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ARTICLES

Analisis Pengaruh Kadar Air dan Porositas terhadap Kuat Tekan, Kuat Tarik, dan Kuat Geser pada Batupasir Formasi Balikpapan dan Pulau Balang, Kabupaten Kutai Kartanegara

Weggie Atanasius Tonapa, Universitas Mulawarman, Indonesia
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Rety Winonazada, Universitas Mulawarman , Indonesia
Tommy Trides, Universitas Mulawarman , Indonesia

Ardhan Ismail, Universitas Mulawarman , Indonesia
01-20
DOI : https://doi.org/10.61132/venus.v4i3.1392

Analisis Upper Bound dan Lower Bound pada Kuat Tekan Batupasir Formasi Balikpapan dan Pulau Balang dengan Metode Uniaxial Compressive Strength, Point Load Index dan Schmidt Hammer

Aisyatur Ridho, Universitas Mulawarman, Indonesia
Tommy Trides, Universitas Mulawarman, Indonesia
Rety Winonazada, Universitas Mulawarman , Indonesia
Albertus Juvensius Pontus, Universitas Mulawarman , Indonesia
Revia Oktaviani, Universitas Mulawarman , Indonesia
21-34
DOI : https://doi.org/10.61132/venus.v4i3.1425

Identifikasi Potensi Bahaya pada Keamanan, Keselamatan, Kesehatan Kerja, dan Lingkungan (K3l) di Gardu Induk Balaraja Lama Menggunakan Metode Hirarc (Hazard Identification, Risk Assessment, Risk Control)

Muhamad Putra Dermawan, Universitas Dian Nusantara, Indonesia
Belinda Ayuningtyas, Universitas Dian Nusantara, Indonesia
35-51
DOI : https://doi.org/10.61132/venus.v4i3.1474

Integrating Circular Economy, Lean, and Financial Performance into Sustainable Fashion Retail Supply Chains: A Conceptual Framework

Hauw-Sen Tan, Universitas Bina Nusantara, Indonesia
Marvin Manuel Utomo, Bina Nusantara University, Indonesia, Indonesia
Henny Wirianata, Tarumanagara University, Indonesia, Indonesia
52-66
DOI : https://doi.org/10.61132/venus.v4i3.1569

Rancang Bangun Cetakan Injection Molding Skala Laboratorium untuk Produk Segi Enam Berbahan Plastik HDPE Daur Ulang

Rinaldi Silalahi, Universitas Medan Area, Indonesia
Tino Hermanto, Universitas Medan Area, Indonesia

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KEYWORDS: Circular Economy, Fashion Retail, Financial Performance, Lean Supply Chain, Sustainable Development Goals

ABSTRACT

The fashion retail industry faces increasing pressure to achieve sustainability while maintaining operational efficiency and financial viability, particularly in supporting SDG 9 and SDG 12. Circular Economy (CE) supports waste reduction and lifecycle extension, while Lean improves operational efficiency; however, their integration with financial performance remains limited. This study develops a conceptual framework for sustainable fashion retail supply chains using a literature-based conceptual design approach. The framework integrates CE as an intervention layer, Lean as an operational governance layer, and Financial Performance as a validation layer consisting of profitability stability and reinvestment capability. The study contributes a system-level integration logic in which CE reshapes structure, Lean stabilizes execution, and financial performance validates economic feasibility.

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Integrating Circular Economy, Lean, and Financial Performance into Sustainable Fashion Retail Supply Chains: A Conceptual Framework

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Abstract. The fashion retail industry faces increasing pressure to achieve sustainability while maintaining operational efficiency and financial viability, particularly in supporting SDG 9 and SDG 12. Circular Economy (CE) supports waste reduction and lifecycle extension, while Lean improves operational efficiency; however, their integration with financial performance remains limited. This study develops a conceptual framework for sustainable fashion retail supply chains using a literature-based conceptual design approach. The framework integrates CE as an intervention layer, Lean as an operational governance layer, and Financial Performance as a validation layer consisting of profitability stability and reinvestment capability. The study contributes a system-level integration logic in which CE reshapes structure, Lean stabilizes execution, and financial performance validates economic feasibility.

Keywords: Circular Economy; Fashion Retail; Financial Performance; Lean Supply Chain; Sustainable Development Goals

1. INTRODUCTION

The fashion retail industry faces increasing pressure to achieve environmental sustainability while maintaining operational efficiency and financial viability. Demand volatility, short product lifecycles, rapid inventory turnover, and overstocking contribute to waste and operational complexity, making sustainable supply chain management a persistent challenge (Jacometti, 2019; Turker & Altuntas Vural, 2014).

Circular Economy (CE) has been increasingly applied to address these challenges by reducing waste, extending product lifecycles, and improving resource utilization (de Brito et al., 2008). Recent reviews have identified recycling, reuse, product life extension, and recovery as important circular practices in fashion supply chains (Repo, 2025). Lean has also been widely applied to improve operational efficiency through waste elimination, process optimization, and resource utilization (Garcia Martin, 2016). The complementary principles of CE and Lean indicate potential for integrating environmental and operational improvements within fashion supply chains (Alfro, 2021).

However, existing approaches have not sufficiently connected these improvements with financial performance. CE practices may require additional activities, resources, and coordination, while Lean primarily emphasizes operational efficiency (Garcia Martin, 2016; Repo, 2025). As a result, environmental and operational improvements alone do not indicate whether circular transformation is financially viable or capable of supporting continued

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investment. The financial dimension therefore remains insufficiently integrated into the relationship between CE and Lean (Hevner et al., 2004).

This study develops a conceptual framework integrating CE, Lean, and Financial Performance within sustainable fashion retail supply chains. Based on a structured literature synthesis, CE is positioned as an intervention layer, Lean as an operational governance layer, and Financial Performance as a validation layer comprising Profitability Stability and Reinvestment Capability. The framework aims to establish an integrated logic connecting sustainability, operational efficiency, and financial viability and to provide a foundation for future empirical research.

2. METHOD

The framework is developed using a modular conceptual synthesis approach in which the conventional fashion retail supply chain is first defined as the structural backbone, followed by the integration of CE interventions, Lean operational mechanisms, and financial performance validation constructs. This approach is consistent with design science principles, which emphasize the development of conceptual artifacts as contributions to knowledge (Hevner et al., 2004). The development process consists of four stages.

Stage 1 - Domain Identification and Construct Extraction

Literature is categorized into four conceptual domains: fashion retail supply chain, CE, Lean, and Financial Performance. A thematic analysis is conducted to extract key constructs, intervention points, operational mechanisms, and performance indicators, following conceptual framework development principles (Jabareen, 2009).

Stage 2 - Supply Chain Structural Definition

The conventional fashion retail supply chain is defined as the structural backbone of the framework, consisting of five sequential stages: product design, material sourcing, production system, sales and distribution, and consumer use as shown in Figure 1. The supply chain consists of five sequential stages: product design, material sourcing, production system, sales and distribution (retail), and consumer use, representing the primary forward flow of materials and products in fashion retail systems (de Brito et al., 2008; Jacometti, 2019; Repo, 2025). In this linear configuration, products exit the system as waste after the consumer use stage.

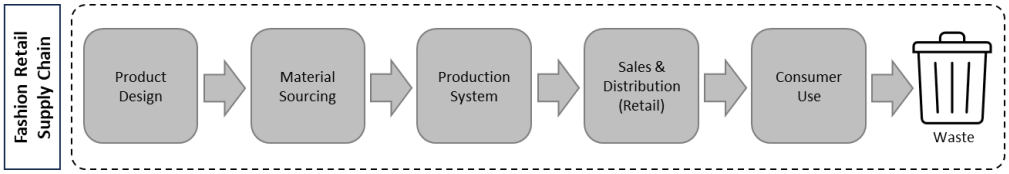

Figure 1. Fashion Retail Supply Chain.

Stage 3 - Modular Configuration and Integration Mapping

A modular design approach is used to group extracted constructs into three functional layers: a CE intervention layer, a Lean operational governance layer, and a Financial Performance validation layer (Jabareen, 2009; Maier & Rechtin, 2009). Integration mapping is then used to identify the functional relationships between each layer and the supply chain backbone (Lambert & Cooper, 2000).

Stage 4 - System Architecture Assembly

The backbone and the three conceptual layers are assembled into a unified framework using systems thinking principles (Checkland, 1999; Sterman, 2002). The resulting framework establishes a coherent linkage between sustainability transformation, operational feasibility, and financial viability.

3. RESULT

Based on the four-stage conceptual synthesis process, the integrated framework is developed through three interrelated layers — Circular Economy, Lean, and Financial Performance — which are subsequently assembled into a unified system architecture.

Circular Economy as an Intervention Layer

Following the establishment of the conventional Fashion Retail Supply Chain as the structural backbone, CE is incorporated as an intervention layer that reorients the linear system toward circularity. Rather than replacing the original backbone, the CE layer introduces targeted interventions that modify selected structures, processes, and lifecycle logic within the fashion retail system. As illustrated in Figure 2, the CE intervention layer consists of three primary streams: sustainable product design orientation, supplier sustainability alignment, and closed-loop structure.

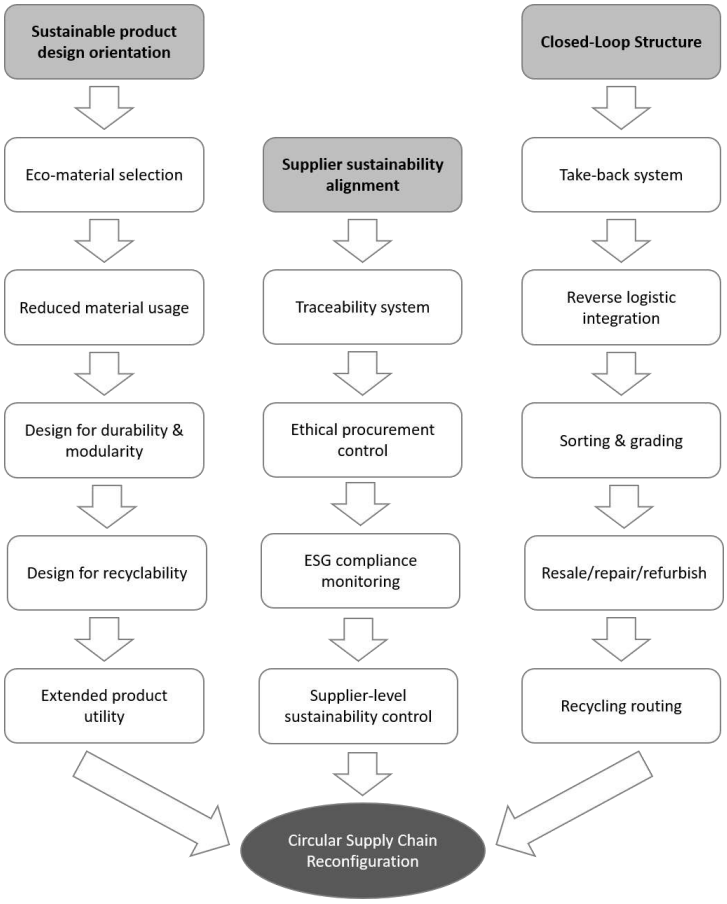

Figure 2. Circular Economy as an Intervention Layer.

The first stream, sustainable product design orientation, addresses upstream product configuration before market entry. Circularity begins at the design stage through eco-material selection, reduced material usage, design for durability and modularity, and design for recyclability. These interventions support extended product utility and reflect the view that circularity in fashion retail must be embedded from the earliest stage of product development rather than relying solely on downstream recovery (de Brito et al., 2008; Lee et al., 2026; Nisrina et al., 2025).

The second stream, supplier sustainability alignment, extends circularity into the upstream supply base by aligning sourcing decisions with sustainability requirements. This is operationalized through traceability systems, ethical procurement control, ESG compliance monitoring, and supplier-level sustainability governance. These mechanisms ensure that circular objectives are embedded across supplier relationships and support design-level circular intentions through upstream operational consistency, particularly in fast fashion supply chains characterized by multi-tier and geographically dispersed sourcing networks (de Brito et al., 2008; Lee et al., 2026; Nisrina et al., 2025).

The third stream, closed-loop structure, addresses the downstream reintegration of products after their initial use phase. In a conventional linear fashion retail supply chain, products typically exit the system after consumer use and end as waste. The CE layer intervenes by introducing a structured closed-loop pathway through take-back systems, reverse logistics integration, sorting and grading processes, resale/repair/refurbishment channels, and recycling routing. These mechanisms create the infrastructure required to redirect used products and materials back into economically or materially valuable channels, thereby reducing material leakage and improving resource recirculation (Jacometti, 2019; Maier & Rechtin, 2009). Together, these three streams produce Circular Supply Chain Reconfiguration, a distributed intervention logic operating across upstream, midstream, and downstream supply chain stages.

Lean as an Operational Governance Layer

The incorporation of CE interventions into the fashion retail supply chain introduces additional operational complexity through sustainability-oriented sourcing, circular recovery structures, and product lifecycle extension mechanisms. In a fast fashion environment characterized by demand volatility, short product lifecycles, and inventory pressure, these interventions may increase process instability if not supported by an appropriate operational control mechanism. To address this, Lean is incorporated as an operational governance layer that stabilizes the system and preserves circular implementation feasibility. As shown in Figure 3, the Lean layer is organized into three streams: waste elimination, inventory responsiveness, and lifecycle extension mechanism.

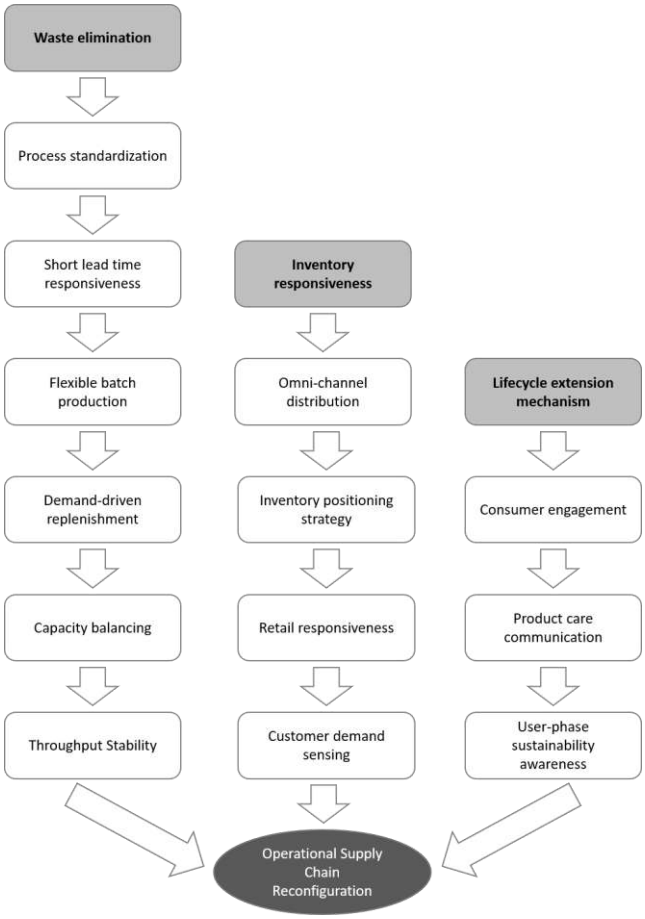

Figure 3. Lean as an Operational Governance Layer.

The first stream, waste elimination, focuses on reducing non-value-adding activities and operational inefficiencies in fashion retail supply chains. It is operationalized through process standardization, short lead time responsiveness, flexible batch production, demand-driven replenishment, and capacity balancing. These mechanisms contribute to throughput stability, which is critical in systems where overproduction, inventory mismatch, and operational delay frequently generate waste. In this framework, waste elimination not only improves efficiency but also creates the operational space needed to absorb the complexity introduced by circular interventions (de Brito et al., 2008; Liker, 2004).

The second stream, inventory responsiveness, reflects the importance of inventory control and demand synchronization in fashion retail operations. This stream is represented through omni-channel distribution, inventory positioning strategy, retail responsiveness, and customer demand sensing. In fashion retail, inventory is both an operational resource and a major source of financial and strategic risk. By improving the system's ability to position, move, and respond to inventory dynamically, Lean supports a more responsive configuration aligned with fluctuating consumer demand and short selling windows (de Brito et al., 2008; Liker, 2004; Maier & Rechtin, 2009)

The third stream, lifecycle extension mechanism, supports operational continuity beyond the point of sale by enabling products to remain useful during the consumer use phase. This stream is reflected through consumer engagement, product care communication, and user-phase sustainability awareness. Although these elements extend beyond traditional factory-based interpretations of Lean, they are highly relevant in fashion retail because product longevity, consumer handling, and post-purchase behaviour directly influence the feasibility of resale, repair, and recovery. Lifecycle extension therefore functions as an operational support mechanism that sustains product utility and reduces premature product disposal (Jacometti, 2019; Johns et al., 2023; Maier & Rechtin, 2009).

Together, these three streams produce Operational Supply Chain Reconfiguration: an increased system capability to manage variability, maintain flow stability, and support responsive execution. This operational reconfiguration forms a critical bridge between sustainability-oriented structural intervention and financial validation, since the benefits of CE cannot be realized unless the system operates reliably and efficiently in practice.

Financial Performance as Validation Layer

The financial performance layer evaluates whether the integration of CE and Lean within the fashion retail supply chain produces economically viable outcomes. While the CE layer reconfigures the supply chain toward sustainability and the Lean layer stabilizes operational execution, the financial performance layer assesses whether these interventions generate sustainable business value (Qorri et al., 2018; Taticchi et al., 2013). In this study, financial performance is conceptualized as a dual-mechanism validation structure comprising Profitability Stability and Reinvestment Capability, as shown in Figure 4. These two dimensions reflect the financial logic of fashion retail systems, where firms must maintain stable profitability while preserving the economic capacity to support future operational continuity and renewal (de Brito et al., 2008; Qorri et al., 2018; Taticchi et al., 2013).

Profitability Stability captures the firm's ability to maintain consistent financial performance despite the complexity introduced by circular interventions and dynamic market conditions. It is shaped by three main financial drivers: circular cost exposure, reflecting the additional cost burden associated with CE implementation; operational cost efficiency, reflecting the cost reduction generated by Lean practices; and recovery revenue potential, reflecting the additional income generated through circular business mechanisms such as resale, repair, refurbishment, and other value recovery channels (Jacometti, 2019; Johns et al., 2023; Yang et al., 2017). The interaction of these drivers determines whether the system can

sustain acceptable and stable profitability while absorbing circular implementation costs and generating additional value from recovered products (Qorri et al., 2018; Taticchi et al., 2013).

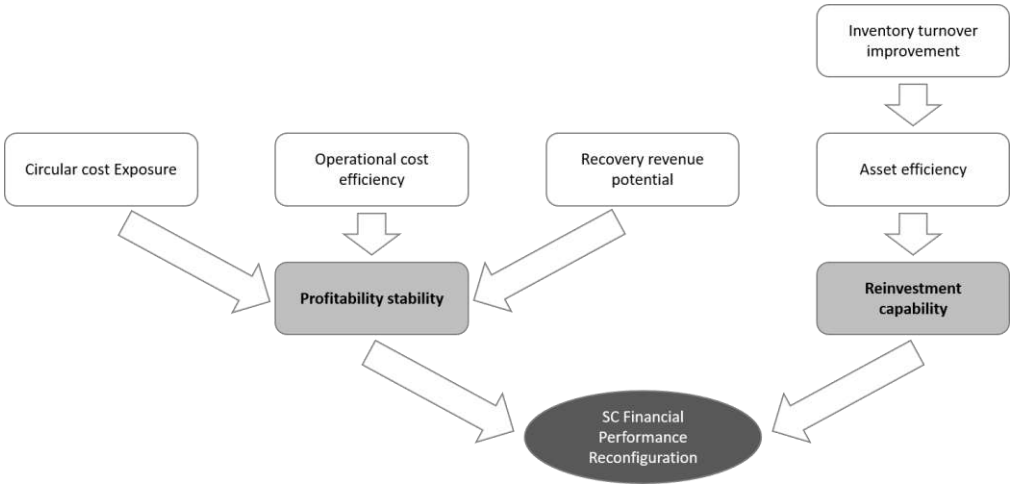

Figure 4. Financial Performance as Validation Layer.

Reinvestment Capability reflects the organization's ability to transform financial outcomes into continued operational and strategic renewal. In fashion retail, business sustainability depends not only on short-term profitability, but also on the ability to restock products, launch new product lines, renew assortments, improve retail operations, and potentially expand store or channel presence (de Brito et al., 2008; Qorri et al., 2018; Yang et al., 2017). Within this framework, reinvestment capability is driven by inventory turnover improvement, which accelerates the conversion of inventory into sales and cash flow, reduces capital lock-in, and supports more responsive retail replenishment. Stronger asset efficiency further improves the firm's capacity to reinvest in future operational improvements, circular initiatives, and commercial growth activities (Qorri et al., 2018; Taticchi et al., 2013).

Table 1. Literature-Refined Financial KPI Specification Based on Dual Financial Mechanisms.

Financial Mechanism	Driver	KPI / Measurement Indicator	Rationale
Profitability Stability	Circular Cost Exposure	Reverse Logistics Cost Ratio	Captures additional cost burden from circular recovery activities
		CE Implementation Cost / Operating Cost	Reflects financial impact of circular transition
	Operational Cost Efficiency	Operating Expense Ratio (OPEX / Revenue)	Measures lean-driven cost control efficiency
		Cost per Unit	Captures efficiency gains from waste elimination
	Recovery Revenue Potential	% Revenue from Circular Channels	Measures contribution of circular business models
		Margin of Circular Products	Evaluates profitability of circular offerings
	Profitability Outcome	Net Profit Margin	Net Profit Margin
		EBITDA Stability	Captures consistency of operational profitability
Reinvestment Capacity	Inventory Turnover Improvement	Inventory Turnover Ratio	Measures speed of inventory conversion into sales
		Days Inventory Outstanding (DIO)	Captures inventory holding efficiency
	Asset Efficiency	Return on Assets (ROA)	Reflects overall asset utilization performance
	Reinvestment Outcome	Free Cash Flow Ratio	Indicates liquidity available for reinvestment
		% Profit Reinvested in Sustainability	Measures commitment to CE & Lean scaling
System-Level Validation	Integrated Output	Integrated Financial Performance Index	Aggregated indicator of overall system performance
		Profit Volatility Index	Measures financial stability and risk exposure

Together, Profitability Stability and Reinvestment Capability determine whether CE–Lean integration is not only operationally feasible and sustainability-oriented, but also financially sustainable within a competitive fashion retail environment. Table 1 presents a literature-informed KPI specification aligned with the two proposed financial mechanisms. The indicators are conceptually derived from the reviewed literature and are intended as performance proxies for assessing the financial feasibility of CE–Lean integration in fashion retail supply chains.

Integrated Framework Assembly

After the development of the backbone and its three supporting layers, the final stage assembles these elements into a unified integrated conceptual framework. The framework is structured around six reconfigured supply chain processes: Sustainable Design Configuration, Sustainable Sourcing Alignment, Adaptive Production System, Market Synchronization, Responsible Consumption, and Circular Recovery Flow.

In this reconfiguration, the conventional sales and distribution stage is conceptually expanded into Market Synchronization to emphasize demand alignment, inventory responsiveness, and omni-channel retail coordination. Similarly, the consumer use stage is reinterpreted as Responsible Consumption to reflect the role of post-purchase behavior in supporting product longevity and downstream circular recovery. Together, these processes represent the transformation of a conventional linear fashion retail supply chain into a sustainability-oriented system in which product and material value can remain within the system rather than exiting as waste.

Table 2. Module Integration Mapping Matrix.

Backbone Process	Embedded CE Mechanism	Embedded Lean Mechanism	Financial Linkage
Sustainable Design Configuration	Sustainable product design orientation	-	Profitability Stability
Sustainable Sourcing Alignment	Supplier sustainability alignment	-	Profitability Stability
Adaptive Production System	-	Waste elimination	Profitability Stability
Market Synchronization	-	Inventory responsiveness	Profitability Stability, Reinvestment Capability
Responsible Consumption	-	Lifecycle extension mechanism	Profitability Stability, Reinvestment Capability
Circular Recovery Flow	Closed-loop structure	-	Profitability Stability, Reinvestment Capability

Table 2 presents the integration mapping matrix specifying where CE and Lean mechanisms are embedded across the backbone processes and how each embedded mechanism relates to the financial performance validation layer. Figure 5 illustrates the complete integrated framework.

The CE layer is embedded at the structural points where circularity is most strategically activated. Sustainable product design orientation is positioned within Sustainable Design Configuration, supplier sustainability alignment within Sustainable Sourcing Alignment, and closed-loop structure within Circular Recovery Flow. These interventions incorporate circular principles into product design, upstream governance, and post-consumption recovery.

The Lean layer is embedded within the operational stages of the backbone to stabilize execution and maintain process feasibility. Waste elimination is positioned within Adaptive Production System, inventory responsiveness within Market Synchronization, and lifecycle extension mechanism within Responsible Consumption. Together, these mechanisms support the operational execution of a more circular and responsive retail system.

The integration mapping further distinguishes between direct and indirect financial relationships. Mechanisms embedded in Adaptive Production System, Market

Synchronization, and Circular Recovery Flow are more directly associated with financial outcomes through operational cost efficiency, inventory velocity, and value recovery revenue. By contrast, mechanisms embedded in Sustainable Design Configuration, Sustainable Sourcing Alignment, and Responsible Consumption contribute more indirectly by strengthening the enabling conditions for long-term economic viability. Overall, the framework conceptualizes the fashion retail supply chain as a system in which CE reshapes structure, Lean stabilizes execution, and Financial Performance validates economic feasibility, providing the final conceptual output of the study and a foundation for future empirical validation.

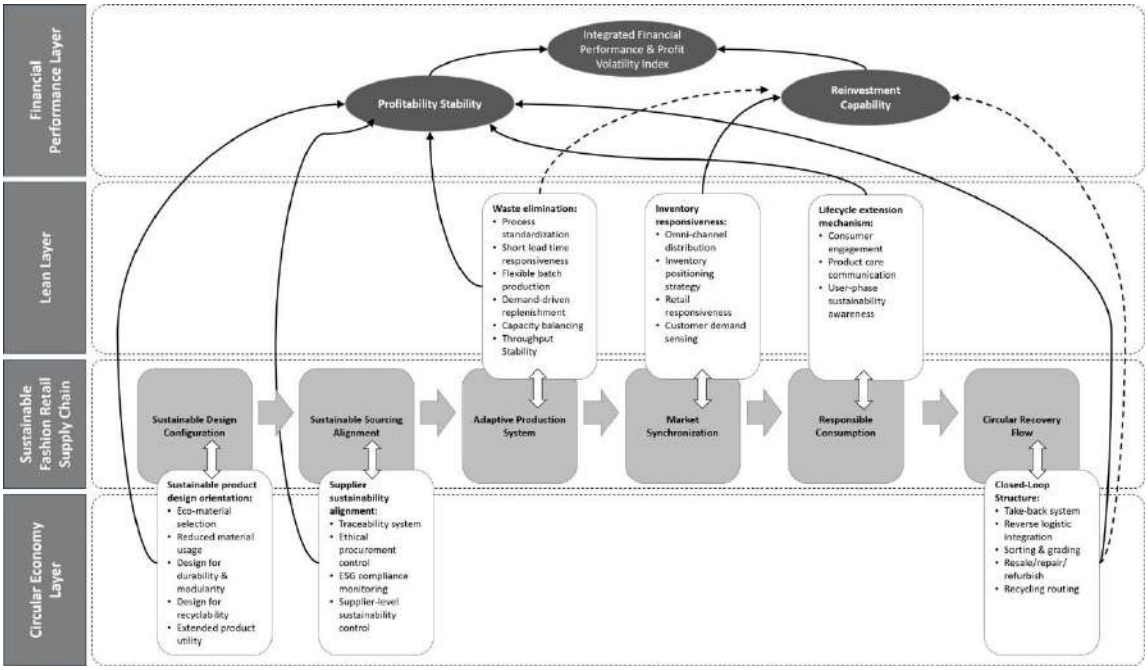

Figure 5. Integrated Circular-Lean Financial Architecture for Sustainable Fashion Retail Supply Chains.

4. DISCUSSION

The findings indicate that sustainability transformation in fashion retail supply chains requires coordination between environmental, operational, and financial considerations rather than addressing them independently. The integration of Circular Economy (CE), Lean, and Financial Performance extends previous studies that have primarily examined these perspectives separately (de Brito et al., 2008; Salibi et al., 2022; Turker & Altuntas Vural, 2014; Yang et al., 2017). This finding suggests that sustainability initiatives should be evaluated not only by their environmental contribution but also by their operational feasibility and financial implications.

The positioning of CE as a structural intervention is consistent with previous research emphasizing the importance of addressing circularity across the supply chain rather than focusing only on downstream recovery activities (Jacometti, 2019). Product design, material selection, durability, and sourcing decisions influence the feasibility of subsequent reuse, recovery, and recycling activities. Thus, the framework suggests that circularity should be considered from the early stages of the fashion supply chain, where decisions can influence subsequent material and product flows.

The findings further indicate that circular practices require operational mechanisms to support their implementation. Reverse logistics, take-back, sorting, repair, and resale can increase process complexity and coordination requirements. The integration of Lean therefore provides an operational perspective for managing these activities through waste reduction, process stabilization, and improved flow. This complements previous research on Lean and CE by connecting circular interventions with the operational conditions required for their implementation (Maier & Rechtin, 2009). However, because the present study is conceptual, the effectiveness of specific Lean mechanisms in improving circular performance cannot yet be established empirically.

Financial Performance provides another important dimension of the framework. Rather than treating financial performance only as a final outcome, the framework considers it a means of assessing whether sustainability improvements can remain economically viable. The distinction between Profitability Stability and Reinvestment Capability reflects the need to maintain current financial performance while preserving the capacity to support future sustainability initiatives (Qorri et al., 2018; Taticchi et al., 2013). This perspective helps address the common tension between the additional resources required for circular practices and the need for long-term economic continuity.

From a managerial perspective, the framework implies that fashion retailers should evaluate sustainability initiatives across three connected questions: where circular interventions should be implemented, how these interventions can be operationally sustained, and whether the resulting system remains financially viable. The framework therefore provides a structured basis for coordinating sustainability, operational efficiency, and financial considerations rather than managing them as separate objectives.

The findings should nevertheless be interpreted within the limitations of a conceptual study. The framework has been developed through literature synthesis and has not yet been empirically tested in a specific fashion retail context. Therefore, the relationships proposed between CE, Lean, and Financial Performance represent conceptual relationships rather than

validated causal effects. Future research should empirically examine these relationships using firm-level data and evaluate whether the proposed financial dimensions can effectively capture the economic consequences of circular and Lean interventions.

5. CONCLUSION

This study developed a conceptual framework that integrates Circular Economy (CE), Lean, and Financial Performance within sustainable fashion retail supply chains, addressing the fragmented treatment of these domains in the existing literature. Structured around a conventional supply chain backbone and reconfigured through CE as an intervention layer, Lean as an operational governance layer, and Financial Performance as a validation layer, the framework proposes a system-level integration logic in which CE reshapes supply chain structure, Lean stabilizes operational execution, and Financial Performance validates long-term economic feasibility. The study contributes theoretically by extending sustainable supply chain and SSCM literature through a more integrated system architecture, while also offering a practical blueprint for managers to design, evaluate, and sustain sustainability transformation in fashion retail. As a conceptual study, the framework remains theoretical and requires future empirical validation. Subsequent research may operationalize the proposed constructs and examine how the strength of CE–Lean–Financial Performance integration varies across different retail formats, product categories, and market conditions to further strengthen its applicability and empirical relevance.

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