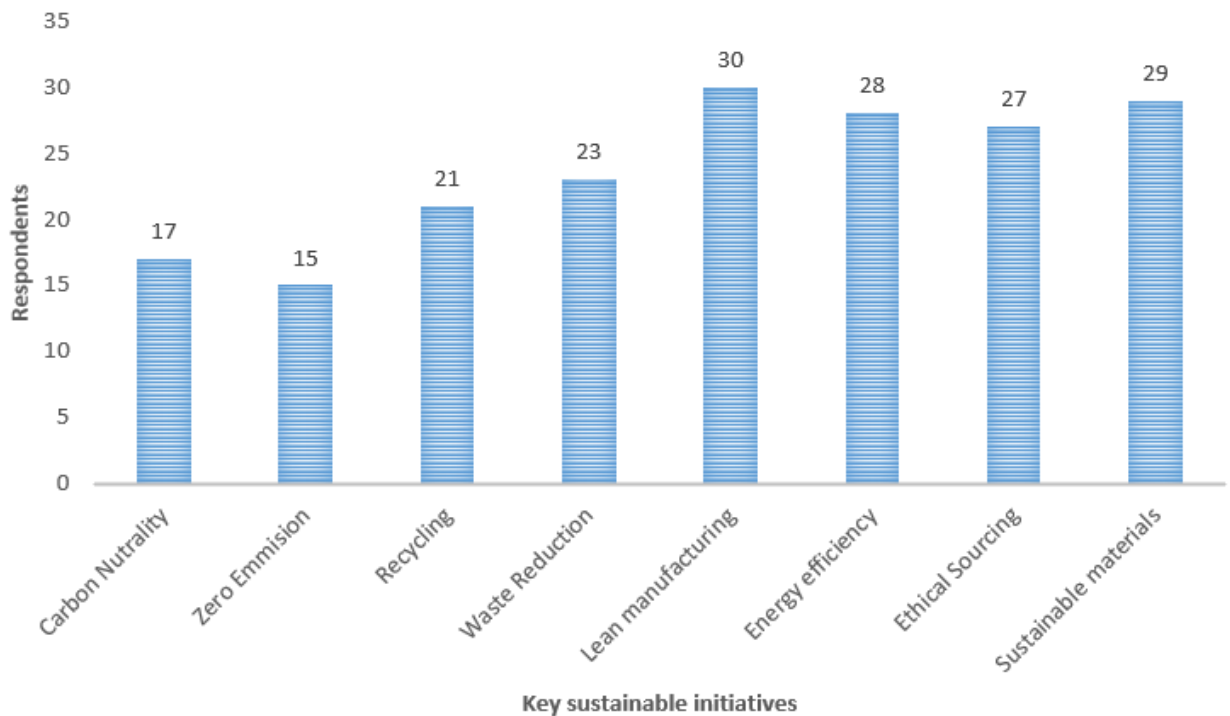


Figure 7 Implemented key sustainable initiatives by companies.

Challenges encountered in implementing sustainability initiatives

The highest percentage of the challenges are high initial cost and resistance to change, each accounting of 27% challenges. About 23% mentioned lack of technical proficiency

while sustainable material availability mentioned by 14% of the respondents. The least mentioned challenge was longer lead time which was 9% when implementing sustainability initiatives in their companies.

Challenges encountered implementing sustainability initiatives

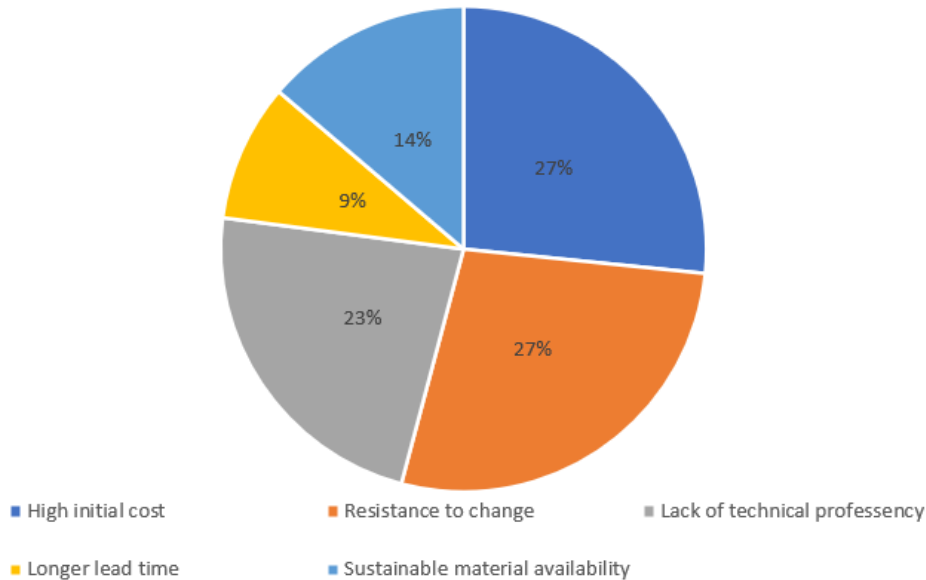


Figure 8 Distribution of challenges encountered implementing sustainable practices

Effect on the efficiency of supply chain

Definitions of supply chain efficiency

90% from the respondents defines that on time delivery and cost reduction as supply chain efficiency. Further described as on time delivery ensure products are delivered to customers on time, meeting demand without delays and cost reduction described as minimizing operational, transportation, and inventory costs while maintaining quality. Other 10% of respondents mentioned that supply chain efficiency as an organization's capacity to use resources, technology, and proficiency in order to minimize logistics expenses and maximize revenues.

Key Performance Indicators (KPIs) use to assess the effectiveness of the supply chain

Survey data indicates the importance of routinely tracking supply chain performance through various distinct sets of key performance indicators. All respondents indicated that operational cost and lead time are critical measurements, with 93% mentioning supplier performance, 90% citing customer satisfaction, and 95% mentioning waste and emissions as common measurements for assessing supply chain efficiency.

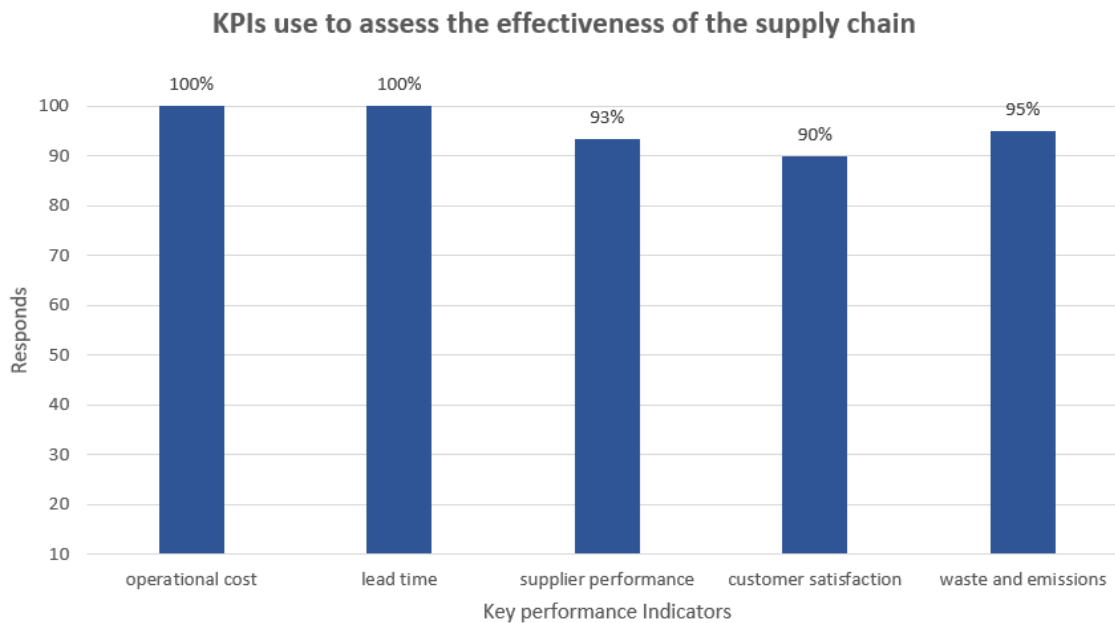


Figure 9 KPIs use to measure the effectiveness of the supply chain

All survey respondents mentioned that their companies monitored and reported above mentioned key performance indicators in every quarter.

Improvement of the implementation of sustainability policies into effect

Based on 30 responses received, Customer satisfaction got all 30 responses as improved. For Operational cost, 21 mentioned improved, 7 saw no change and 2 mentioned got worse. Waste and emissions improved for 16, nothing change for 10 and 4 responds to not measuring. Supplier performance improved for 18 respondents while 5 saw no change and 7 mentioned got worse. Lastly under lead time, 15 responded improved, 5 mentioned no change and 10 saw got worse. These results shows that the most of key

performance indicators are generally led to improvements while supplier performance and lead time still shows some challenges.

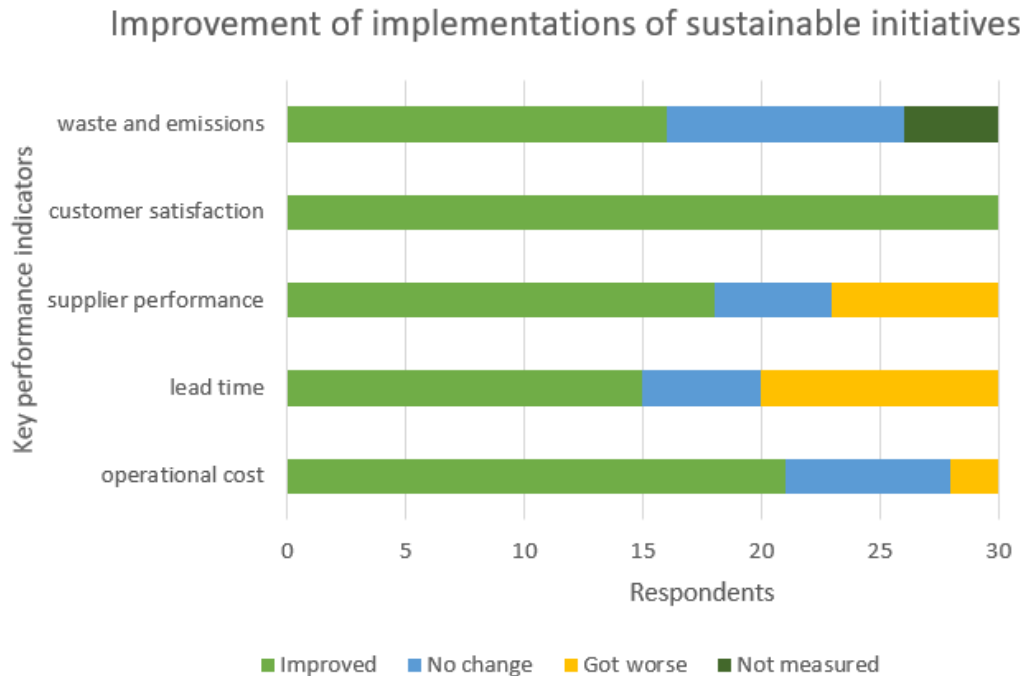


Figure 10 Improvement of the implementation of sustainability policies

Supplementary feedback

The ways sustainability practices be better supported or rewarded

In this part, respondents were requested to specify in what ways the garment sector may better encourage or reward sustainability practices. According to the figure below, 90% of the respondents indicated performance-based incentives as a preferable approach to support or reward sustainability initiatives; all the respondents emphasized setting clear performance criteria and certifications. Recognition awards at national or worldwide level 80%; Incentivizing innovation in sustainable materials and processes 75%; Promoting circularity and ensuring ethical labor practices 70%; Encouraging transparency and traceability throughout the supply chain 60%; least number of respondents mentioned empowering consumers with better information about sustainable options 55% as their

opinions. These points of view reveal the need of improved rewarding or supporting in the apparel industry.

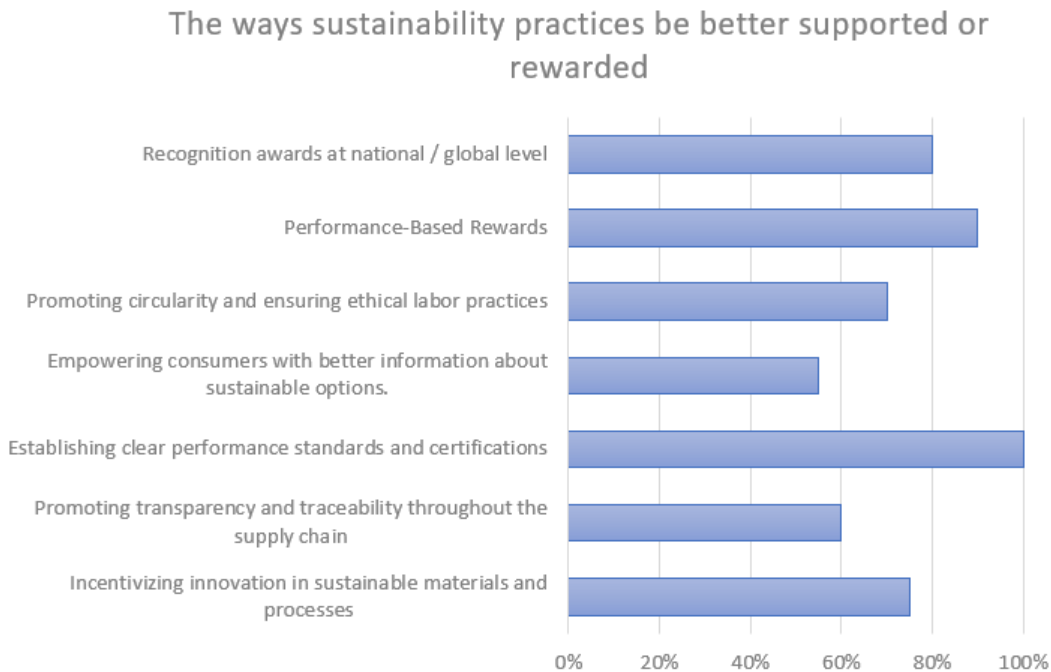


Figure 11 The ways sustainability practices be better supported or rewarded

Best practice or lesson learned in regarding sustainable supply chain

Out of total 30 respondents, only two respondents from company A and B responded to the question, are there any best practice or lesson learned that you would like to share with us in regarding sustainable supply chain? Supply chain manager from company A mentioned that, pre-and post-consumer waste recycling project support to produce fabric and garments from waste, water treatment and recycling plant support to reuse waste water. Company B mentioned that they are doing environmental sustainability practices at national level and mentioned China cotton case study as an example. All other respondents mentioned that they do not have any comment on this question.

Finally, the survey enquired whether participants would be interested in taking part in a follow-up interview, and 8 respondents indicated their willingness to do so. In response to that, we have carried out follow-up interviews with 8 participants, comprising 4

individuals from each company. And balance 22 respondents mentioned that they will not be able to participate on follow up interviews.

5.2 Results analysis of follow up interview

This section outlines the results of follow up interviews conducted. This study involved 8 participants in the interviews, with 4 interviewees from each company represented. All eight participants held managerial positions.

The interview data were examined manually by reading each participant's responses. To complete this process, analysis of qualitative data was carried out using thematic analysis and a six-step framework introduced by Braun and Clarke (2006). To make sure we interacted directly with the data and kept valuable details from the participants, we used the manual process. The initiative was carried out in these organized steps:

Each interview discussion was re-read by me to become very familiar with the content. The first observations, patterns and distinct comments were noted down.

Step 1 data familiarization: First, each interview transcript was read many times manually to gain a deep understanding. Taken the notes on primary patterns and observations.

Step 2 creation of initial codes: Main concepts and significant word phases were marked and coded manually. Codes we created inductively from the collected data and deductively from the study's theoretical data, aligning with objectives of the research related to supply chain and sustainability practices.

Step 3 theme searching: The collection of themes was checked to verify they supported the findings in the data. Some theme combinations were produced and the linked data selections were reviewed to confirm they were useful.

Step 4 theme review: To ensure that the accuracy of presented data, themes were reviewed and some themes were combined or polished, and supporting data extracts were reviewed once again to confirm their inclusion.

- Step 5 naming and defining themes: All the themes were set and given understandable names such as "Key sustainability initiatives adoption," "Impact of supply chain efficiency and KPIs", "Challenges in implementation", "Best Practices,

“Collaboration & Long-Term Commitment” and “Industry Support & Future Outlook”

Step 6 Preparing the report: The Report was prepared by organizing the final themes and adding in direct quotes from those who had participated, to keep the Report authentic and rich. These narratives expressed shared ideas and thoughts, also sharing perspectives that were not the same, helping us understand the research questions better.

Because thematic analysis looks for patterns in many datasets, it is very useful for examining complex organization routines, leaving researchers able to notice both similarities and differences among members (Braun & Clarke, 2006). Since both inductive and deductive coding were applied, the analysis drew from the facts in the data and was also consistent with existing research and the research framework.

Figure 12 demonstrates the process of how themes were organized from the original codes into thematic groupings (see below). Because of the strict process, the researcher’s findings are both reliable and accurate to what garment industry managers experience.

Rather than finding categories from the data, this research has relied on previous research to update study assumptions. The important concepts and categories used in the analysis were chosen after reviewing a huge volume of literature on sustainability and supply chain efficiency. The pre-determined concepts made it easier to arrange the information and major topics addressed were sustainability initiatives, efficient supply chains and difficulties in implementation.



Figure 12 Flow chart structure for theme mapping

As shown in Figure 12, a close analysis of all interview transcripts led to organized themes of data under main topics from the framework. Throughout this part of the study, the researcher focused on the ways participants' responses aligned with the research questions. With continued analysis, some areas of interest and similar topics appeared within the major sections. Key points in the model were adjusted many times to represent what participants actually discussed. Upon concluding the analysis, the themes emerged from the respondents' comments and were organized into five key themes. Commonly adopted sustainability initiatives highlighting the common sustainable and socially responsible actions taken by companies. impact on supply chain efficiency highlighting at how these sustainability practices influence operational performance. measuring supply chain efficiency by introducing the methods, tags or numbers used to examine how efficiently a supply chain is operating. Then challenges in implementation which demonstrate high initial cost, lack of resources and resistance to change. Lastly best practices/ industry support along with future outlook, showing how and why sustainability is growing in the industry.

With the themes out of the way, a narrative analysis was implemented. As a result, the researcher could study how stories were built by the participants, as well as what meanings and values were important to them in their experiences. Narrative analysis examines how people use stories to learn about themselves and share what they think is important (Riessman, 2008). Adopting a narrative approach allowed for a better reflection of the sustainability practices and the motivations, concerns or expectations of those involved. Analyzing the themes in the interviews was useful, yet listening to how people narrated their experiences helped to discover the many ways they built their experiences into narratives (Polkinghorne, 1995). As a result, the richness of the findings grew from including both themes that appeared in all contexts and those that were specific to each industry. Direct quotes from the respondents were included to support the analysis, providing authentic evidence and illustrating their perspectives in their own words. Connecting thematic themes and narrative analysis allowed a detailed and nuanced understanding of the data, revealing both shared patterns and individual insights across the two apparel companies.

5.2.1 Commonly adopted sustainability initiatives

To understand the commonly adopted sustainability practices, the follow up interviews were conducted for two leading garment companies in Sri Lanka. The aim of this interview is to advance deeper understanding on commonly adopted sustainable initiatives of the apparel sector.

Carbon neutrality and zero emissions

Adoption of carbon neutrality and zero emissions initiatives was one of the common sustainability initiatives mentioned during the interview.

“I believe, carbon neutrality and zero emissions follow the global trends of sustainability and the increased regulatory pressure to decrease the carbon footprints. We have worked towards carbon-neutral operations. For example, our company resolve to strive for carbon-neutral status at our “Mihila” production plant is a mark of the serious steps

being taken by the sector to achieve environmental goals. In 2012, Mihila earned Carbon Neutral® certification and it was the first apparel factory in Asia to achieve this certification.” (Respondent from company A)

“Well in our company, the milestone was made possible by extensive energy efficiency work, such as setting up a big rooftop solar system that created more than 1.2 million kWh every year from 2020. Even the initial cost is high, achieving carbon neutrality is considered to be a milestone not only because of the environmental implications but also can be used as a form of marketing due to the increased concern in sustainability among consumers. (Respondent from company A)

“As per my opinion, deciding on zero emissions involves spending more on solar and wind energy projects. Our company had placed solar panels in our premises, which allows us to use less non-renewable energy.” (Respondent from company B)

“I think moving toward lower-carbon production involves a lot of money, and most of the companies including ours nowadays depend on external support to cover the costs.” (Respondent from company B)

“Yes, this project is meant to save money long-term because running renewable energy systems can reduce operating costs in the future. organizations that start becoming carbon neutral will gain an improved public image, since it coincides with important global and community sustainability regulations.” (Respondent from company B)

As per the above comments from interviewees from both companies, the fact that renewable energy infrastructure can be quite costly at the start was seen as a problem for both companies., Still, businesses that have managed the transition well point out that it lowered their environmental impact and increased how well they operate, emphasizing sustainability’s growing impact in the industry.

Recycling and waste reduction

Another important focus on sustainability, as pointed out in the interview, was reducing waste and recycling.

“As per my understanding, setting up zero-waste systems, mainly to manage and recycle fabrics and make continued use of formerly wasted materials. In the circular economy,

many companies including ours focus on recycling, and use methods like material recycling, closed system manufacturing, and turning waste into energy. As a company we have recycled 34 million items, resulting in half as much waste ending up in landfills.” (Respondent from company A)

“Of course. we are struggling with implementing recycling programs to our full potential as recycling include complicated logistics, a lack of standard ways to collect waste, and the need for better technology.” (Respondent from company A)

“I think, recycling is very important in the production of clothes since it reduces environmental harm linked to textiles. If we recycle fabric waste, we don’t have to use as many virgin materials, which helps us to save resources.” (Respondent from company B)

“Well, using recycling lowers our expenses related to waste, so our company can ensure that we are environmentally responsible at the same time as we manage our financials well.” (Respondent from company B)

“Companies need to educate their employees about recycling and make sure environmentally friendly habits become part of the company culture. We are currently conducting such programs at our company.” (Respondent from company B)

As per the interview participants, we can conclude that, those companies that have included recycling as a priority have seen significant benefits for the environment and improve their bottom line, strengthening the effort meaningfully.

Lean manufacturing and energy efficiency

Lean manufacturing and energy efficiency were another major sustainability initiative mentioned during the interviews. Both companies pay special attention to lean manufacturing in their sustainability strategies, as revealed in their comments.

“It is important in lean manufacturing to cut down on waste, make the process more efficient, and create optimal methods for production. Let me tell you an example, we have introduced JIT production (Just in Time), 5S method (Sort, set in order, Shine, Standardize, Sustain), and Kaizen (continuous improvement) to improve our operations.” (Respondent from company A)

“I think, following Lean, many organizations including ours have used less unnecessary material, which resulted in lower running expenses and lowered impacts on the environment.” (Respondent from company A)

“In my opinion, energy efficiency has become something we really care about when it comes to being more sustainable. The adoption of equipment that uses less energy, optimizing production lines to use less energy, and using lights and heating devices that save energy are some of the things we have done to save energy.” (Respondent from company A)

“Energy-saving measures not only help us to reduce on environmental impact but also let our company save money on our utility bills over time. I would like to say that the initial investment in energy-efficient technologies usually ends up saving a lot of money to the company in the long run.” (Respondent from company B)

“As per my experience, the challenges associate with Lean manufacturing and efficiency in energy usually related with upfront costs to set up the new systems and how much some people in the company resistance to change” (Respondent from company B)

“I think, switching to energy-efficient equipment can help save money and produce well quality products, it usually needs a lot of upfront cost and many of the employees might not want to adopt with the changes to their usual work. However, companies including us that have adopted these concepts were better off in the long run, because we ended up with cost saving and less energy consumption as key outcomes.” (Respondent from company B)

Ethical sourcing and sustainable materials

The interview comments indicate that ethical sourcing has become significant part to the Sri Lankan garment manufacturing companies' sustainability practices.

“Well, ethical sourcing means procuring materials in a way that is environmentally responsible, socially beneficial, and economically viable. Our organization was actively choosing to source eco-friendly alternatives such as organic cotton, recycled materials and non-toxic dyes.” (Respondent from company A)

“Our company prioritize sourcing materials that are environmentally friendly and ensure that all suppliers meet their ethical standards.” (Respondent from company A)

“As per my experience, customer satisfaction has increased due to the implementation of ethical sourcing practices. Most of our partnering brands focus on openness and responsible supply chains can win out in the market as consumers become more aware of the moral issues related to their purchases.” (Respondent from company A)

“Ethical sourcing has become essential when meeting the increasing consumer demand for greater transparency in fashion industry. Some of our customers are asking more and more about the origin of the materials and how they were produced. Ethical sourcing is now a necessity for us to remain competitive in the industry. We need to continue ethical sourcing practices in order to stay relevant in the market.” (Respondent from company B)

“Companies including us, that adopting in ethical sourcing practices integrate these activities with their broader sustainability strategy, considering the social and environmental aspects of sourcing.” (Respondent from company B)

“Our organization has gained increased customer satisfaction and loyalty by promoting our ethical sourcing initiatives through marketing and certification labels such as Global Organic Textile Standard (GOTS) and Fair Trade.”

As per the comments from both companies, we can conclude that the main focuses of this initiatives are reducing the carbon footprint of raw material production, ensuring fair wages for workers, and supporting local communities. Companies’ commitment to responsible sourcing and sustainability are interconnected. Every item they produce is considered to support together the people and the planet.

5.2.2 Impact on supply chain efficiency

To understand the impact of supply chain efficiency, the follow up interviews were conducted within two leading apparel companies in Sri Lanka. The aim of this interview is to gain deeper understanding on effect on the Efficiency of the supply chain in apparel sector.

Operation efficiency and reduction in lead time

As per the findings from interviews conducted, the adoption of sustainability practices has improved the company operational effectiveness. Companies that applied Lean manufacturing and energy efficient production to their manufacturing process has noticed significant improvements in their operations. These techniques were stated to minimize production down times, fast production cycles, and simplified daily operations.

“I think, improved introduction of energy-saving equipment reduced the time spent on maintenance and repair, letting us for smooth manufacturing process and reduced our production lead times. Even though it costs initially, we can have benefits in long run”
(Respondent from company A)

“The practice of eco-friendly systems in logistics allowed our company to optimize routes we traveled, lower packaging waste and contributed to improved efficiency in operations.” (Respondent from company A)

“As per my understanding, a result of using green logistic, transportation costs dropped and customer delivery times became faster. Also, we were able to make every stage of our supply chain improved and meet the needs of our customers more effectively as a result of these improvements.” (Respondent from company B)

“If we talk about challenges, particularly in making sure sustainability goes hand in hand with our current plans. Having long run benefits will overcome the initial costs” (Respondent from company B)

In summary as per the received comments, implementing new sustainable measures in often made production planning more difficult in initial stages, until the company started to benefit in the long run. In the end, sustainability initiatives made a huge difference to operational efficiency, as it led to shorter lead times and more effective production operations.

Cost efficiency and waste reduction

As per the interviews, recycling and waste reduction were stated benefits for companies that have incorporated sustainability. As per the comments, the companies who follow circular economy practices and adopted waste-reducing systems reduced their expenses in raw material procurement, waste disposal, and energy consumption. Companies re-using materials and waste reduced their use of expensive raw materials and reduced expenses for disposing of waste.

“Our company’s recycling projects had significantly reduced waste management expenses. But we face challenges in implementing as it costs a lot in initial stages but can see benefits in the long run” (Respondent from company A)

“Energy-efficient methods and equipment reduced the overall expenses involved in operating the company. Less power consumption led to reduce utility charges. The long-term financial benefits of sustainability initiatives were clear, though the upfront costs to implement sustainable initiatives were expensive, the companies will be able to offset those cost quickly with ongoing cost savings in energy, materials, and waste disposal.” (Respondent from company B)

Even though it is more cost-efficient, both companies still face the issue of having to invest a lot in the beginning. For smaller organizations, new technologies and processes often cost too much to implement. At the same time, the respondents from companies pointed out that long term cost savings over time gave them a strong reason to keep focusing on sustainability.

Optimizing resources

Actions taken for sustainability have boosted the supply chain’s use of resources. Most interviewees, said that using green logistics and energy efficient technologies resulted in companies saving on overall resource consumption.

“I think, switching to renewable energy sources such as solar power allowed our company to make better use of energy by relying less on non-renewable energy.” (Respondent from company A)

“Resource-efficient methods in manufacturing help to save resources, such as water, material conservation and as a result, the amount of waste reduced and maximize the use of available resources.” (Respondent from company A)

Sustainable sourcing practices also contributed for better resource optimization as per the interview comments.

“By turning to sustainable resources and reducing reliance on virgin resources, our company was able to use resources more efficiently. Also, the growing trend in consumer demand for environmentally friendly products made it easier for us to improve their brand reputation while optimizing their resources.” (Respondent from company B)

“As per my understanding, resources optimization was not always an easy task. Instead of adopting more renewables, lack of important infrastructure to support change on a large-scale adoption of renewable energy and sustainable materials. It was challenging for companies based in remote locations to access resources that help them operate sustainably.” (Respondent from company B)

In summary, apart from the challenges which interviewees mentioned, successfully resource optimized companies resulted in significant achievements and benefits related to both sustainability and cost efficiency.

5.2.3 Measuring supply chain efficiency

To understand the importance of measuring supply chain, the follow up interviews were conducted within two leading garment companies in Sri Lanka. The objective of this interview is to increase deeper understanding on assessing the efficiency of the supply chain in apparel sector.

Key performance indicators (KPI)

According to interviews held, routinely track supply chain performance using several distinct sets of key performance indicators. Common measurements for evaluating supply chain efficiency are operational cost, lead time, supplier performance, customer satisfaction and waste and emissions.

“Operational cost and lead time or on time delivery plays a major role in understanding which actions lead to both efficiency and sustainability improvements.” (Respondent from company A)

“Lead time was an essential factor in achieving on-time deliveries despite adjustments in production and logistic guidelines influenced by sustainability aims.” (Respondent from company A)

Participants explained during interviews how they monitor supplier performance against sustainability standards to ensure environmental and social values within their supply chains.

“I think, operational costs and lead times, or on-time delivery, are critical in analyzing the actions that contribute to both efficiency and sustainability enhancements.” (Respondent from company B)

“Customer satisfaction is becoming a major consideration in performance measurement because customer demand for eco-friendly and ethically produced garments.” (Respondent from company B)

In addition, interviews revealed that reducing waste and emissions is a key performance indicator linking improvements in environmental practices with enhancements in operational effectiveness. Inventory turnover and order accuracy were also mentioned during the interviews as supplementary KPIs which companies strive to optimize resources and enhance responsiveness. Together, these KPIs establish an evaluative framework by which companies assess both the environmental impact and effectiveness of their supply chains.

Influence of sustainability initiatives on supply chain efficiency as measured by KPIs

As per the findings from the interviews, it indicated that businesses adopting initiatives for carbon neutrality and energy efficiency reported measurable reduction in operational cost and enhanced performance from their suppliers.

“Working with environmentally responsible vendors built stronger supply chain partnerships, allied with sustainability objectives. Companies including ours, that introduced waste reduction and recycling programs also reported tangible progress toward waste

and emissions KPIs, with an added benefit of improved lead times due to minimized processing delays attributed to improved waste management.” (Respondent from company A)

“Our customers are satisfied with our sourcing practices and that ethical sourcing helps boost brand reputation and maintain customer loyalty.” (Respondent from company B)

In addition, adopting lean manufacturing techniques was consistently mentioned in interviews as the major driver of improvements in lead time and order accuracy.

Measurable improvements in KPIs following adoption of sustainability practices

The findings from follow-up interview showed that many participants noticed an increase in their supply chain performance indicators after implementing sustainability programs. Reducing energy consumption and minimizing waste were found to be the causes for lower operational costs, based on the comment from respondent of company A.

“Lead times reduced because of the integration of lean practices and green logistical strategies.” (Respondent from company A)

“Ongoing collaborations with suppliers aimed at increasing sustainability and adopting shared environmental targets resulted in improvements in supplier performance.” (Respondent from company A)

“Customer satisfaction improved considerably, due to enhanced product quality, ethical standards and cooperate transparency. Additionally, clear reductions in waste and emissions, validating effective sustainability efforts.” (Respondent from company B)

Relationship between sustainability initiatives and supply chain efficiency improvements

Study of interview data shows that sustainability practices and supply chain efficiency are closely connected but somewhat complicated. Respondents made clear links between practices such as waste minimization and energy efficiency with reduced operational costs and improved management of resources.

“Improved supplier relationships and higher product quality resulted in positive changes to supplier performance and customer satisfaction KPIs.” (Respondent from company A)

“Personally, I think that the success of the business in sustainability projects is much influenced by strategic planning and ongoing KPIs.” (Respondent from company B)

During interviews, it was highlighted that organizations success within sustainability is reliant on thoroughly integrating sustainability into strategic planning and consistently monitoring key performance indicators. However, as per the details shared during the interview, high initial cost and resistance to change can delay tangible improvements in KPIs.

5.2.4 Implementing challenges of sustainability practices

To understand the challenges in executing sustainability practices, the follow up interviews were conducted within two top apparel companies in Sri Lanka. The aim of this interview is to gain deeper understanding on challenges which appear during the implementation of supply chain in apparel sector.

High initial cost

The interview conducted revealed that the significant challenge in implementing sustainability initiatives is the high initial cost which companies need to spend on adopting sustainable practices and green technologies. As stated during the interviews, industries admitted that being sustainable offers many benefits in the future, though at the beginning, the upfront capital investments needed in energy efficient machinery, renewable energy sources, and sustainable sourcing. Which will be specially for smaller companies. “The high costs burden related to initial investment can be mention as a biggest barrier to widespread use of sustainability practices across the industry.” (Respondent from company A)

“Coming up with the necessary resources for sustainable change was not easy. Both the financing and resources available to large scale companies like us are often more than enough to manage with these costs. however, finding the necessary funding for

sustainability projects can be hard for organizations that are smaller.” (Respondent from company B)

“Is important to receive support from external parties, be it government support or financial institutions in order to overcome this challenge” (Respondent from company B)

In conclusion, companies that have invested in sustainability policies noticed that the cost of investments was covered by the long-term cost savings from resource optimization, waste reduction, and energy efficiency. For this reason, several interviewees confirmed that after a few years of being active in operations, companies experienced a solid return on investment (ROI) from their sustainability projects.

Resistance to change

Many of the participants pointed out during the interview that resistance to change was a big challenge when implementing new things.

“As per my understanding, moving towards sustainability usually means reforming the company culture, changing how products are made, and retraining employees to do things differently. Adapting to the new ways of doing things met some resistance, mainly from employees used to do things differently in the past. New green technologies, energy efficient machinery and new waste management system often met with resistance by both managers and workers as many people either doubted their benefits or were not used to the new methods and rules.” (Respondent from company A)

“In order to overcome this struggle required businesses to place more emphasis on the role of leadership in pushing sustainability efforts. Clear leadership, effective communication and training programs were needed to ensure employees the importance of sustainability and motivate them to follow it.” (Respondent from company B)

Many participants mentioned that as sustainability was adopted as part of the company’s culture, resistance decreased and employees became more willing to join in on green projects.

Lack of technical proficiency

The lack of technical expertise within organizations was also seen as a big challenge when trying to implement sustainability practices. Some of interviewees said the company don't have readily available required specialized knowledge of sustainable practices, such as renewable energy systems or energy-efficient machinery. The need for skilled people to initiate sustainable projects often led businesses seek for external consultants and specialists, which added to the cost and complexity of implementation.

"I think, smaller companies often found it really hard to get enough people trained in terms of sustainability due to shortage of expertise. Since they lack enough financial resources to hire experts or set up training programs in sustainable practices." (Respondent from company A)

"Investing on technical training for employees on new technology made it easier for everyone to bridge this knowledge gap when it came to using the sustainable technologies." (Respondent from company B)

Interviewees also mentioned that people need ongoing education and upskilling to ensure that continued success of sustainability initiatives in the company.

5.2.5 Best practices/ industry support and future outlook

Lastly, we will understand the best sustainable practices, industry support and future outlook of sustainability practices. The follow up interviews were conducted within two leading apparel companies in Sri Lanka.

Collaborating along the supply chain

Collaboration between companies in the supply chain was revealed to be extremely important from the interview findings. Often, sustainability initiatives work best when the manufacturing company, its suppliers, logistics team, and customers all play a role as a team.

“Companies should team up with their suppliers to use sustainable raw materials and to ensure proper environmental practices all along the supply chain.” (Respondent from company A)

“Those companies that cooperated with their logistics partners managed to reduce emissions from transportation and improve efficiency. We are a kind of company.” (Respondent from company B)

“We are working closely with customers to fulfill their sustainability needs and align their production processes and plans accordingly.” (Respondent from company B)

In conclusion, interview summary shows that the company should involve customers in their collaborative approach as well. Communicating with customers about their sustainability efforts helped companies to enhance not only their brand reputation but also customer loyalty as well.

Planning and long-term commitment

It was also clear from the interviews that businesses need to plan long-term and remain dedicated to sustainability. Sustainability strategies that were seen as long-term plans helped companies succeed.

“Sustainability should be included in both the core values and business strategies. Sustainable practices not only involve companies to reduce their impact on the environment but also to gain competitive edge in market and the industry. We are making it happen” (Respondent from company A)

“Having clear, measurable goals allowed us to track our progress and make adjustments when needed. Commitment for the long-term focus ensures that sustainability initiatives are sustainable themselves and provide continued benefits.” (Respondent from company B)

To conclude according to the comments during the interview, it is important to set realistic sustainability goals and continue monitoring progress in long term planning of a company.

Reporting and continues monitoring

Finally, from the comments received during the interview, it was seen that reporting and continues monitoring is very important for success of green initiatives.

“Companies that implemented regular audits on their sustainability efforts and tracked their progress by using key performance indicators (KPIs) could more easily asses the effectiveness of their sustainable initiatives” (Respondent from company A)

“Monitoring allowed companies like us to figure out areas to improve and let us make better decisions based on our data.” (Respondent from company B)

Interviewees who adopted to continuous monitoring their progress stated that,

“As a company which adopted to continuous monitoring our progress, we can say that keeping an eye on things made it easier for us to meet our sustainability goals and adjustments in real time.” (Respondent from company B)

To conclude, by regularly reporting about companies’ sustainability achievements, companies ensure accountability and also let their investors, customers, and workers know company’s successes.

Industry support and future outlook

In addition to best practices, Support from the industry and projections for the future covered during the interview.

“Government and policy makers should run a huge roll when it comes to industry support. Our current government currently supporting us with the new national wide awareness programs like “Clean Sri Lanka” but we further need their involvement in achieving sustainability targets” (Respondent from company A)

“Sponsorships, policy making, investing on infrastructure and nationwide awareness by the government authorities further need in achieving sustainability goals” (Respondent from company B)

“Since we are the 2nd largest exporter in the country, our industry needs to be more concerned when making new rules and regulations and also as a company, we are

walking towards a sustainable future with the support of government bodies and investors.” (Respondent from company B)

In summary, Industry is still looking for sponsorships, supportive new policies and awareness among the country to implement further sustainable initiatives within the apparel industry.

5.3 Summary of key findings

This section concludes the sustainable practices in supply chain industry experts survey and follows up interview results. Based on the interviews conducted, it can be seen that Sri Lankan garment manufacturing companies are adopting several sustainable practices in their supply chain. The most frequent practices include carbon neutrality, waste reduction, ethical sourcing, and energy efficiency. These initiatives positively resulted in more efficient supply chains by improving operational efficiency, cost reduction and resource optimization.

The application of these practices is met with certain challenges. Major barriers to companies include high initial costs, resistance to change, and lack of technical knowledge. Even so, following best practices, such as cross-supply chain collaborations, long term planning, and continuous monitoring, can help companies to integrate sustainability in to their operations successfully.

This study examines the most frequently implemented sustainability initiatives within the garment manufacturing sector in Sri Lanka and their effects on supply chain efficiency. This study examines deeper into key performance indicators utilized to assess supply chain efficiency, as well as the main challenges that manufacturing firms encounter when implementing sustainability practices.

5.4 Theme mapping

Both survey and interview results show that several key themes describe the sustainability approaches used by clothing companies in Sri Lanka and what impact they have on the supply chain. Such themes fit well with the study’s research objectives and

Sustainable supply chain Management Theory (SSCM), Triple Bottom Line (TBL) framework and the principles of a Circular Economy.

The following table explains the sustainability measures used by Sri Lankan garment companies and shows their relationship to major theories such as Sustainable Supply Chain Management (SSCM), the Triple Bottom Line (TBL) framework and principles of a Circular Economy. It also points out the differences these methods make in the performance of a supply chain.

Sustainability Approaches Used in apparel Companies in Sri Lanka	Sustainable Supply Chain Management Theory (SSCM)	Triple Bottom Line (TBL) Framework	Principles of a Circular Economy	Impact on Supply Chain Efficiency
Carbon neutrality and zero emissions	Incorporation of environmental stewardship within supply chain activities	Focus on environmental sustainability (Planet)	Focus on reducing carbon emissions and advancing renewable energy sources	Minimized operational expenses and enhanced environmental adherence
Recycling and waste reduction	Implementation of sustainable procurement and waste management strategies	Social responsibility and environmental sustainability	Advancement of closed-loop systems and resource reutilization	Financial efficiencies achieved by material optimization and reduction in waste
Lean manufacturing and energy efficiency	Optimization of processes to develop resource efficiency	Economic (Profit) and environmental aspects	Primarily concentrated on efficiency, indirectly	Reduced lead times, low energy usage, enhanced operational efficiency

			promoting sustainability	
Ethical sourcing and sustainable materials	Focus on social equity and engagement with suppliers	Societal (People)and ecological issues	Facilitates circular sourcing and sustainable resource utilization	Improved brand reputation, supplier efficacy, and customer satisfaction

Table 1 Relationship between implemented sustainability approaches and major theoretical frame works

Table 1 reveals that Sri Lankan garment manufacturers have fully blended SSCM with the TBL framework by ensuring all three TBL aspects. They follow the ideas of a circular economy, mainly helping to reduce waste and choose ethical sources which allows companies to use resources more wisely. Altogether, applying these techniques has helped supply chains reduce costs, reach better results, get along better with suppliers and serve customers more effectively. The matching of these systems confirms that sustainability strategies are supported by theories and actually useful for the apparel companies in Sri Lanka.

In summary, the themes derive from the data show how Sri Lanka's garment industry is made more sustainable. All these efforts together meet the aims of the study: implementation of key sustainable initiatives, measurable improved efficiency, challenges in implementation, best practices and roll of external assistance. The findings show that SSCM, TBL and Circular Economy provide helpful guidance for making the sector more sustainable. This structure helps explain the interactions between sustainability activities and supply chain performance in Sri Lankan garment production.

6 Conclusion and recommendations

6.1 Discussion on the results and findings

This research paper addresses the gap in the literature regarding sustainable practices within the supply chain of Sri Lankan apparel manufacturing companies. Numerous studies focus on sustainable supply chain management (SSCM), primarily addressing the motivations for companies to engage in SSCM practices. SSCM has primarily been studied all over the world to learn what motivates companies to make their operations sustainable. For example, as shown by Seuring and Müller (2008) and Gunasekara et al. (2021), factors such as complying with regulations, meeting what customers want and social responsibility are drivers in green supply chains. Nevertheless, there is not much in the way of specific research on the Sri Lanka apparel sector, underscoring the importance of this study.

This research was carried out by studying sustainability programs at two top Sri Lankan clothing manufacturers that have different length of operation, based on surveys and interviews of the relevant personnel. The results prove that many important sustainability approaches are currently in place such as lean manufacturing, sustainable materials, energy efficiency, ethical sourcing, waste reduction, recycling, carbon neutrality, and zero emissions. Ferrazzi et al. (2025) stated in their global report that lean manufacturing improves both environmental sustainability and how operations are managed and the research findings reflect this.

Both companies encounter challenges such as resistance to change, High initial cost, lack of technical proficiency, sustainable material availability and longer lead time. They match the conclusions of Chkanikova & Mont (2015), who found that financial challenges and the way companies are organized generally prevent growth in developing countries. Resisting change strongly indicates that there should be a leadership-driven transformation of the company's culture, according to Kotter (1996).

The report also looked at the main KPIs that are used to assess how well the supply chain is performing. The main metrics were Operational cost, lead time, waste and emissions, supplier performance and customer satisfaction. These performance indicators fit with

what Gunasekaran & Patel (2001) propose for balanced measurement of financial, environmental and social performance.

Improvements were mainly seen in operational cost reduction, customer satisfaction, and waste/emissions reduction. As a result, sustainability programs serve to enhance the TBL approach by handling economic, environmental and social elements all at once. Lean manufacturing succeeded in cutting down production waste and savings which literature links to the support of sustainable practices (Abdelilah et al., 2025). Still, both the variation in lead times and supplier performance suggest that there is a tough relationship between sustainability and operating efficiently, reinforcing Hassan's (2025) view that full sustainability often means overcoming many operational obstacles.

In addition, both businesses place importance on rewarding sustainability by establishing clear performance standards and certifications, performance-based rewards, recognition awards at national level, incentivizing innovation in sustainable materials and processes, promoting circularity and ensuring ethical labor practices, promoting transparency and traceability through the supply chain and empowering consumers with better information about sustainable options. According to Wren (2022), this method fits with their suggestions for greener operations in the supply chain.

Altogether, the research supports the main research questions by showing that most Sri Lankan apparel companies concentrate on lean manufacturing, energy saving, sustainable sourcing and going carbon neutral. They help improve the supply chain and lower costs, while also keeping customers satisfied, as evaluated by KPIs. Even now, companies and governments still face big difficulties overcoming expensive barriers and resisting change.

6.1.1 Sustainability practices adoption

It is shown in research that Sri Lankan apparel manufacturing companies are implementing key sustainable solutions, for example lean manufacturing, sustainable materials, energy efficiency, ethical sourcing, waste reduction, recycling, carbon neutrality, and zero emissions. Many manufacturers worldwide are using lean manufacturing because it helps them use fewer resources, work more efficiently, meet environmental standards

and improve their economy (Ferrazzi et al., 2025; Abdelilah et al., 2025). It demonstrates that lean manufacturing supports both better operations and environmental care, addressing the research objective of identifying common sustainable practices.

When companies source ethically and purchase sustainable materials, they are meeting more consumers' expectations for corporate social responsibility and openness, just as Camiciottoli (2024) noted that ethical sourcing helps build trust and loyalty around a brand. The results prove how Sri Lankan apparel companies achieve global environmental goals by revealing the most common initiatives implementing.

Even though the advantages are acknowledged, reaching carbon neutrality often involves spending considerable amounts of money which interviewees pointed out and Moazzem et al. (2021) support. Even so, businesses aim for carbon neutrality to protect the environment and to retain a competitive edge which matches Circular Economy guidelines focused on recovering resources and minimizing waste (Geissdoerfer et al., 2017). The result of this study confirms the research aim by showing businesses appreciate that choosing greener solutions is important, in addition to following regulations. Also, authorities in the apparel sector are now realizing the need to switch their focus from economics to a full sustainable supply chain approach that considers both the environment and people. Since the industry is a major factor in global harm to the environment (Niinimäki et al., 2020), this evolution is necessary. As it attends to both the employees and environmental challenges outlined by Elkington (1999), the Triple Bottom Line, the apparel industry in Sri Lanka makes important contributions to becoming more sustainable and therefore achieves the main focus of this study.

6.1.2 Impact on supply chain efficiency and KPIs

Adoption of key sustainability practices within the supply chain led to higher performance in key supply chain indicators. Identified improvements during the research are, operational cost reduction, efficiency in lead time, supplier reliability, customer satisfaction, and reduction in waste/emissions, which perfectly align with the triple bottom line's balanced measurement of performance.

As an example, applying lean manufacturing and green logistics practices allowed factories to complete production faster and deliver finish goods on time more quickly at low costs. Such results highlight previous research that suggests lean manufacturing's dual role in cost savings and sustainability.

As per the research findings, improvements in customer satisfaction underlines the role of ethical and sustainable practices in enhancing brand loyalty and market competitiveness. Yet, the achievement of mixed results both in lead time and supplier performance underlines the difficulty of achieving full sustainability without interrupting operational agility which is a challenge covered earlier by Hassan (2025).

Measuring KPIs quarterly shows that the maturing approach to sustainability performance measurement and is similar to sustainability performance recommendations in SSCM literature by Gunasekaran & Patel (2001). In summary keeping track of data continuously supports businesses to figure out how to improve and maintaining the flexibility needed in supply chain sustainability management.

6.1.3 Challenges in implementing sustainability

Despite notable advancements, high initial costs were frequently identified as a significant challenge, particularly for smaller manufacturers, supporting the findings of Chkani-kova & Mont (2015) regarding financial limitations in the adoption of sustainable practices. Capital investments in renewable energy infrastructure, energy-efficient equipment, and waste management systems create substantial entry barriers, thereby restricting wider adoption.

Resistance to change has become a significant cultural and organizational challenge. Sustainability transitions necessitate changes in processes, employee attitudes, and management strategies, frequently encountering skepticism or resistance (Kotter, 1996). The findings of the study correspond with existing literature that highlights leadership, communication, and training as essential factors in addressing resistance.

Shortages in technical expertise limit the effectiveness of implementation, as specialized knowledge is essential for managing and sustaining new technologies and sustainable materials. This aligns with the statement by Mbago et al. (2025) that capacity-building

initiatives are critical for the sustainability of long-term sustainable supply chain management success. These challenges support the necessity for multi-stakeholder support, encompassing financial, educational, and regulatory interventions, to create a beneficial environment.

6.1.4 Best practices and industry support

Successful sustainability integration was characterized by cross-supply chain collaboration and long-term commitment. Engagement with suppliers, establishment of shared sustainability objectives, and transparent reporting contribute to overall system enhancements and risk reduction (Gusmerotti et al., 2025). Ongoing monitoring and reporting of sustainability KPIs improve accountability and facilitate adaptive management, consistent with Elkington's (1997) support for comprehensive sustainability performance evaluation. Government involvement via awareness programs, policy incentives, and developments in infrastructure is essential for advancing sustainable manufacturing in Sri Lankan apparel industry. This specifies that policy frameworks and industry support mechanisms facilitate sustainable transitions, as evidenced globally (Srivastava, 2007; United Nations, 2015).

6.1.5 Theoretical contributions

Research in this area helps improve knowledge about SSCM by adding findings from apparel manufacturing in Sri Lanka. The Introduction and Literature Review chapters highlight that while SSCM ideas have received plenty of attention in developed economies, understanding how Sri Lanka and other emerging economies implement these ideas is still lacking (Fernando & Rupasinghe, 2022 and Gunasekara et al., 2021). By exploring sustainability measures, issues and achievements in Sri Lankan apparel companies, this study helps close this gap.

Additionally, the data confirms that models like SSCM, TBL and the Circular Economy still work well in developing countries. By revealing how Sri Lankan apparel companies fit environmental stewardship, social responsibility and economic viability into their supply

chains, the study moves the theory of SSCM past standard limits. As an example, the use of circular economy methods, for instance in waste reduction, resource recovery and closed-loop systems, is demonstrated to achieve positive results both for sustainability and the company's operations.

In developing countries, this study reveals that things like insufficient funds, hesitation to adapt and limited technology play a special role in shaping sustainability work. Such findings allow current SSCM models to be strengthened by adding the social and economic details affecting sustainable projects. With this research, the identified gap in the literature is resolved and the theory of SSCM gains value by being based on real cases from international supply chains in a developing country.

6.2 Recommendations

The subsequent recommendations are proposed based on the findings and supported by scholarly evidence and the recommendations are divided into two perspectives: apparel manufacturing industry and Policymakers, Industry Bodies and country.

6.2.1 Apparel manufacturing industry

Enhance Strategic Investment in Green Technologies can be count under top recommendation for companies to success in implementing supply chain initiatives. Investment in renewable energy and energy-efficient machinery is essential despite initial costs, as the long-term operating savings and carbon reduction advantages surpass the upfront expenditures (Ferrazzi et al., 2025; Moazzem et al., 2021).

Organizations can successfully implement sustainability initiatives if they design a well-planned framework for change and team development, with leaders and teams involved. Leadership must actively foster a culture of sustainability and allocate resources for training to address resistance and skill shortages. A strong change management and capacity building structure is created when executives commit, the company supports sustainability and relevant skills are developed for everyone in the workforce with adequate courses. It is important to address barriers to change by updating individuals how

sustainability plays a key role in strategy. Referring to Kotter's change model from 1996, it helps to generate insistence among employees, gather support from prominent leaders and lead by always repeating the company's goals and mission. With the support of this framework, workers can adjust smoothly and provide valuable support toward sustainability goals.

Cultivate partnerships with suppliers and logistics providers to exchange best practices and synchronize sustainability objectives, thereby strengthening resilience and efficiency. To enhance supplier collaboration, teamwork among supply chain partners is essential to increase both sustainability and operational efficiency. Companies ought to actively reach out to providers, transport firms and other essential parties to bring sustainability plans together, exchange experiences and develop new approaches. Close, honest and beneficial relationships formed by companies can help all involved challenge sustainability complications together such as reducing emissions and improving how resources management. Gusmerotti et al. (2025) emphasize that group collaboration improves the ability of supply chains to deal with both environmental and market changes. Using platforms for teamwork, taking part in shared training activities and evaluating performance together are other ways to improve coordination and responsibility all through the supply chain.

Expand Sustainability Metrics and Reporting involves, implement thorough and regular KPI monitoring to inform decision-making and transparently convey progress to stakeholders. A good way to make decisions and earn trust is to use wide-ranging sustainability metrics and reporting methods. Monitoring important performance metrics (KPIs) linked to environmental, social and economic sustainability should be made a priority for organizations. Keeping an eye on these key performance indicators allows companies to spot issues that require improvement, check how far along they are with their goals and assess if sustainability measures are working well. Reporting facts openly is important to show investors, customers, regulators and the public about what the company is doing which adds credibility to the business. Seuring & Müller (2008) argue that such accountability as part of supply chain management encourages ongoing development and shows commitment to long-lasting goals.

Achieving more sustainability and cost savings requires businesses to use circular economy among their daily operations, focusing on closed-loop systems and eco-designs. A circular economy approach means planning products that are made to last, can be re-used and recycled, so less unnecessary materials are needed and less garbage is created. By using take-back programs, remanufacturing and renewable or recycled materials, companies can lessen their harm to the environment and generate extra value stream. According to Geissdoerfer et al. (2017), adding circularity helps the environment and also strengthens the economy by reducing costs of needed materials and guarding against possible delays in supply chains. Favoring circular ways of working enables companies to stay profitable for years as resources continue to decrease.

6.2.2 Policy makers, industry bodies and country

Helping SMEs with financial support allows them to make the transition toward greater sustainability. Many SMEs have a hard time investing in green technology, as the initial costs are usually too high. For this reason, it helps to provide purposeful support with grants, special tax breaks or affordable loans. Using these financial tools, SMEs can purchase ecofriendly machinery, reduce their waste and follow sustainability rules. As Govindan et al. (2021) argue, making financing easier for SMEs not only benefits how environmental initiatives operate but also improves the sustainability of companies and the whole supply chain. Developing the financial strengths of SMEs is essential for making sustainability part of the fashion industry for everyone.

Having and following strong sustainability rules helps maintain accountability and uniform environmental standards in the apparel industry. Each country should create specific laws that outline what is acceptable in using resources, releasing emissions, managing their workforce and waste control. Standards for certifying firms and tools to confirm compliance should go along with these rules to keep companies authentic. Srivastava (2007) believes that effective oversight of rules gives businesses a clear incentive to exceed basic levels of compliance. If regulators introduce basic standards, companies will understand that being sustainable is a normal requirement, leading to better environmental and social results across the industry.

Training and sharing knowledge play an important role in helping organizations develop the skills for embracing and using green practices. Numerous experts in developing places find themselves lacking knowledge in sustainable approaches and efficient methods of supply chain management. As a result, collaborative training courses between academic institutions, NGOs and experts should be implemented. According to Mbago et al. (2025), organizations should deal with both the important planning and management concerns of sustainability and be adjusted to meet regional needs. Sharing and teaching proper information to workers and managers greatly supports the success and endurance of sustainability projects. These platforms support people in using successful practices which helps create a continuous cycle of learning and new ideas in the sector.

Informing the public about sustainable fashion helps shape how consumers buy and pushes businesses to improve their work ethics for better profits. People who understand the importance of environment and social responsibility tend to shop and support brands that act with care for both. There should be an effort to point out how sustainable fashion helps the environment, what damage fast fashion does and the need to consume wisely. This can be done through media outlets, educational activities and working closely with the community. Camiciottoli (2024) observes that spreading information among the public can lead to both changes in what consumers buy and expectations on companies to emphasize sustainability at work. When people know more, they can help build a marketplace that is committed to sustainable development in the apparel sector for the long term.

Investing in research and helping innovative ideas in sustainability is necessary to find suitable solutions for the Sri Lankan apparel sector. Thanks to changing global needs and environmental issues, ongoing work on R&D can bring about discoveries in sustainability, efficient energy use and circular manufacturing. The United Nations (2015) highlights that aiming to fund particular innovation can both support technological progress and allow solutions that are both affordable and available on a wide scale. When research is backed in this manner, Sri Lanka can keep up with others worldwide and focus on its sustainable future.

6.3 Limitations of the research

The present study has certain limitations that constrain its potential. The research focuses entirely on the Sri Lankan garment industry, and the findings may not be applicable to other industries or countries. This study investigates only two garment manufacturing companies, therefore limiting the potential for result generalization due to the small sample size. The researcher encounters challenges in conducting in-depth study due to access limitations imposed on confidential industry data. This restriction impacted the ability to validate certain claims through quantitative metrics or longitudinal data. This study is conducted over a limited timeframe, which may not adequately reflect long-term sustainability implications, and it also addresses self-reported bias. The data obtained from surveys or interviews may include individual biases that could compromise the veracity of the information gathered and the values found in the data may not be accurate due to social or memory biases.

However, since new issues can be identified during coding, there is always a risk that the researcher's view might influence and affect theme-finding. On another note, it is possible for analysts to explain the data favorably, because themes can have multiple interpretations.

Moreover, the inductive approach is fine for finding examples in exploratory research, but it limits testing possible hypotheses and establishing proper connections, hence holding back from definitively judging how sustainable practices affect the supply chain's efficiency. The study indicates its limitations in order to establish transparent research methodologies for future research in sustainable supply chain management.

6.4 Recommendations for future research

In view of these limitations, forthcoming studies should consider a wider and deeper approach to know more about sustainability practices in the apparel industry and beyond. Adding more companies, SMEs, exporters and firms from different regions of Sri Lanka would make the results more reliable and tell a better story about how different industries adopt sustainability.

A mixture of qualitative and quantitative research is suggested to back up qualitative results with evidence. Following sustainability initiatives over a long period and observing their effects on the supply chain, finances and environment would help identify their lasting effects, something the current study cannot conduct due to time limits.

International studies of apparel manufacturers from different parts of the world could reveal the special socio-economic, regulatory and cultural elements that have an influence on sustainability. Doing comparative analysis can uncover the best ways of operating and methods that can work well in changing markets. Exploring the link between consumer actions and supply chain behavior should help improve sustainability. Studying how people make choices about what to buy and use can help improve efforts to improve sustainability. Studying suppliers, government agencies and industry groups helps to see the full picture of what is affecting sustainable supply chain management. Using reliable performance data and popular tech-based tools such as tracking for supply chains or sustainability reporting can greatly improve how accurate and reliable future scientific studies are. Working on these subjects will increase the practical and theoretical impact on sustainable supply chains in the apparel sector and beyond.

6.5 Concluding remarks

In Sri Lanka, the apparel manufacturing sector is now following sustainable practices that safeguard both the environmental and social responsibility along with operational efficiency. According to this research, stronger leadership collaboration along with teamwork, improved expertise, capacity development and supportive rules to foster sustainable development in the apparel industry. The successful implementation of sustainability practices in supply chains will be critical for refining Sri Lanka's global competitiveness and for making significant contributions to environmental stewardship and social equality.

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Appendices

Appendix 1. Survey questions

1. Section A: Company Profile
 1. Company name?
 2. Current position in the company?
 3. Size of the company?
 4. Years of Operation?
 5. Does the company currently following sustainability initiatives?
2. Section B: Sustainable practices
 1. Key sustainable practices currently implemented by the company?
 2. To what extent are the following initiatives implemented in your company?

Initiative	Not Implemented	Partially Implemented	Fully Implemented	Planning to Implement
Green logistics				
Ethical sourcing				
Energy-efficient production				
Waste reduction/recycling				
Use of renewable energy				
Water conservation				
Sustainable packaging				
Others (please specify):				

3. Depending on your experience, how have sustainability initiatives affected your supply chain operations?
4. What kind of challenges have you met in when executing these sustainability initiatives?
3. Section C: Effect on the Efficiency of the Supply Chain
 1. In your organization, what exactly defines supply chain efficiency?

2. a) Which Key Performance Indicators (KPIs) would you use to evaluate the effectiveness of the supply chain in your company?

b) What is the frequency of these KPIs monitored or reported?

- ✓ Monthly
- ✓ Quarterly
- ✓ Annually
- ✓ On-demand
- ✓ Not regularly

3. Based on your experience, to what extent have the following improved since the implementation of sustainability policies into effect?

| Improved | No Change | Got worse | Not Measured |

Lead time | | | |

Operational cost | | | |

Supplier performance | | | |

Customer satisfaction | | | |

Waste and emissions | | | |

Any other improvements (please specify):

4. Could you supply any particular statistics or case studies illustrating how sustainability projects have improved supply chain performance?

4. Section D: Supplementary Feedback

1. In your opinion, in what ways sustainability practices be better supported or rewarded in the apparel industry?

2. Are there any best practice or lesson learned that you would like to share with us in regarding sustainable supply chain?

3. Would you able to participate in a follow-up interview?

- Yes (please provide contact) No

Appendix 2. Interview question

Section A: Sustainability Practices

1. Could you describe the main sustainability practices currently implemented in your company?
2. What were the key reasons or drivers behind adopting these initiatives?
3. Which practices (e.g., green logistics, ethical sourcing, etc.) have been most impactful? Why?

Section B: Challenges in Implementation

4. What major challenges have you encountered while implementing sustainability practices?
5. How did your company address these challenges?
6. Was there resistance from staff, suppliers, or other stakeholders?
7. How supportive has your top management been in pushing for sustainability?

Section C: Measuring Supply Chain Efficiency

8. How does your company define supply chain efficiency?
9. Which Key Performance Indicators (KPIs) do you use to assess it?
10. Do you think your current KPIs capture the sustainability impact adequately? Why or why not?

Section D: Impact of Sustainability Initiatives

11. Can you provide examples of how sustainability practices have affected supply chain performance (e.g., cost, lead time, customer satisfaction)?
12. Have these changes been positive, neutral, or negative overall? Why?

Section E: Industry Support and Future Outlook

13. How can the apparel industry in Sri Lanka better support sustainability in supply chains?