

How Lean Management Drives Operational Excellence in Sri Lanka's Apparel Sector: A Pathway to Competitive Advantage

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Abstract

This study investigates the correlation between lean management practices and operational performance in Sri Lanka's apparel industry, focusing on the significance of continuous improvement, waste elimination, leadership support, and supplier involvement in fostering operational efficiency. Motivated by the severe impacts of an economic downturn on the garment industry, this research underscores the urgent need for effective management strategies to sustain competitiveness. The study adopts a quantitative approach, collecting data through structured questionnaires from a sample of 275 managerial-level employees across 10 major apparel manufacturing companies in Sri Lanka. The sample was selected using purposive sampling, ensuring that participants have direct involvement with lean management practices. The analysis reveals that continuous improvement, leadership support, and supplier involvement significantly enhance operational performance, while waste elimination shows no significant impact in this context. These findings suggest that achieving the ambitious export targets set by Sri Lanka's apparel industry requires a strategic shift towards operational efficiency and quality enhancement. The study highlights the effectiveness of lean practices in improving operational outcomes, while also indicating that traditional strategies such as waste elimination may need re-evaluation. The implications of this research are critical for industry leaders aiming to navigate the challenges of global competition and economic pressures, as it suggests a strategic focus on continuous improvement, robust leadership, and integrated supplier involvement to drive efficiency and growth. These results not only contribute to the academic understanding of lean management but also offer practical insights for enhancing operational performance in a key sector of Sri Lanka's economy.

Keywords: Apparel industry, Continuous improvement, Leadership support, Lean management, Operational performance, Supplier involvement, Waste elimination

1. Introduction

The apparel sector in Sri Lanka plays a pivotal role in the nation's economy, contributing significantly to both employment and export revenues. As part of its strategic objectives, the industry has set an ambitious goal of achieving an export value of \$8 billion by the year 2025. This target underscores a shift in focus from merely reducing costs to prioritizing quality and the production of specialized items, which are critical for maintaining a competitive edge in the global market. The process of delivering high-quality finished products to clients is inherently complex, encompassing various stages such as design, product development, raw material acquisition, production, and distribution. These stages are highly interrelated, requiring seamless coordination to achieve successful outcomes. In an environment of intensified competition, achieving operational efficiency has become not only a goal but a necessity, as enterprises that fail to operate efficiently risk facing the threat of closure. Operational performance, therefore, is a key determinant of organizational success, hinging on several critical factors such as cost, quality, delivery, and adaptability.

The lean management approach, rooted in the renowned Toyota Production System, offers a systematic methodology aimed at eliminating waste, optimizing resource use, and reducing costs. Lean management focuses on addressing eight distinct categories of waste within the production process: transportation, inventory, motion, over-processing, defects, overproduction, waiting, and the underutilization of talent (Liker, 2004). Originally pioneered by Toyota in Japan, the lean management concept has gained widespread global traction and is now extensively implemented across various manufacturing industries (Womack, Jones, & Roos, 1990). Its principles of efficiency and waste reduction are particularly relevant to the apparel industry, where margins are often tight, and operational efficiency can significantly impact profitability.

In Sri Lanka, the clothing sector has been proactive in adopting lean management practices, with approximately 714 companies integrating these principles into their operations (Export Development Board, 2023). This widespread adoption is driven by the industry's need to enhance operational efficiency, improve product quality, and bolster competitiveness in an increasingly challenging global marketplace (Jayalath & Gunasekara, 2022). Research consistently demonstrates that lean management can lead to substantial improvements in production efficiency and product quality, thereby supporting the apparel industry's objective of reaching higher export values (Shah & Ward, 2003). Furthermore, the implementation of lean principles enables Sri Lankan apparel manufacturers to meet stringent international standards and exceed customer expectations, contributing to long-term sustainability and growth (Hodge, Goforth, & Sainsbury, 2017).

Beyond enhancing operational performance, lean management serves as a strategic tool for achieving competitive advantage by fostering a culture of continuous improvement and innovation. The lean philosophy emphasizes the importance of employee involvement, leveraging their insights to

streamline processes, which can result in significant productivity gains and cost savings (Bhasin, 2012). As the Sri Lankan apparel industry continues to navigate the challenges posed by global competition and economic pressures, the strategic application of lean management practices will be crucial in achieving not only operational excellence but also securing a sustainable competitive edge in the market. This approach not only aligns with the industry's economic goals but also supports broader objectives such as improving working conditions, enhancing product quality, and ensuring long-term sustainability.

In conclusion, the apparel industry in Sri Lanka stands at a critical juncture, where the adoption of lean management practices could define its future trajectory. By focusing on operational efficiency, quality enhancement, and continuous innovation, the industry can not only meet its ambitious export targets but also establish itself as a global leader in apparel manufacturing.

2. Problem Statement

The prevailing economic crisis in Sri Lanka, exacerbated by a substantial increase in the inflation rate to 48.19%, has severely impacted the garment industry. In January 2023, garment exports suffered a notable loss of \$388.9 million, reflecting an 18.8% decrease compared to the previous year and an 8.7% drop from December 2022 (Central Bank of Sri Lanka, 2023). This sharp decline underscores the urgent need for improved operational performance to sustain competitiveness in the garment industry. The economic downturn has intensified the challenges faced by Sri Lankan apparel manufacturers, making the adoption of effective management strategies critical for survival and growth.

The garment industry, a significant contributor to Sri Lanka's economy, has traditionally relied on cost-reduction measures to maintain its competitive edge. However, the current economic environment demands a shift in focus towards enhancing operational efficiency and quality. According to the Joint Apparel Association Forum (JAAF), the Sri Lankan apparel sector aims to achieve an export value of \$8 billion by 2025, emphasizing the importance of quality and specialized items over mere cost reduction (JAAF, 2022). This goal highlights the necessity for innovative management approaches that can drive operational excellence and ensure long-term sustainability.

The study by Klein et al. (2020) underscores the importance of waste reduction and continuous improvement as catalysts for process transformation, principles that are integral to lean management. Lean management, which originated from the Toyota Production System, focuses on eliminating waste, optimizing resources, and reducing costs. It addresses eight categories of waste: transportation, inventory, motion, additional processing, defects, overproduction, waiting, and untapped talent (Liker, 2004). Despite the widespread adoption of lean practices globally, many Sri Lankan apparel manufacturers struggle to fully leverage the benefits of these strategies.

Given the significant challenges faced by the apparel industry, this research aims to investigate the correlation between lean management practices and operational performance in Sri Lanka's apparel manufacturing sector. This study aims to provide practical insights on integrating lean practices with Sustainable Development Goals (SDGs) 8 and 12, which emphasize decent work and economic growth, and responsible consumption and production, respectively (United Nations, 2015). By improving operational efficiency and minimizing waste, lean management not only supports economic growth through enhanced productivity and competitiveness but also advances sustainable industrial practices. This dual focus allows businesses to expand sustainably while reducing their environmental impact, contributing to wider economic and environmental goals. The research will address existing gaps and propose actionable strategies to optimize lean practices, thereby enhancing operational performance and promoting sustainable development within the Sri Lankan apparel industry.

3. Literature Review

3.1 Theoretical Underpinning

Lean management traces its origins back to the Toyota Production System introduced in the 1970s, which emphasized efficiency and waste reduction (Gunarathne et al., 2017). Over the decades, lean management has been characterized in various ways, focusing on the relentless pursuit of waste removal and optimizing resources to deliver value to the client (Bhamu & Sangwan, 2014; Al-Shawi & Manhal, 2020). Lean management identifies eight types of waste: defects, overproduction, waiting, underused talent, transportation, inventory, motion, and overprocessing (Pierce & Rich, 2015). This methodology emphasizes value, value flow, process flow, pull production, and perfection, advocating for a systematic approach to achieving high performance and continuous value addition (Liker & Morgan, 2006).

Contemporary studies have reaffirmed the relevance of lean management across various industries, highlighting its ability to provide a competitive edge and improve operational performance (Al-Shawi & Manhal, 2020). Lean management's holistic approach not only addresses waste but also integrates continuous improvement, leadership support, and supplier involvement as critical components (Gustafsson & Frost, 2018). (Gustafsson & Frost, 2018).

3.2 Continuous Improvement and Operational Performance

Continuous improvement, a core principle of lean management, involves the ongoing effort to enhance products, services, or processes by making incremental improvements over time (Klein et al., 2022a). This approach is fundamental to lean management, aiming to achieve more with fewer resources and align organizational activities with strategic objectives (Gupta et al., 2016). It

encompasses both internal and external processes, focusing on optimizing organizational activities, redrawing flow, reducing waste, and generating lower costs (Klein et al., 2022b).

Studies have shown that continuous improvement practices significantly impact operational performance by fostering a culture of regular evaluation and enhancement (Goh, Goh, & Ho, 2021). Organizations that embrace continuous improvement tend to exhibit higher efficiency, better quality control, and greater adaptability to market changes (Demir, 2020). Moreover, recent research by Aij and Teunissen (2021) highlights the importance of leadership support in sustaining continuous improvement initiatives, ensuring long-term operational excellence. Continuous improvement not only improves operational metrics but also contributes to employee engagement and satisfaction by promoting a culture of ongoing learning and development (Bhattacharjee & Gopalakrishnan, 2021). (Demir, 2020).

Hypothesis 1 (H1): There is a relationship between continuous improvement and operational performance in the apparel industry in Sri Lanka.

3.3 Waste Elimination and Operational Performance

Waste management in lean practices involves identifying and removing unnecessary steps in processes that do not add value (Klein et al., 2022a). Among lean practices, the elimination of waste is a fundamental aspect, seen as a continuous pursuit in lean management philosophy (Wickramasinghe & Wickramasinghe, 2017). Tools such as value stream mapping are employed to identify inefficiencies and streamline processes (Abbasian-Hosseini et al., 2012).

Research indicates that effective waste elimination leads to significant improvements in operational performance, including reduced costs, enhanced quality, and faster delivery times (Tiso et al., 2021). By focusing on waste elimination, organizations can create more efficient workflows and reduce the likelihood of defects and delays (Alves & Alves, 2015). Contemporary studies by Wilson and Roy (2018) emphasize the role of technology in enhancing waste elimination efforts, suggesting that digital tools can further streamline processes and improve accuracy in waste identification. Furthermore, Bhamu and Sangwan (2020) argue that integrating waste elimination practices with sustainability initiatives can enhance both operational efficiency and environmental performance, contributing to long-term business success. (Alves & Alves, 2015).

Hypothesis 2 (H2): There is a relationship between waste elimination and operational performance in the apparel industry in Sri Lanka.

3.4 Supplier Involvement and Operational Performance

Supplier involvement is critical in lean management as it ensures that all parts of the supply chain are optimized for efficiency and quality (Gunasekaran et al., 2015). Effective supplier involvement

includes developing partnerships, sharing information, and collaborating on continuous improvement initiatives (Lamming et al., 2001). Studies have shown that strong supplier relationships contribute to improved operational performance by enhancing the quality of inputs, ensuring timely delivery, and fostering innovation (Dabhilkar et al., 2016). When suppliers are integrated into the lean management framework, they can contribute to the overall efficiency and competitiveness of the organization (Vanichchinchai, 2019).

Recent research underscores the strategic importance of supplier involvement in achieving operational excellence. For instance, Hald and Ellegaard (2020) highlight that close collaboration with suppliers leads to enhanced operational flexibility and responsiveness. They argue that such collaborations are essential for managing supply chain disruptions and maintaining continuous improvement efforts. Furthermore, Flynn, Huo, and Zhao (2019) emphasize that supplier integration in lean practices results in better alignment of processes and goals, thereby reducing waste and improving quality.

Contemporary studies also explore the role of digital technologies in enhancing supplier involvement. Choi et al. (2019) discuss how digital platforms facilitate real-time information sharing and collaborative planning between manufacturers and suppliers. This digital integration supports lean management by enabling more accurate demand forecasting and inventory management, ultimately leading to improved operational performance.

Hypothesis 3 (H3): There is a relationship between supplier involvement and operational performance in the apparel industry in Sri Lanka.

3.5 Leadership Support and Operational Performance

Leadership support is essential in lean management as it provides the necessary direction, resources, and motivation for continuous improvement initiatives (Klein et al., 2022a). Leaders play a crucial role in fostering a culture that supports lean principles, facilitating communication, and ensuring that lean strategies are aligned with organizational goals (Ashtiani et al., 2017). Leadership support involves developing and implementing structures and processes that anticipate and respond to the challenges of lean initiatives that cross internal boundaries, transforming commitments to change into actual change, and supporting and sustaining new behaviors and practices.

Research indicates that leadership support significantly impacts operational performance by enabling organizations to effectively implement lean practices, sustain improvements, and achieve long-term success (Aij & Teunissen, 2017). Leaders who are committed to lean management can drive transformational change and create an environment conducive to continuous improvement (Ravi &

Subramanian, 2016). This support is not limited to top management but extends to all levels of leadership, ensuring that lean principles are integrated throughout the organization.

Contemporary literature highlights the evolving role of leadership in lean management. Marodin and Saurin (2021) suggest that transformational leadership, which inspires and motivates employees to exceed expectations, is particularly effective in implementing lean practices. They found that transformational leaders are more successful in fostering a culture of continuous improvement and sustaining lean initiatives over time.

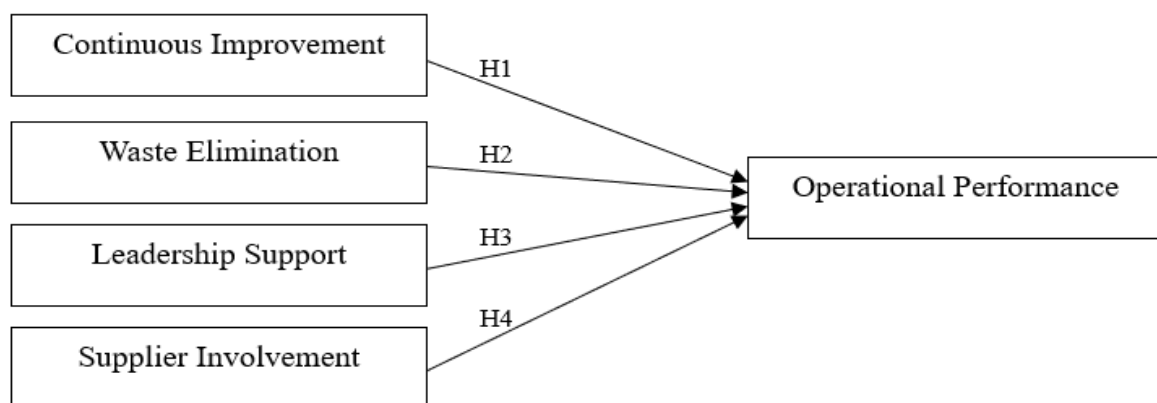
Moreover, a study by Jadhav, Mantha, and Rane (2019) points out that leadership support is critical in overcoming resistance to change, a common barrier in lean implementation. Effective leaders can facilitate change management by communicating the benefits of lean practices and involving employees in decision-making processes, thus enhancing buy-in and commitment to lean initiatives.

Recent developments also emphasize the importance of leadership training and development in lean management. According to Hu et al. (2020), providing leaders with specific training on lean principles and tools enhances their ability to support and sustain lean transformations. This training equips leaders with the skills needed to identify and address barriers to lean implementation, further improving operational performance.

Hypothesis 4 (H4): There is a relationship between leadership support and operational performance in the apparel industry in Sri Lanka. (Lamming et al., 2001).

4. Conceptual Framework

Figure 1: Conceptual Framework



Source: Author generated

4.1 Continuous Improvement

Continuous improvement is defined as an ongoing effort to enhance products, services, or processes through incremental and breakthrough improvements (Klein et al., 2022a). It involves systematically refining and optimizing processes to achieve higher levels of efficiency and effectiveness (Demir, 2020). Gupta et al. (2016) describe it as the core of management philosophy aimed at doing more with fewer resources by linking continuous improvement activities to strategic objectives.

4.2 Waste Elimination

Waste elimination in lean management refers to the systematic identification and removal of non-value-adding activities from processes to enhance efficiency (Wickramasinghe & Wickramasinghe, 2017). Abbasian-Hosseini et al. (2012) emphasize that waste elimination is a continuous pursuit in lean philosophy, utilizing tools such as value stream mapping to identify and eradicate inefficiencies.

4.3 Supplier Involvement

Supplier involvement entails the active participation of suppliers in an organization's processes to enhance quality, reduce costs, and improve overall performance (Gunasekaran et al., 2015). Dabhilkar et al. (2016) highlight that supplier involvement in product development can significantly improve alignment and coordination, resulting in better operational performance.

4.4 Leadership Support

Leadership support in lean management is crucial for providing direction, resources, and motivation necessary for successful implementation of lean practices (Klein et al., 2022a). Aij and Teunissen (2017) argue that effective leadership is essential for fostering a culture of continuous improvement and overcoming resistance to change.

4.5 Operational Performance

Operational performance is typically defined as the efficiency and effectiveness of an organization's processes in producing goods and services (Shah & Ward, 2003). It encompasses several dimensions, including cost, quality, delivery, and flexibility (Ravi & Subramanian, 2016). According to Demir (2020), operational performance is a critical determinant of organizational success, reflecting the ability to meet customer requirements and achieve competitive advantage.

5. Methodology

5.1 Research Philosophy

The research philosophy describes the strategy or technique used in the research. This study is based on Positivism philosophy, wherein the researcher maintains a strategic distance from individual bias and is not part of the study (Melnikovas, 2018; Gunarathne et al., 2017).

5.2 Research Approach

The main approach used for theory development in this research is the deductive approach, which focuses on variable testing and hypothesis formulation (Saunders et al., 2019).

5.3 Research Choice

This research utilizes a quantitative method, specifically a mono-method research choice, where data collection was performed using a structured questionnaire with a 5-point Likert scale derived from previous studies related to lean management practices (Bhatta et al., 2017; Klein et al., 2022a; Bashar et al., 2021b).

5.4 Unit of Analysis

The unit of analysis for this research is managerial-level employees in apparel manufacturing companies in Sri Lanka. This is due to the focus on evaluating the impact of lean management practices at the managerial level within these organizations.

5.5 Population and Study Sample

The population for this study comprises apparel manufacturing companies in Sri Lanka that had implemented lean manufacturing practices by 2019, as identified in previous research (Aryarathne & Galahitiyawe, 2020b). This population includes a total of 714 apparel manufacturing plants operating across the country. These companies represent a significant portion of Sri Lanka's textile and garment industry, which is a key driver of the nation's economy.

To ensure the study's findings are robust and representative, the top 10 apparel manufacturing companies were selected for the sample, based on their market capitalization. These companies collectively account for more than 75% of the market share, making them critical players in the industry and ideal for this study (Top Apparel Manufacturing Companies Based on Market Capital in Sri Lanka, n.d.). The selection of these companies ensures that the study captures insights from the most influential firms in the sector, where the implementation of lean practices is likely to have the most significant impact on operational performance.

A total sample size of 275 managerial-level employees was determined, aligning with established methodologies in similar studies within the field (Aryarathne & Galahitiyawe, 2020a). This sample

size allows for sufficient statistical power to detect meaningful relationships between lean management practices and operational outcomes. Specifically, data were collected from 28 managerial-level employees from each of the 10 selected manufacturing plants. These employees were chosen because of their direct involvement in the implementation and oversight of lean manufacturing practices, making their insights particularly valuable for understanding the operational impact of these practices.

The study employed purposive sampling, a non-probability sampling method, to select participants. This approach was chosen due to its effectiveness in targeting specific individuals who possess the necessary expertise and experience related to lean management practices. Purposive sampling ensures that the participants included in the study have the requisite knowledge to provide informed responses, thereby enhancing the reliability and relevance of the findings (Aryarathne & Galahitiyawwe, 2020a). This method is particularly suitable for this research as it focuses on managerial-level employees who are not only familiar with but also play a critical role in the execution of lean strategies within their organizations.

This sampling strategy, combined with the carefully selected sample size and population, ensures that the study provides a comprehensive and accurate assessment of the impact of lean management practices on operational performance within Sri Lanka's leading apparel manufacturing companies.

5.6 Measurement of Constructs

Respondents were asked to rate the extent of lean management practices implemented in their organization on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). The constructs include:

Continuous Improvement- This construct involves encouraging continual improvement, frequently measuring product and process quality, using QC tools, and extensively applying the PDCA (Plan-Do-Check-Act) cycle (Klein et al., 2022a; Gupta et al., 2016).

Waste Management- This construct includes efforts to reduce waste, suggesting waste reduction, identifying waste, and continuously working to eliminate waste (Klein et al., 2022a; Wickramasinghe & Wickramasinghe, 2017).

Leadership Support- This construct assesses the involvement of top executives, their anticipation of change, encouragement of lean-based improvements, allocation of resources, and trust in managers (Klein et al., 2022a; Ashtiani et al., 2017).

Supplier Involvement- In lean management, supplier involvement is crucial as it ensures that all parts of the supply chain are optimized for efficiency and quality (Gunasekaran et al., 2015). Effective

supplier involvement includes developing partnerships, sharing information, and collaborating on continuous improvement initiatives (Lamming et al., 2001).

Operational Performance- This construct includes improvements in process efficiency, adherence to product specifications, timely delivery, production flexibility, and speed of launching new products (Klein et al., 2022a; Aij & Teunissen, 2017).

5.7 Data Analysis Strategies

Data collected via questionnaires were analysed using the Statistical Package for Social Sciences (SPSS). Descriptive and inferential analyses were used to describe the aspect of lean management practices on the operational performance of apparel manufacturing plants. Additionally, correlation and regression analyses were employed to analyse the relationship between the independent and dependent variables.

6. Analysis and Findings

6.1 Demographic Analysis

Table 1: Companies

Company name	Frequency	Percent
Brandix	27	11%
Emjay International	18	7%
Hayleys fabric	30	12%
Hela clothing	27	11%
Hydramani	28	11%
Intex South Asia	37	15%
MAS	34	14%
Star garments	19	8%
Yuppy socks	11	4%
Virtue tape industry	20	8%
Total	251	100%
Sample size	275	
Response percentage	91%	

Table 1 presents detailed demographic data concerning the companies involved in the study. The research surveyed a total of 251 managerial-level employees across ten leading apparel manufacturing companies in Sri Lanka. Initially, a sample size of 275 was targeted, resulting in an impressive response rate of 91%. This high response rate reflects the strong engagement and willingness of the managerial staff to contribute to the study, which enhances the reliability and representativeness of the findings.

Notably, the table also highlights that the highest response rates were recorded from Intex South Asia, which accounted for 15% of the total responses, and MAS, contributing 14%. This substantial participation from these two companies underscores their significant role within the industry and suggests a strong commitment to lean management practices among their managerial teams.

The high level of engagement from Intex South Asia and MAS not only enriches the dataset but also provides valuable insights into how leading firms within the Sri Lankan apparel sector are adopting and benefiting from lean management practices.

6.2 Reliability Analysis

Table 2: Reliability

Variables	No of items	Cronbach's Alpha
Continuous improvement	5	0.946
Waste elimination	5	0.949
Leadership support	5	0.949
Supplier involvement	5	0.951
Operational performance	5	0.947

The study demonstrates high reliability across various constructs related to lean management, with Cronbach's Alpha values indicating strong internal consistency for each scale. The continuous improvement scale, essential for maintaining competitive advantage, shows a Cronbach's Alpha of 0.946, reflecting its high reliability (Demir, 2020). Similarly, the waste elimination scale records a Cronbach's Alpha of 0.949, verifying its effectiveness in measuring efforts to reduce non-value-adding activities, a core aspect of lean management (Wickramasinghe & Wickramasinghe, 2017). Leadership support, critical for the successful implementation of lean practices, also presents strong internal consistency with a Cronbach's Alpha of 0.949, emphasizing its role in providing necessary direction and resources (Aij & Teunissen, 2017). The supplier involvement scale, with the highest Cronbach's Alpha of 0.951, underscores the importance of including suppliers in lean initiatives to

boost quality and innovation (Gunasekaran et al., 2015). Lastly, the operational performance scale shows a Cronbach's Alpha of 0.947, confirming consistent measurement of critical organizational success factors like cost, quality, delivery, and flexibility (Ravi & Subramanian, 2016). Overall, all constructs surpass the acceptable reliability threshold of 0.7, ensuring the validity of the data collected in the study.

6.3 Correlation Analysis

Table 3: Correlation Analysis

		Mean_CI	Mean_WE	Mean_LI	Mean_SI	Mean_OP
Mean_CI	Pearson	1	.881**	.864**	.835**	.820**
	Correlation					
	Sig. (2-tailed)		.000	.000	.000	.000
	N	251	251	251	251	251
Mean_WE	Pearson	.881**	1	.912**	.888**	.840**
	Correlation					
	Sig. (2-tailed)	.000		.000	.000	.000
	N	251	251	251	251	251
Mean_LI	Pearson	.864**	.912**	1	.920**	.872**
	Correlation					
	Sig. (2-tailed)	.000	.000		.000	.000
	N	251	251	251	251	251
Mean_SI	Pearson	.835**	.888**	.920**	1	.866**
	Correlation					
	Sig. (2-tailed)	.000	.000	.000		.000
	N	251	251	251	251	251
Mean_OP	Pearson	.820**	.840**	.872**	.866**	1
	Correlation					
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	251	251	251	251	251

** . Correlation is significant at the 0.01 level (2-tailed).

The correlation analysis reveals robust positive relationships between various lean management practices and operational performance within Sri Lanka's apparel industry. Notably, Continuous Improvement (CI) and Operational Performance (OP) exhibit a correlation coefficient of 0.820, which underscores the significant role that continuous improvement practices play in enhancing operational

performance. This finding aligns with the literature, which consistently highlights continuous improvement as a critical driver of efficiency and effectiveness in production processes (Demir, 2020).

Similarly, the correlation between Waste Elimination (WE) practices and operational performance is strong, with a coefficient of 0.840. This relationship indicates that the systematic removal of wasteful activities—such as excess inventory, unnecessary motion, and defects—substantially contributes to operational efficiency. Effective waste elimination not only reduces costs but also streamlines processes, leading to faster delivery times and improved product quality (Wickramasinghe & Wickramasinghe, 2017).

Leadership Support (LS) emerges as an even more potent factor, showing the strongest positive correlation with operational performance, marked at 0.872. This highlights the pivotal role that leadership plays in the successful implementation and sustainability of lean practices. Leaders who are committed to lean principles can drive organizational change, foster a culture of continuous improvement, and ensure that resources are allocated effectively to support lean initiatives (Aij & Teunissen, 2017). Leadership support is therefore essential for overcoming resistance to change and embedding lean practices deeply within the organizational fabric.

Additionally, Supplier Involvement (SI) demonstrates a strong correlation with operational performance, with a coefficient of 0.866. This suggests that active engagement with suppliers, through collaborative planning, information sharing, and joint problem-solving, can significantly enhance operational outcomes. When suppliers are integrated into the lean management framework, they contribute to improved quality of inputs, more reliable delivery schedules, and greater innovation, all of which are critical for maintaining a competitive edge in the global apparel market (Gunasekaran et al., 2015).

Overall, these findings underscore the substantial impact that enhancing continuous improvement, waste elimination, leadership support, and supplier involvement can have on operational performance. In the context of Sri Lanka's apparel manufacturing sector, where competition is fierce and operational efficiency is paramount, these lean practices are not just beneficial—they are essential. The correlations observed suggest that a comprehensive approach to lean management, which integrates these key practices, can drive significant improvements in operational outcomes, positioning Sri Lankan apparel manufacturers to better meet both domestic and international market demands.

6.4 Regression Analysis

Table 4: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.893 ^a	.797	.794	.41002

Table 5: Anova Table

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	162.702	4	40.675	241.953	.000 ^b
	Residual	41.356	246	.168		
	Total	204.058	250			

a. Dependent Variable: Mean_OP

b. Predictors: (Constant), Mean_SI, mean_CI, Mean_WE, Mean_LI

Table 6: Coefficient Analysis

		B	Std. Error	Beta		
1	(Constant)	.380	.122		3.108	.002
	Mean_CI	.184	.062	.189	2.955	.003
	Mean_WE	.057	.077	.060	.736	.463
	Mean_LI	.335	.088	.336	3.805	.000
	Mean_SI	.337	.075	.346	4.482	.000

a. Dependent Variable: Mean_OP

Table 7: Hypotheses Testing Results

Hypothesis	Result
There is a significant relationship between Continuous improvement and operational performance.	Accepted
There is a significant relationship between Waste elimination and operational performance.	Rejected
There is a significant relationship between Leadership support and operational performance.	Accepted
There is a significant relationship between Supplier involvement and operational performance.	Accepted

The model summary (Table 4) indicates an R square value of 0.797, suggesting that 79.7% of the variance in operational performance, the dependent variable, is explained by the four independent variables: Continuous Improvement (CI), Waste Elimination (WE), Leadership Support (LS), and

Supplier Involvement (SI). This high R square value reflects the substantial explanatory power of the model, indicating that these factors collectively account for a significant portion of the variability in operational performance. Furthermore, the Adjusted R square value of 0.794, which adjusts for the number of predictors, reaffirms the model's robustness and reliability in explaining the dependent variable.

The ANOVA results (Table 5) provide further validation of the model's strength, with an F-value of 241.953, which is statistically significant at the $p < 0.001$ level. This highly significant F-value demonstrates that the regression model as a whole is statistically significant, meaning that the independent variables—CI, WE, LS, and SI—jointly explain a significant amount of the variance in operational performance. This finding underscores the importance of these variables in influencing operational outcomes within the context of the study.

In the coefficient analysis (Table 6), the individual contributions of each independent variable to the model are elucidated. Continuous Improvement (CI) shows a coefficient of 0.184 with a p-value of 0.003, indicating a statistically significant positive relationship with operational performance. This suggests that improvements in continuous improvement practices are likely to lead to enhancements in operational performance. In contrast, Waste Elimination (WE) exhibits a coefficient of 0.057 with a p-value of 0.463, indicating that this variable is not significantly related to operational performance in the current model, highlighting a potential area where further investigation or strategy refinement might be necessary.

Leadership Support (LS) emerges as a critical factor, with a coefficient of 0.335 and a p-value of 0.000, indicating a strong and significant positive impact on operational performance. This finding suggests that leadership's role in guiding and supporting lean management initiatives is pivotal in driving operational success. Similarly, Supplier Involvement (SI) also demonstrates a significant positive relationship with operational performance, with a coefficient of 0.337 and a p-value of 0.000, underscoring the importance of integrating suppliers into the lean management framework to enhance efficiency and performance outcomes.

The hypotheses testing results (Table 7) corroborate these findings, confirming that H1, H3, and H4—concerning Continuous Improvement, Leadership Support, and Supplier Involvement, respectively—are accepted, indicating significant positive relationships with operational performance. However, H2, which posited a significant relationship between Waste Elimination and operational performance, is rejected, suggesting that waste elimination does not significantly impact operational performance in this study's context.

While the study provides valuable insights, it also acknowledges certain methodological limitations. Notably, the study did not test the assumptions critical for Ordinary Least Squares (OLS) regression,

such as linearity, independence of errors, homoscedasticity, and normality of residuals. These assumptions are vital for ensuring the reliability and validity of the regression results, and failure to verify them could lead to biased outcomes and inaccurate conclusions (Wooldridge, 2015). Additionally, the study opted for multiple regression, despite the ordinal nature of some dependent variables, which could have benefited from ordinal regression models like ordered logit or probit. These models might provide more accurate estimates for ordinal data, reflecting the complexity of the relationships being studied (Long & Freese, 2014). Nevertheless, by adhering to key assumptions where possible, the study maintains that multiple regression remains a valid and insightful method for analysing the relationships between the variables in question.

7. Discussion

The findings from the coefficient analysis and hypothesis testing results reveal several important insights into the relationship between lean management practices and operational performance in Sri Lanka's apparel industry. One of the key takeaways is the significant positive relationship between Continuous Improvement (CI) and operational performance, as indicated by a coefficient of 0.184 and a p-value of 0.003. This result aligns with a substantial body of literature that underscores the critical role of continuous improvement in driving operational efficiency and effectiveness. Continuous improvement entails a systematic, ongoing effort to enhance products, services, and processes, directly contributing to the overall operational performance of an organization. The impact of these practices is well-documented, with studies showing that continuous improvement leads to better quality, reduced cycle times, and increased customer satisfaction—factors that are essential for achieving operational excellence (Demir, 2020; Bessant & Caffyn, 1997; Imai, 1986). This finding supports the perspective that organizations focusing on continuous improvement are more likely to achieve sustainable operational success over time.

In contrast, the analysis revealed a non-significant relationship between Waste Elimination (WE) and operational performance, as indicated by a coefficient of 0.057 and a p-value of 0.463. This finding stands in contrast to some previous studies that have emphasized the importance of waste reduction as a critical component of lean management aimed at enhancing performance (Womack & Jones, 1996). The unexpected outcome suggests that, within the context of Sri Lankan apparel manufacturing, other factors may overshadow the direct impact of waste elimination. This could imply that while waste elimination is important, its benefits may be more indirect or require a longer time to manifest significantly in operational performance metrics. It is possible that the maturity level of lean practices within the companies studied, or specific industry challenges unique to Sri Lanka,

could impact the effectiveness of waste elimination strategies. Further research could be instrumental in exploring these aspects to understand the nuances behind this finding (Hofer et al., 2012).

Leadership Support (LS) emerged as another critical factor positively influencing operational performance, with a significant coefficient of 0.335 and a p-value of 0.000. This finding underscores the essential role that leadership plays in the successful implementation of lean management practices. Effective leadership ensures that the organization has a clear vision, adequate resources, and a culture that supports continuous improvement and adherence to lean principles (Aij & Teunissen, 2017). Leaders are instrumental in driving change, facilitating effective communication, and ensuring that lean strategies are aligned with the broader organizational goals (Ashtiani & Arshadi, 2017). This result is consistent with existing literature that highlights the importance of proactive and committed leadership in sustaining lean initiatives and embedding a culture of continuous improvement across the organization (Dombrowski & Mielke, 2014). The influence of leadership on operational performance is profound, as it not only drives immediate improvements but also ensures the long-term success and competitiveness of the industry (Ravi & Subramanian, 2016).

Finally, the analysis highlights the significant positive relationship between Supplier Involvement (SI) and operational performance, as indicated by a coefficient of 0.337 and a p-value of 0.000. This finding emphasizes the importance of integrating suppliers into the lean management framework. Effective supplier involvement is critical for developing strong partnerships, sharing valuable information, and collaborating on continuous improvement initiatives (Gunasekaran et al., 2015). Research indicates that strong supplier relationships contribute to improved quality of inputs, timely delivery, and innovation, all of which are crucial for achieving operational excellence (Dabhilkar et al., 2016). The integration of suppliers into the lean management process significantly enhances the overall efficiency and competitiveness of the organization. This finding is further supported by studies that underscore the critical role of supplier involvement in achieving lean supply chain objectives and enhancing overall performance (Vanichchinchai, 2019; Gunasekaran et al., 2015).

Overall, these findings highlight the multifaceted nature of lean management practices and their varying impacts on operational performance in Sri Lanka's apparel industry. The positive relationships between continuous improvement, leadership support, and supplier involvement with operational performance demonstrate the importance of these factors in achieving excellence. However, the unexpected results regarding waste elimination suggest that more nuanced, context-specific strategies may be necessary to fully leverage the benefits of lean practices in this industry.

8. Conclusions, Practical Implications and Suggestions for Future Research

This study provides a comprehensive analysis of the impact of lean management practices—specifically continuous improvement, waste elimination, leadership support, and supplier involvement—on the operational performance of Sri Lanka's apparel industry. The findings indicate that continuous improvement, leadership support, and supplier involvement play significant roles in enhancing operational performance. However, the anticipated positive impact of waste elimination was not observed, suggesting that the current strategies employed for waste management in the industry may require a thorough re-evaluation.

The positive correlation between continuous improvement and operational performance underscores the critical importance of fostering a culture of ongoing enhancement within organizations. To effectively embed this culture, companies should invest in regular training sessions, workshops, and other developmental programs that empower employees to take an active role in identifying and implementing process improvements. Encouraging continuous feedback and fostering an environment where innovation and incremental improvements are valued can lead to substantial gains in operational efficiency and product quality.

Leadership support emerged as another pivotal factor influencing operational success. The findings highlight the necessity for management to demonstrate a strong, visible commitment to lean principles. Leaders who actively participate in lean initiatives and maintain open communication channels with their teams can significantly bolster continuous improvement efforts. By fostering a culture of trust and collaboration, leaders can drive transformational changes that align operational practices with strategic goals, thereby enhancing overall performance.

The study also emphasizes the significant impact of supplier involvement in the lean management framework. Establishing strong, collaborative partnerships with suppliers, particularly by involving them early in the product design and development stages, ensures that suppliers are fully aligned with the company's lean objectives. This collaborative approach not only enhances the quality of inputs but also improves production processes, leading to greater efficiency and operational excellence. Supplier integration into the lean framework is thus a critical strategy for achieving sustained improvements in both product quality and production efficiency.

Despite these successes, the lack of a significant relationship between waste elimination and operational performance suggests that the current waste management strategies may not be as effective as expected. This finding points to the need for organizations to reassess their waste elimination practices to ensure that they are not merely focusing on waste reduction as an isolated goal, but rather integrating it into a broader strategy that aligns with overall operational objectives. Companies may need to adopt more sophisticated tools and techniques, or perhaps reconsider the

specific aspects of waste management that are emphasized, to better contribute to operational efficiency.

Looking ahead, this study opens several avenues for future research. Longitudinal studies could be particularly valuable, providing deeper insights into how lean management practices influence operational performance over time. Such studies would help to establish a clearer causal relationship and identify the long-term benefits of sustained lean management efforts. Additionally, comparing the impact of lean practices across different sectors could offer a broader understanding of how these practices perform in various industrial contexts. This comparative approach could help identify sector-specific challenges and best practices, offering more tailored strategies for different industries.

Furthermore, incorporating qualitative research methods, such as interviews and case studies, could complement the quantitative findings of this study. These methods would allow for a more nuanced exploration of the mechanisms through which lean practices influence operational performance, providing richer, context-specific insights. Such qualitative data could help uncover the subtleties of how lean management practices are perceived and implemented within organizations, offering a more comprehensive understanding of their impact.

In conclusion, while this study highlights the significant benefits of lean management practices in improving operational performance, it also underscores the need for continuous assessment and adaptation of these practices. By addressing the gaps identified in waste elimination strategies and exploring the suggested avenues for future research, organizations can better harness the full potential of lean management to drive sustained operational excellence and competitive advantage in the global marketplace.

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