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CIRCULAR ECONOMY-BASED FASHION DESIGN: TOWARD ACHIEVING THE UN SUSTAINABLE DEVELOPMENT GOALS

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Abstract

This study investigates product design processes aligned with circular economy (CE) principles in the fashion industry. It focuses on the integration of digital technologies, the role of leadership, and enabling conditions that support sustainable design practices. This study is aligned with achieving the United Nations Sustainable Development Goals, particularly SDG 12 (Responsible Consumption and Production), SDG 9 (Industry, Innovation, and Infrastructure), and SDG 13 (Climate Action).The research draws upon two major conceptual foundations: Design for Circular Economy (DfCE) and Sustainable Product Development (SPD). It also incorporates contemporary leadership and institutional transformation theories to analyze how innovation is driven by organizational vision and collaborative ecosystems.This qualitative single-case study utilized grounded theory techniques to collect and analyze data from a pioneering sustainable fashion enterprise. Data were gathered through in-depth interviews with nine stakeholder groups, site observations, and document reviews. The analysis was enhanced by integrating Rasli et al.'s five-pillar sustainability model and leadership theory from Vasudevan et al. Findings reveal that CE-aligned product design is deeply iterative and modular, supported by technologies such as AI, blockchain, and 3D simulation. Visionary leadership and cross-sector partnerships serve as critical enablers of sustainable innovation. Human capital structure and stakeholder engagement also significantly shape the success of CE implementation in fashion. The study proposes a replicable framework for integrating CE and SPD principles in fashion design. It highlights the importance of leadership, technological fluency, and organizational culture in driving systemic change towards sustainable innovation.This study provides empirical evidence and theoretical synthesis that advance the understanding of how circular design in fashion can directly contribute to the SDGs. It offers actionable strategies for fashion enterprises aiming to implement regenerative and future-ready design models.

Keywords: circular economy, fashion design, sustainable product development, digital innovation, leadership, SDGs 9, 12, 13, qualitative case study

Introduction

In recent years, the fashion industry has faced growing scrutiny due to its environmental impact, resource consumption, and linear production models that emphasize rapid turnover and excessive waste. As global awareness of sustainability deepens, scholars and practitioners have increasingly turned to the circular economy (CE) as a paradigm capable of redefining product development and consumption in fashion. CE principles such as recyclability, modularity, and product longevity are being recognized as critical to addressing the sector's ecological footprint (Ellen MacArthur Foundation, 2017). A foundational concept that supports this shift is Design for Circular Economy (DfCE)**,** which provides a framework for integrating sustainable thinking throughout the design process (Moreno et al., 2016). Alongside DfCE, the Sustainable Product Development (SPD) model highlights the importance of balancing environmental, economic, and social considerations during product innovation (Hallstedt et al., 2009). The urgency of integrating sustainability into industrial sectors is further emphasized by the United Nations Sustainable Development Goals (SDGs)**.** Particularly relevant are SDG 12 (Responsible Consumption and Production)**,** SDG 9 (Industry, Innovation and Infrastructure)**,** and SDG 13 (Climate Action)**,** which collectively call for system-wide transformations in material use, industrial processes, and

climate-conscious innovation. Research indicates that circular fashion can be a vital contributor to these goals by promoting ethical consumption, reducing carbon footprints, and extending product life cycles (Fletcher & Tham, 2019)

While theoretical models such as DfCE and SPD are well established, empirical studies exploring their real-world application within fashion enterprises remain limited, especially regarding how digital technologies and organizational leadership facilitate circular design. Notably, technologies such as 3D digital prototyping, artificial intelligence (AI), and blockchain are increasingly leveraged to enhance design efficiency and material traceability (Pencarelli, 2020). Simultaneously, scholars have highlighted that successful circular strategies are not solely driven by tools but also depend on human and systemic enablers**,** including leadership vision, stakeholder collaboration, and value-centric culture (Kirchherr et al.,2018). Given this context, this study employs a qualitative case study methodology to investigate how CE principles are operationalized in fashion product design. Drawing on interviews, field observations, and document analysis from a pioneering but anonymous sustainable fashion enterprise, this research examines the intersection of digital innovation, leadership behavior, and systemic change. The findings aim to deepen the understanding of how CE and SPD frameworks are implemented in practice and to provide replicable insights for fashion enterprises seeking to transition toward regenerative models aligned with the UN SDGs**.**

Research Objectives

1. To study the product design processes aligned with circular economy principles in the fashion industry
2. To analyze how technology is applied in circular product design within the fashion sector
3. To identify the key factors and enabling conditions for developing sustainable design approaches in the context of fashion

Research Questions

1.What are the characteristics and processes of fashion product design under circular economy principles?

2.How does technology contribute to the promotion of circular product design in the fashion industry?

3. What factors influence the success of sustainable fashion product design development using circular economy concepts?

Literature Review

The intersection of product design, sustainability, and circular economy (CE) has received increasing academic attention over the past decade, especially in the context of the fashion industry. Scholars have explored how design processes can respond to environmental crises by integrating circularity, technological advancement, and ethical consumption. A recurring theme in the literature is the theoretical foundation that underpins circular product innovation, particularly through the lens of Design for Circular Economy (DfCE) and Sustainable Product Development (SPD) frameworks.

Circular Economy in Fashion Product Design

Circular Economy (CE) theory emphasizes resource efficiency, product longevity, and systems thinking to reduce waste and environmental degradation (Ellen MacArthur Foundation, 2017). In the fashion sector, CE has been applied to reimagine material sourcing, garment design, and end-of-life strategies. According to Moreno et al. (2016), circular design principles include modularity, durability, reparability, and recyclability all of which are particularly applicable to

fashion products that face rapid turnover cycles. This directly supports the research objective of studying design processes aligned with CE principles. Studies also point out that circular design is not only technical but socio-cultural, requiring shifts in consumer perception and industry mindsets (Fletcher & Tham, 2019).

Technological Integration in Circular Product Innovation

Recent studies emphasize the role of Industry 4.0 technologies such as AI, 3D printing, and blockchain in supporting CE strategies in product design. Digital prototyping, for instance, allows for more accurate testing with minimal waste, while AI facilitates data-driven design decisions and predictive trend analysis (Pencarelli, 2020). These technologies enhance the feasibility of implementing CE in fast-paced industries like fashion. The SPD theory further contributes to understanding how technology facilitates decision-making that balances economic viability, environmental performance, and social value throughout the product lifecycle (Hallstedt et al., 2009). This body of knowledge provides the conceptual basis for analyzing how technology contributes to circular fashion design, which aligns with the second research objective.

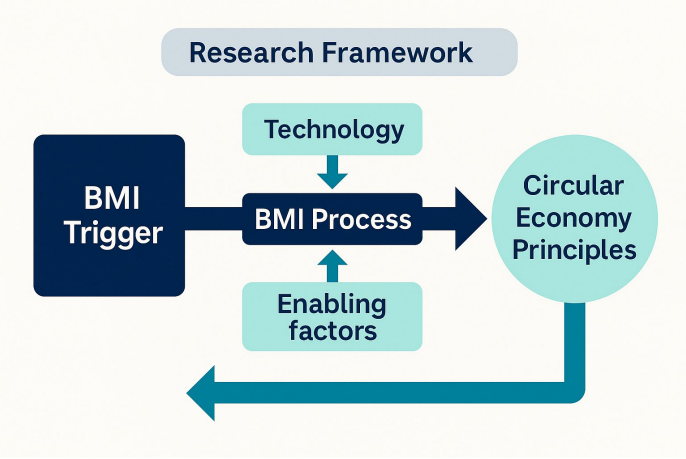
Human and Systemic Factors in Sustainable Design

In addition to tools and methods, the success of sustainable product design depends heavily on organizational and cultural readiness. Scholars have identified enabling conditions such as leadership commitment, stakeholder collaboration, regulatory support, and consumer awareness (Kirchherr et al., 2018). SPD theory is particularly useful in explaining how these system-level factors influence design outcomes. For example, Baumann et al. (2002) suggest that sustainable design processes require not only technical capacity but also internal motivation and ethical alignment with sustainability values. These insights correspond to the third research objective regarding the key factors and enabling conditions for successful sustainable fashion product development.

Integration of Theory and Practice

The combination of DfCE and SPD frameworks in recent research suggests a shift from isolated design tactics to more systemic and integrative approaches. As emphasized by Bocken et al. (2016), CE-aligned product development must consider not only the artifact but also the business model, user behavior, and after-use scenarios. This theoretical synthesis supports a more holistic understanding of circular fashion innovation and provides the necessary foundation for empirical investigation in this study.

Research Framework



The research framework presents a cohesive model that explains how sustainable fashion product design emerges from the integration of circular economy principles and technological innovation. Circular economy principles serve as the foundational philosophy, encouraging resource efficiency, waste minimization, and product longevity. When these principles are combined with advanced technologies such as AI, digital prototyping, and material innovation they enable new forms of design that are both sustainable and adaptable to the fast-paced nature of the fashion industry. The interaction between these two elements fosters the development of fashion products that are environmentally responsible, economically viable, and socially meaningful. This framework thus supports a holistic understanding of how systemic change in design practices can be achieved through circular thinking and digital tools.

Research Methodology

This study adopts a qualitative single-case study methodology to deeply explore how Circular Economy (CE) principles are operationalized in fashion product design. The research focuses on a leading sustainable fashion enterprise (which has requested anonymity) to gain detailed insights into internal practices, strategic behavior, and innovation mechanisms. The single-case approach is particularly suitable for examining complex and contextual organizational processes involving design, leadership, and stakeholder interaction.

1. Grounded Theory Techniques

The data analysis in this study employs Grounded Theory techniques, a method aimed at generating theory inductively from the field rather than testing pre-existing hypotheses. Through constant comparative analysis, data were coded, categorized, and synthesized into emerging themes. This bottom-up approach allowed the researcher to interpret how circular design practices and leadership behaviors arise organically from real-world organizational contexts. The strength of Grounded Theory lies in its ability to capture complex social dynamics and to theorize them systematically, making it well-suited for uncovering the multi-dimensional nature of sustainable innovation in fashion design.

2. Data Collection Methods

Data collection was conducted through three main qualitative techniques, ensuring a holistic and robust understanding of the case organization:

-In-depth, Semi-Structured Interviews

Interviews were conducted with nine stakeholder groups, covering various roles such as founders, designers, technologists, supply chain managers, consultants, NGO partners, and consumers. The use of semi-structured interviews enabled flexibility, allowing participants to share detailed, experience-based narratives while still aligning with the study's core objectives. These interviews provided rich data on processes, decision-making, and stakeholder values.

-Site Observations

Direct observation of the organization's design practices and workspace offered non-verbal and contextual insights. The researcher observed the application of technologies such as AI, 3D simulation, and blockchain, as well as interpersonal communication, team collaboration, and work culture. This method revealed behavioral patterns and informal dynamics that interviews alone could not capture.

-Document Analysis

Internal documents such as sustainability reports, design guidelines, workflow manuals, and marketing materials were reviewed. These documents helped triangulate interview and

observational data and allowed for a deeper understanding of strategic positioning, organizational goals, and operational alignment with CE and SPD principles.

3.Triangulation The study employed data triangulation to ensure credibility and reliability. By cross-validating insights from interviews, observations, and documents, the researcher reduced subjectivity and strengthened analytical rigor. This triangulated approach also helped reveal patterns and contradictions that enriched the thematic analysis.

4. Ethical Considerations Ethical research practices were strictly followed throughout the study. Informed consent was obtained from all participants, and confidentiality protocols were maintained to protect the identity of the case organization and interviewees. The anonymity of the firm was particularly respected due to the sensitivity of its proprietary practices and strategic positioning.

5. Theoretical Integration To reinforce analytical depth, the study integrates insights from two key theoretical models: Transformational Leadership Theory by *Asokan Vasudevan et al. (2024)*: This theory highlights how visionary leadership can elevate organizational performance through motivation, purpose-driven culture, and change facilitation. In this study, the founder's transformational leadership emerged as a pivotal driver of circular innovation. The Five-Pillar Institutional Sustainability Model by *Rasli et al. (2024)*: Although originally developed in the context of higher education, this model comprising policy alignment, operations, leadership, stakeholder engagement, and innovation provided a relevant lens for understanding systemic change in the fashion sector. The alignment of the case organization's practices with this model supported cross-sector transferability of the findings.

Circular Design Trigger &Circular Design Process

This study employs a qualitative single-case study methodology to examine how circular economy (CE) principles are operationalized within fashion product design. The research is grounded in an ontological perspective that recognizes the complexity of socio-technical systems and the subjectivity of stakeholder experiences. As such, the qualitative approach is particularly suited to explore the nuanced and context-dependent nature of design processes, stakeholder behaviors, and organizational structures that underpin sustainable innovation. By using in-depth, semi-structured interviews, site observations, and document analysis, the study captures the triggers and iterative characteristics of circular design in a real-world fashion enterprise. Grounded theory techniques were applied to inductively identify patterns and themes, enabling a comprehensive understanding of how digital technologies, organizational values, and leadership interact to shape circular outcomes.

The selected organization, which has requested anonymity, represents a pioneering model in circular fashion, integrating recyclability, modularity, and low-impact materials across its design operations. It actively adopts advanced tools such as 3D digital prototyping, AI-assisted design, and blockchain for traceability, while also fostering social inclusion and cross-sector partnerships. The triangulation of interview data, field observations, and internal documents ensured the reliability of findings, while ethical protocols were observed to maintain confidentiality and informed consent. To deepen the methodological foundation, the study integrates theoretical insights from Asokan Vasudevan et al. (2024), whose work on transformational leadership in public institutions demonstrates its positive effect on organizational performance excellence. These findings offer conceptual relevance to the present case, where the founder's transformational leadership has played a pivotal role in cultivating a purpose-driven design culture, enhancing team motivation, and embedding sustainability into both strategy and

practice. This leadership model not only supports organizational alignment but also functions as a systemic enabler of CE innovation. This integration is directly aligned with the objectives of the United Nations Sustainable Development Goals. Transformational leadership strengthens SDG 9 (Industry, Innovation, and Infrastructure) by promoting adaptive capacity and interdisciplinary collaboration; supports SDG 12 (Responsible Consumption and Production) through values-driven design decisions and sustainable material use; and advances SDG 13 (Climate Action) by institutionalizing long-term ecological strategies. Thus, the research methodology does more than investigate CE in practice it also affirms that leadership is a key trigger in realizing scalable and regenerative sustainability outcomes in the fashion industry.

Table 1. Details of Interviewees (Anonymized and with Key Performant aligned with Research Objectives)

Interviewee Code	Profile Description	Number of Interviews	Key Performant (Relevance to Research Objectives)
R1	Founder & CEO (Background in sustainable fashion design and entrepreneurship)	3	**Visionary leader** who initiates and guides circular design culture (Obj. 1 & 3); fosters values-based decision-making and aligns strategy with CE principles (Obj. 3).
R2	Head of Circular Innovation (Specialist in materials and system design)	1	**Process and material innovator** developing modularity, recyclability, and closed-loop design systems (Obj. 1 & 3).
R3	External Consultant in Circular Economy Strategy	1	**System-level strategist** bridging CE theory with design operations; identifies enabling policies, practices, and indicators for CE transition (Obj. 3).
R4	Lead Fashion Designer	1	**Design practitioner** applying CE principles in real-world fashion creation; translates abstract sustainability goals into tangible products (Obj. 1).
R5	Digital Technologist (3D simulation and AI in fashion)	1	**Technology enabler** using AI and 3D prototyping to reduce waste, support rapid iteration, and enhance design precision (Obj. 2).
R6	Supply Chain Manager (focus on sustainable sourcing and traceability)	1	**Operational link** for sustainable material sourcing and traceability; supports implementation of CE across the supply chain (Obj. 1 & 3).
R7	Sustainability Communications Officer	1	**Narrative builder** who aligns internal stakeholders and external communities with CE values; ensures buy-in and long-term engagement (Obj. 3).

Interviewee Code	Profile Description	Number of Interviews	Key Performant (Relevance to Research Objectives)
R8	Two representatives from partner NGOs and academic institutions	2 (1 each)	**Cross-sector collaborators** contributing external validation, theoretical grounding, and educational outreach supporting systemic change (Obj. 3).
R9	Five fashion consumers (students and eco-conscious users)	5 (1 each)	**Feedback providers** representing user needs and behaviors; their awareness and choices influence sustainable design adoption (Obj. 1 & 3).

This research approach allows for a holistic and nuanced understanding of circular fashion product design, capturing both technical and social dimensions of innovation. By employing grounded theory techniques and continuous comparative analysis, emerging themes and patterns were inductively identified. Despite the organization's anonymity, the research contributes valuable empirical insights into how CE and SPD frameworks are operationalized in practice highlighting pathways for other fashion enterprises seeking to transition towards sustainable and regenerative business models.

Results

DataAnalysis

This research approach allows for a holistic and nuanced understanding of circular fashion product design, capturing both technical and social dimensions of innovation. By employing grounded theory techniques and continuous comparative analysis, emerging themes and patterns were inductively identified. Despite the organization's anonymity, the research contributes valuable empirical insights into how CE and SPD frameworks are operationalized in practice highlighting pathways for other fashion enterprises seeking to transition towards sustainable and regenerative business models.In further deepening the data analysis, the sustainability framework developed by Rasli, Zhou, and Abas, McXin Tee (2024) was integrated to interpret how leadership, systemic design, and organizational transformation collectively shape sustainability-driven outcomes. Although their research focused on higher education institutions, their five-pillar framework comprising policy alignment, operations, leadership, stakeholder engagement, and innovation resonates clearly with the findings in this case. The fashion enterprise exhibited congruent patterns of strategic leadership, ecosystem collaboration, and value-centric design, which echo Rasli et al.'s systemic dimensions. This cross-contextual alignment confirms that the success of circular product design and its alignment with SDGs particularly SDG 12, SDG 9, and SDG 13 requires both technical capabilities and organizational commitment. Thus, combining grounded analysis of CE and SPD theories with Rasli et al.'s institutional sustainability model enriches the analytical depth and reinforces the transferability of the framework across sectors.

Findings

The findings of this case study validate the proposed research framework and highlight a multifaceted understanding of how circular economy (CE) principles are practically applied in fashion product design. The design processes observed were highly iterative and modular, deeply aligned with Design for Circular Economy (DfCE) principles, emphasizing recyclability, durability, and disassemblability. The organization adopted cradle-to-cradle strategies and material sensitivity, evident in the use of biodegradable fabrics and minimized composite

materials, to reduce waste and extend product lifespans. Technological integration emerged as a key enabler of these goals. Tools such as 3D digital prototyping accelerated design iterations, blockchain enhanced traceability, and artificial intelligence (AI) was leveraged for predictive design and resource optimization. These applications resonate with the Sustainable Product Development (SPD) framework, which emphasizes the balance between ecological responsibility and economic viability.

Beyond technical factors, human and systemic dimensions played a decisive role in the success of circular fashion innovation. Leadership commitment proved foundational, as the founder's vision instilled a purpose-driven culture and strategic partnerships with NGOs and academic institutions facilitated knowledge exchange and community engagement. Consumers were also actively engaged, co-creating value through feedback that guided ongoing design development. These dynamics underscore the importance of systemic innovation that includes both organizational culture and stakeholder collaboration.In further enriching the analysis, this study incorporates insights from the recent work of Shao et al. (2025), co-authored by Walton Wider, which investigates the relationship between human capital structure and innovation performance. The case organization's diverse and specialized team structure spanning digital technologists, designers, sustainability officers, and external collaborators mirrors the conditions identified by Shao et al. as conducive to innovation. The firm's ability to operationalize CE principles was not only supported by tools and leadership but also by the intentional structuring and leveraging of human resources, which fostered creative autonomy and technological fluency.

Together, these findings affirm that achieving sustainable fashion design under CE requires more than adopting new technologies or frameworks. It demands the integration of regenerative design principles with systemic leadership, organizational capacity, and human capital strategy. This multi-dimensional approach directly supports several UN Sustainable Development Goals particularly SDG 9 (Industry, Innovation, and Infrastructure) through cross-disciplinary collaboration, SDG 12 (Responsible Consumption and Production) through sustainable material use and product lifecycle thinking, and SDG 13 (Climate Action) through environmentally informed decision-making embedded in organizational practices.

Key Theme	Data Points	Outcomes
Substantial technical and professional expertise	Expertise in sustainable design, entrepreneurship, material systems, and digital technology.	Enabled technological integration and innovation alignment with CE principles.
Substantial creative skills	Idea generation, iterative and modular thinking, cradle-to-cradle approaches.	Continuous innovation in design, embedding CE values at every stage.
Individual characteristics	Purpose-driven leadership, ethical values, openness to challenge norms.	Built a value-centric design culture, influenced sustainability priorities.
External ties: intra- and extra-industry	Partnerships with NGOs, academic institutions, and community labs.	Facilitated collaboration, knowledge exchange, and social inclusion.
Strategic choices based on environmental	Use of biodegradable materials, blockchain	Achieved circularity goals and improved supply chain

risks/opportunities	traceability, design for disassembly.	transparency.
Incentives and bonus	Motivation driven by passion and mission, not financial incentives.	Enhanced employee commitment and purpose-aligned innovation.

Table2.Summary Table of Findings and Drivers

The table above, titled "Summary Table of Findings and Drivers," presents the core findings of the research on fashion product design under circular economy principles. It categorizes key insights into six thematic dimensions: substantial technical and creative expertise, circular design practices, human and systemic factors, technological integration, leadership influence, and consumer engagement. For each dimension, the table outlines specific data points derived from interviews, observations, and document analysis, as well as the corresponding outcomes observed in the case study. This structure allows a clear linkage between the qualitative data collected and the practical implications for sustainable fashion innovation. The table highlights the organization's pioneering efforts in combining design-for-disassembly, cradle-to-cradle models, advanced digital tools, and inclusive leadership to drive both ecological and social value in the circular fashion space. Despite the anonymity of the firm, the framework and findings provide a replicable reference for other companies aiming to integrate CE and SPD strategies into their design and development processes.

Discussion

Effect of Leadership in Circular Design Innovation	**Data Points**	**Outcome**
Influence creativity and circular idea generation	Empowered teams with design autonomy; valued creative risk-taking; encouraged exploration of cradle-to-cradle and modular design; founder's background in sustainable fashion	High creativity; integration of circular principles; diverse innovations in recyclable, disassemblable garments
Contribution to structural systems	Implemented clear sustainability guidelines; adopted design-for-disassembly and lifecycle-based planning protocols	Systematized circular design workflow; improved traceability and long-term planning
Evaluation of feedback and co-creation	Gathered consumer feedback via social platforms; limited engagement with bottom-up idea integration from junior teams	External co-creation improved; internal creativity flow was top-down, limiting full organizational engagement
Motivating and inspiring teams	Weekly meetings with staff; supported staff-led initiatives; provided cross-functional growth opportunities (e.g., designers in tech R&D roles)	Employee satisfaction; strong team cohesion; cross-disciplinary innovation emerged
External engagement and ecosystem building	Partnered with universities, NGOs, and fashion labs; hosted community-based design sprints	Enhanced knowledge sharing; built sustainable ecosystems beyond the company

Table3 : Effect of Leadership in Circular Fashion Innovation

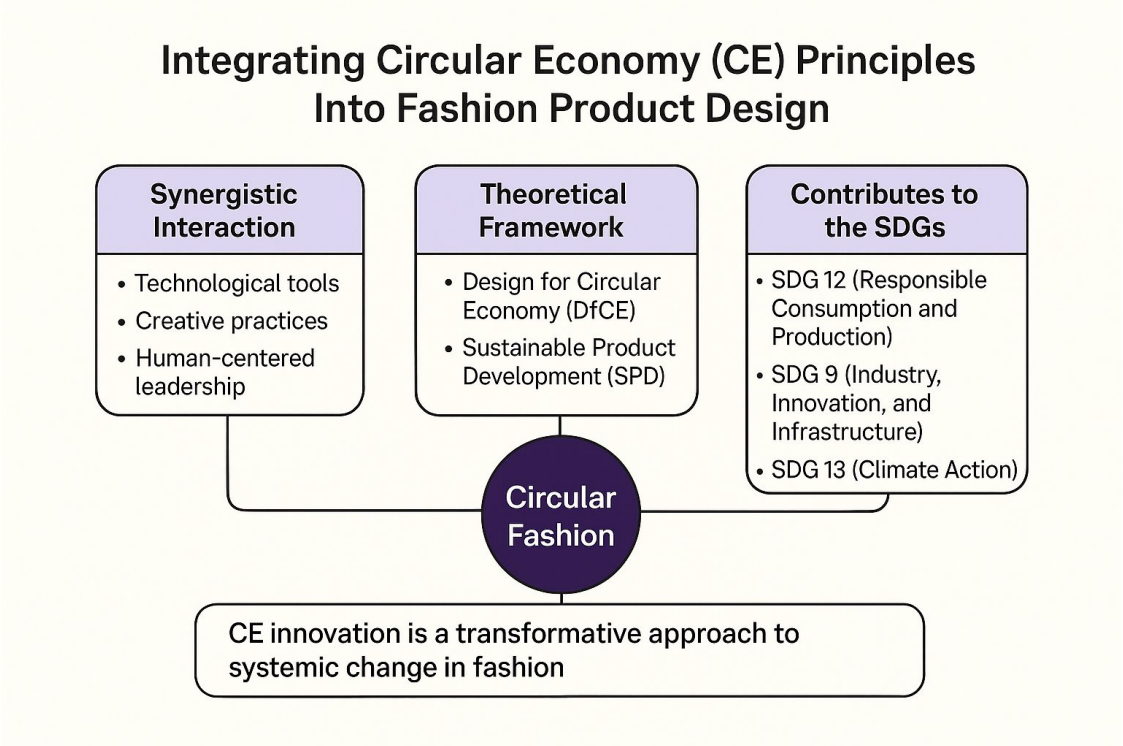
This study highlights the central role of leadership in enabling business model innovation (BMI) within the context of circular fashion. Drawing upon a single case study of a pioneering sustainable fashion organization, the findings echo past research indicating that leadership is both

a driver of initiation and a steward of continuity in innovation processes (Desai & Mahadik, 2011). The founder's personal values, creative autonomy, and background in sustainable fashion shaped the organization's design culture. Like the entrepreneurial leader in the reference study who focused on his strengths, networks, and aspirations (effectuation theory: Who am I? What do I know? Whom do I know?), the case company's leader built a purpose-driven culture grounded in cradle-to-cradle thinking and long-term regenerative goals. His leadership encouraged experimentation in disassemblable garment design and the use of biodegradable fabrics, reflecting an alignment with DfCE and SPD frameworks (Hallstedt et al., 2009).

While the leader enabled cross-disciplinary learning and supported staff-led initiatives, a top-down structure in idea evaluation somewhat limited the full potential of team-generated innovation. This finding mirrors prior literature suggesting that micromanagement, even with good intentions, can unintentionally stifle broader creativity (Mitchell & Coles, 2003).The leader's approach to ecosystem development through partnerships with academic institutions and NGOs provided critical access to resources, ideas, and legitimacy. This strategic choice aligned with Kirchherr et al. (2018), who emphasized the importance of stakeholder collaboration in circular transitions. Overall, the findings support the theoretical claim that successful circular design innovation requires not only technical tools and frameworks but also leadership that balances creative freedom with structural clarity, and vision with collaboration. Future research might expand by applying the leadership–innovation interaction framework to multiple companies and sectors.

This research affirms that the integration of circular economy (CE) principles into fashion product design depends on the interplay between digital innovation, sustainable practices, and visionary leadership. The case study reveals that CE-aligned fashion design is inherently iterative and modular, enabled by technologies such as AI and blockchain, and guided by leadership that fosters ethical values and systemic collaboration. These findings are not only consistent with the frameworks of Design for Circular Economy (DfCE) and Sustainable Product Development (SPD) but also reinforce the fashion industry's potential to contribute to the UN Sustainable Development Goals (SDGs) notably SDG 12 (Responsible Consumption and Production), SDG 9 (Industry, Innovation, and Infrastructure), and SDG 13 (Climate Action). Moreover, this study's implications align with broader efforts to embed sustainability into industrial innovation, as demonstrated in the research by Tian, Kanchanawongpaisan, and Fei (2025), which explores how sustainable engineering practices in Thailand's industrial parks support both SDG 12 and SDG 13. Their work emphasizes systemic transformation through technology and policy integration similar to how leadership and digital tools enable sustainable design in fashion. Together, both studies highlight that advancing sustainability across sectors requires more than technical adaptation; it demands cultural, organizational, and policy-level shifts to foster long-term impact.

Conclusions and Recommendations



This study investigates the application of circular economy (CE) principles in fashion product design, with a particular focus on leadership, technology, and systemic enablers. While circularity has become a growing area of interest within sustainable innovation, the specific processes through which fashion enterprises integrate CE into design remain underexplored. Addressing this gap, the research examined how design strategies, technological tools, and leadership behaviors interact to foster sustainable innovation in a single case organization operating anonymously by request.Drawing on frameworks from Design for Circular Economy (DfCE) and Sustainable Product Development (SPD), the study developed and tested a research framework to explain how circular design emerges in practice. It was found that product design aligned with CE values such as recyclability, disassemblability, and modularity was driven by both technological integration (e.g., 3D simulation, AI, blockchain) and leadership vision. The founder's ethical leadership and strategic partnerships played a critical role in cultivating a value-centric innovation culture. Furthermore, consumer engagement and external collaborations with NGOs and academia supported knowledge sharing and ecosystem growth. The study concludes that CE innovation in fashion is not merely a technical challenge but also a human and organizational one. Leadership serves as both the trigger and the catalyst for systemic change, shaping not only design priorities but also team motivation and cross-sector collaboration. These findings provide a grounded, empirical validation of the proposed framework and offer practical insights for fashion enterprises seeking to adopt regenerative models through circular and sustainable design thinking.

Recommendation

1.Foster visionary leadership that integrates circular economy principles into fashion design by promoting a culture of sustainability, experimentation, and stakeholder collaboration.

2.Accelerate the integration of digital technologies such as AI, 3D prototyping, and blockchain to enhance material efficiency, design transparency, and sustainable product innovation

References

Baumann, H., Boons, F., & Bragd, A. (2002). *Mapping the green product development field: Engineering, policy and business perspectives*. Journal of Cleaner Production, 10(5), 409–425.

Bocken, N. M. P., de Pauw, I., Bakker, C., & van der Grinten, B. (2016). *Product design and business model strategies for a circular economy*. Journal of Industrial and Production Engineering, 33(5), 308–320.

Ellen MacArthur Foundation. (2017). *A new textiles economy: Redesigning fashion's future*. Ellen MacArthur Foundation.

Hallstedt, S., Thompson, A., & Lindahl, P. (2009). *Key elements for implementing a strategic sustainable development approach in the product innovation process*. Journal of Cleaner Production, 18(8), 118–129.

Kirchherr, J., Reike, D., & Hekkert, M. (2018). *Conceptualizing the circular economy: An analysis of 114 definitions*. Resources, Conservation and Recycling, 127, 221–232.

Moreno, M., De los Rios, C., Rowe, Z., & Charnley, F. (2016). *A conceptual framework for circular design*. Sustainability, 8(9), 937.

Pencarelli, T. (2020). *The digital revolution in the fashion industry*. The TQM Journal, 32(4), 827–846.

Eisenhardt, K. M. (1989). *Building theories from case study research*. Academy of Management Review, 14(4), 532–550.

Yin, R. K. (2009). *Case study research: Design and methods* (4th ed.). Thousand Oaks, CA: Sage Publications.

Fletcher, K., & Tham, M. (2019). *Earth logic: Fashion action research plan*. The JJF: London.

Pencarelli, T. (2020). The digital revolution in the travel and tourism industry. *Information Technology & Tourism*, 22(4), 455–476.

Hallstedt, S. I., Ny, H., Robèrt, K. H., & Broman, G. (2009). An approach to assessing sustainability integration in strategic decision systems for product development. *Journal of Cleaner Production*, 18(8), 703–712..

Baumann, H., Boons, F., & Bragd, A. (2002). Mapping the green product development field: Engineering, policy and business perspectives. *Journal of Cleaner Production*, 10(5), 409–425.

King, N. (2012). Doing template analysis. In G. Symon & C. Cassell (Eds.), *Qualitative organizational research* (pp. 426–450). London: SAGE.

Desai, A. V. & Mahadik, V. V. (2011). *Designing a business model for sustainable innovation in India: A case study*. International Journal of Innovation Management, 15(4), 731–750.

Mitchell, D. & Coles, C. (2003). *The ultimate competitive advantage of continuing business model innovation*. Journal of Business Strategy, 24(5), 15–21.

Kirchherr, J., Reike, D. & Hekkert, M. (2018). *Conceptualizing the circular economy: An analysis of 114 definitions*. Resources, Conservation and Recycling, 127, 221–232.

Baumann, H., Boons, F., & Bragd, A. (2002). Mapping the green product development field: Engineering, policy and business perspectives. *Journal of Cleaner Production*, 10(5), 409–425.

Eisenhardt, K. M. (1989). Building theories from case study research. *Academy of Management Review*, 14(4), 532–550.

Ellen MacArthur Foundation. (2017). *A new textiles economy: Redesigning fashion's future*. Ellen MacArthur Foundation.

Tian, L., Kanchanawongpaisan, S., & Fei, Z. (2025). *Advancing Sustainable Engineering Practices In Industrial Parks: A Pathway to Achieving SDG 12 and SDG 13 in Thailand*. *Journal of Lifestyle and SDGs Review*, 5(1)

Rasli, A., Zhou, F. & Abas, I. McXin Tee,(2024). A framework for higher education institutions sustainability: A multi-method study. *Journal of Infrastructure, Policy and Development*, 8(5), 3566.

Shao, H., Jin, Q., Guo, Y., Zhou, F., Wider, W. & Lu, L. (2025). *The relationship between the structure of firms' human capital and corporate innovation performance*. PLOS ONE, 20(4)

Mohammad, S. I. S., Vasudevan, A., Alrifae, A. A. M., Al refai, Y. A. M., Kutieshat, R. J., Alkhawaldeh, M. M. K., Al sarayreh, A., Mohammad, A. A. S., & Mohammad, D. I. (2024). *The impact of transformational leadership on organizational performance excellence in social security institutions*. In Frontiers of Human Centricity in the Artificial Intelligence-Driven Society 5.0 (pp. 341–354). Springer Nature Switzerland.