

Identification of the Components of Environmental Innovation, Green Supply Chain Management, Circular Economy Capabilities, and Financial Performance Through Qualitative Content Analysis

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ABSTRACT

The present study aimed to identify and explain the components of environmental innovation, green supply chain management, circular economy capabilities, and financial performance through qualitative content analysis using the multi-grounded theory approach. This study was conducted using a qualitative exploratory design based on multi-grounded theory. The statistical population included university experts, senior managers, sustainability specialists, and experienced professionals in environmental management, green innovation, and supply chain systems associated with airport organizations in Tehran. Participants were selected through purposive and snowball sampling, and sampling continued until theoretical saturation was achieved. Finally, 17 experts participated in semi-structured in-depth interviews. In addition to field interviews, 40 scientific studies published between 2015 and 2025 were systematically reviewed through meta-synthesis to strengthen the theoretical grounding of the extracted concepts. Data analysis was conducted through open, axial, and selective coding using continuous comparative analysis. To ensure trustworthiness, member checking, peer review, rich description, and inter-coder reliability assessment based on Cohen's Kappa were employed. The findings led to the extraction of a comprehensive qualitative model consisting of causal conditions, contextual conditions, enabling factors, strategies, the central category, and multidimensional consequences. Environmental innovation in the context of green supply chain management emerged as the central category of the model. The main causal conditions included institutional sustainability requirements, organizational environmental responsibility, and competitive green market pressures. Contextual conditions involved green governance, environmental culture, technological infrastructure, and socio-environmental justice. Knowledge-based, technological, digital, and financial capabilities were identified as major enabling factors. Strategic responses included green product design, reverse logistics, green procurement, smart environmental monitoring, and sustainability-oriented governance systems. The consequences of the model included improved financial performance, operational efficiency, green competitiveness, social sustainability, environmental performance, and institutional learning.

Keywords: Environmental Innovation, Green Supply Chain Management, Circular Economy, Financial Performance, Sustainable Development.

1. Introduction

Environmental degradation, climate change, depletion of natural resources, and increasing global regulatory pressures have transformed sustainability from a voluntary organizational initiative into a strategic necessity for firms and supply chains operating in highly competitive environments. Contemporary organizations are increasingly expected to balance economic performance with environmental responsibility while simultaneously responding to stakeholder expectations, technological transformations, and sustainability-oriented regulations (Singh et al., 2025; Wang & Guocheng, 2023). In this context, environmental innovation, green supply chain management (GSCM), and circular economy (CE) capabilities have emerged as critical organizational mechanisms for achieving sustainable competitiveness and long-term financial resilience (Mondal et al., 2025; Shahzad et al., 2024). The growing integration of sustainability principles into operational and strategic decision-making demonstrates that firms can no longer rely solely on traditional linear production systems based on extraction, consumption, and disposal. Instead, organizations are increasingly shifting toward regenerative and circular systems emphasizing resource efficiency, recycling, remanufacturing, waste reduction, and closed-loop supply chains (Pasca et al., 2023; Schöggel et al., 2023).

Green supply chain management has become one of the most influential approaches for integrating environmental concerns into organizational processes and interorganizational networks. GSCM extends sustainability principles beyond the boundaries of individual firms and incorporates environmental considerations into sourcing, production, logistics, distribution, reverse logistics, and end-of-life product management (Hu, 2023; Nikseresht et al., 2023). Recent studies suggest that organizations implementing green supply chain practices experience improvements in operational efficiency, waste reduction, stakeholder trust, and market competitiveness (Fernando et al., 2022; Shaharudin et al., 2023). Furthermore, the emergence of circular supply chain practices has intensified the strategic relevance of GSCM by promoting closed-loop material flows, sustainable resource utilization, and product life-cycle optimization (Agyabeng-Mensah et al., 2024; Mohamed Azeem El Fatih, 2024). These developments indicate that green transformation is no longer limited to environmental compliance but has become deeply connected

to innovation capability, digital transformation, and financial performance.

Environmental innovation represents one of the central pillars of sustainable organizational transformation. Environmental innovation refers to the development and implementation of environmentally friendly products, processes, technologies, and business models designed to reduce ecological impacts while simultaneously enhancing organizational performance (Li et al., 2022; Liu & Wang, 2022). Green innovation enables firms to optimize energy consumption, minimize waste generation, improve resource efficiency, and develop environmentally responsible production systems (Chishty, 2023; Le, 2024). In addition, environmental innovation contributes to organizational legitimacy and strengthens firms' competitive positioning in global markets characterized by increasing environmental awareness and sustainability requirements (Agyabeng-Mensah et al., 2023; Wang & Guocheng, 2023). Recent evidence also demonstrates that environmental innovation positively influences financial outcomes by reducing operational costs, improving efficiency, and enhancing access to green investment and sustainable financing mechanisms (Beatriz de Souza Mello et al., 2022; Sadaa et al., 2024).

The concept of circular economy has gained considerable scholarly and practical attention due to its potential to transform traditional economic systems into regenerative and restorative models. Circular economy seeks to eliminate waste and maximize resource value through reuse, recycling, remanufacturing, and continuous circulation of materials within production and consumption systems (Mondal, 2025; Pasca et al., 2023). Unlike the linear economy model, which follows a "take-make-dispose" logic, the circular economy emphasizes closed-loop systems and sustainable resource cycles (Giudice et al., 2020; Yu et al., 2021). Circular economy capabilities enable organizations to redesign processes, products, and supply chains in ways that simultaneously improve environmental sustainability and economic efficiency (Malhotra, 2023; Marrucci et al., 2022). These capabilities include reverse logistics competency, circular product design, digital traceability systems, resource recovery mechanisms, and collaborative innovation networks (Elaine Aparecida Regiani de et al., 2020; Schöggel et al., 2023). Consequently, organizations adopting circular economy practices are more likely to achieve sustainable performance advantages and long-term resilience.

Technological advancement has further accelerated the integration of environmental innovation and circular

economy principles into supply chain systems. Industry 4.0 technologies, artificial intelligence, Internet of Things (IoT), blockchain systems, big data analytics, and digital platforms increasingly serve as enablers of sustainable operations and green transformation (Arsawan et al., 2024; Govardhan et al., 2025). These technologies facilitate environmental monitoring, predictive maintenance, intelligent logistics, waste management optimization, and transparent supply chain traceability (Bułkowska et al., 2023; Lee & Mangalaraj, 2022). Moreover, digital technologies strengthen organizations' ability to collect, analyze, and utilize environmental data for strategic decision-making (Riso & Morrone, 2023; Sadaa et al., 2024). Research indicates that firms equipped with strong digital capabilities demonstrate greater flexibility and adaptability in implementing green and circular practices (Shafique et al., 2023; Umar et al., 2021). As a result, digital transformation and sustainability transformation are increasingly viewed as interconnected strategic processes rather than separate organizational initiatives.

Despite the growing body of literature concerning green innovation, circular economy, and sustainable supply chains, several conceptual and empirical gaps remain unresolved. First, many existing studies examine environmental innovation, green supply chain practices, or circular economy capabilities separately rather than analyzing the dynamic relationships among these constructs in an integrated framework (Mondal, 2025; Siddiqui et al., 2024). Second, much of the existing literature relies heavily on quantitative approaches focused on testing predefined relationships, while comparatively fewer studies explore the underlying dimensions, contextual conditions, and conceptual structures shaping the interaction between environmental innovation and circular supply chain systems (Ngetich et al., 2022; Nikseresht et al., 2023). Third, the majority of prior studies have concentrated on manufacturing sectors in developed economies, leaving a limited understanding of how these phenomena manifest in infrastructure-intensive and service-oriented sectors such as aviation and airport systems (Mohamed Azeem El Fatih, 2024; Singh et al., 2025). This gap is particularly important because airports and aviation-related organizations face substantial environmental pressures associated with energy consumption, emissions, logistics complexity, and stakeholder scrutiny.

Furthermore, financial performance remains a contested issue within sustainability research. While many studies suggest that green innovation and circular practices improve

long-term economic outcomes, others argue that sustainability implementation may impose significant short-term financial burdens on firms (Beatriz de Souza Mello et al., 2022; Fernando et al., 2022). Consequently, there is a growing need to clarify how environmental innovation and circular supply chain capabilities contribute to financial performance through organizational, technological, and institutional mechanisms. Existing evidence indicates that sustainable practices may improve profitability through efficiency enhancement, cost reduction, resource optimization, improved stakeholder relationships, and access to sustainable investment opportunities (Le, 2024; Siddik et al., 2023). However, the pathways connecting these variables remain insufficiently conceptualized, especially in emerging and transitional organizational contexts.

Stakeholder pressure has also emerged as a major driver of sustainable transformation within organizations and supply chains. Governments, regulators, customers, investors, suppliers, and communities increasingly demand environmentally responsible behavior and transparent sustainability practices (Agyabeng-Mensah et al., 2024; Wang & Guocheng, 2023). Environmental regulations, ESG reporting requirements, carbon reduction commitments, and sustainability standards have intensified the need for organizations to adopt green innovation strategies and circular business models (Shahzad et al., 2024; Singh et al., 2025). In response, firms are increasingly developing collaborative sustainability networks and interorganizational partnerships aimed at sharing environmental knowledge, green technologies, and circular capabilities (Agyabeng-Mensah et al., 2023; Schögl et al., 2023). These developments suggest that sustainable transformation is not solely an internal organizational process but rather a network-based phenomenon shaped by institutional and relational dynamics.

Another important issue concerns the role of dynamic organizational capabilities in enabling green transformation. Dynamic capabilities refer to the organization's ability to integrate, reconfigure, and adapt resources in response to environmental changes and strategic challenges (Marrucci et al., 2022; Mondal et al., 2025). Firms possessing stronger dynamic capabilities are better positioned to implement environmental innovation, absorb green technologies, and redesign supply chain processes in alignment with circular economy principles (Li et al., 2022; Malhotra, 2023). Additionally, strategic green capabilities such as sustainability-oriented leadership, environmental knowledge management, and green technological readiness

significantly influence organizations' success in implementing circular and green supply chain initiatives (Shafique et al., 2023; Shaharudin et al., 2023). This perspective reinforces the importance of examining sustainability transformation through a systemic and capability-oriented lens.

Recent scholarship has also highlighted the importance of interorganizational collaboration and environmental information exchange in achieving sustainable supply chain performance. Collaboration among suppliers, manufacturers, logistics providers, regulators, universities, and technology partners enables organizations to overcome sustainability barriers and accelerate innovation diffusion (Agyabeng-Mensah et al., 2024; Schöggel et al., 2023). Digital collaboration platforms and green knowledge-sharing systems facilitate coordination across complex supply networks and improve environmental decision-making (Lee & Mangalaraj, 2022; Riso & Morrone, 2023). Simultaneously, ethical leadership and environmental orientation strengthen organizational commitment to sustainability goals and improve the effectiveness of circular supply chain initiatives (Agyabeng-Mensah et al., 2023; Le, 2024). Therefore, sustainable transformation requires not only technological readiness but also institutional alignment, cultural adaptation, and collaborative governance structures.

In recent years, the convergence of Industry 4.0 technologies and sustainability-oriented management has significantly reshaped organizational strategies. Smart manufacturing systems, blockchain-enabled waste tracking, AI-based predictive analytics, and IoT-supported environmental monitoring systems are increasingly integrated into green supply chain frameworks (Bułkowska et al., 2023; Govardhan et al., 2025). These technologies enhance traceability, transparency, resource optimization, and operational flexibility while reducing environmental uncertainty and inefficiencies (Shahzad et al., 2024; Siddiqui et al., 2024). Additionally, firms integrating technological innovation with circular economy principles demonstrate superior sustainable performance and adaptability under changing environmental conditions (Chourasiya & Malviya, 2025; Yu et al., 2021). Consequently, environmental innovation today is deeply interconnected with digital capability development and strategic sustainability management.

Although previous studies have provided valuable insights into sustainable supply chains and circular economy implementation, the complexity of the relationships among environmental innovation, green supply chain management,

circular economy capability, and financial performance still requires deeper conceptual exploration. The interaction between institutional pressures, organizational capabilities, technological enablers, collaborative networks, and sustainability outcomes remains insufficiently theorized within a unified qualitative framework (Mondal et al., 2025; Siddiqui et al., 2024). Moreover, many existing studies focus on isolated dimensions of sustainability without adequately addressing the multidimensional and systemic nature of green transformation processes (Pasca et al., 2023; Singh et al., 2025). Therefore, there is a clear need for qualitative and theory-building studies capable of identifying the underlying components, contextual mechanisms, and conceptual linkages among these constructs.

Accordingly, the present study seeks to identify the components of environmental innovation, green supply chain management, circular economy capabilities, and financial performance through qualitative content analysis and multi-grounded theory in order to develop a comprehensive conceptual framework explaining the interrelationships among these constructs within the context of sustainable organizational transformation.

2. Methods and Materials

This study was conducted using a qualitative, exploratory research design based on qualitative content analysis. The main purpose of the qualitative phase was to identify and explain the key components, dimensions, and indicators of environmental innovation, green supply chain management, circular economy capabilities, and financial performance in the context of airport companies. The study was applied in terms of purpose, because its findings were intended to provide a practical conceptual basis for managers and policymakers seeking to improve environmental sustainability, supply chain efficiency, circular resource use, and financial outcomes. The statistical population consisted of senior managers, deputies, experienced experts, university professors, and specialists familiar with planning, environmental management, engineering, sustainable development, logistics, and green supply chain issues in airport companies located in Tehran. Participants were selected through purposive sampling and snowball sampling, with emphasis on professional experience, theoretical knowledge, and direct familiarity with the research phenomenon. Sampling continued until theoretical saturation was achieved; that is, when the interviews no longer produced substantially new concepts or categories.

Finally, 17 experts participated in the study and were interviewed in depth.

Data were collected through semi-structured interviews and documentary-library review. The semi-structured interview protocol was designed based on the main concepts of the study, including environmental innovation, green supply chain management, circular economy capabilities, and financial performance. The interview questions were open-ended and allowed participants to explain their experiences, perceptions, and interpretations freely. Before each interview, the purpose of the study was explained to the participants, informed consent was obtained, and confidentiality of responses was assured. Interviews were recorded with permission and then transcribed verbatim for analysis. In addition to interview data, relevant scientific articles, books, theoretical sources, and prior studies published between 2015 and 2025 were reviewed to strengthen the theoretical grounding of the extracted concepts. This combination of field interviews and documentary evidence made it possible to compare expert-based empirical insights with the existing body of knowledge and to develop a more comprehensive set of components and indicators.

The qualitative data were analyzed through systematic qualitative content analysis. First, all interview transcripts were prepared, organized, and reviewed several times to obtain an overall understanding of the data. In the next step, meaningful units, including sentences, phrases, and paragraphs related to the research objectives, were identified and coded. Open coding was used to extract initial concepts directly from the participants' statements. Similar codes were then compared, merged, and classified into broader subcategories and categories. Through continuous comparison between interview data and documentary evidence, the main dimensions and components of environmental innovation, green supply chain management,

circular economy capabilities, and financial performance were refined. To ensure trustworthiness, member checking was conducted by providing selected participants with the extracted codes and categories for confirmation. Peer review was also used by asking qualitative research experts to examine the coding process and category formation. Transferability was supported through rich description of the research context, participants, and analytical procedures. Reliability of coding was assessed through recoding by a second coder on selected interviews, and the agreement between coders indicated acceptable consistency. The final output of the qualitative analysis was a validated set of dimensions, components, and indicators that formed the conceptual foundation of the study.

3. Findings and Results

The qualitative findings were extracted through the integration of semi-structured interviews with 17 experts and the systematic review of selected studies published between 2015 and 2025. The analysis was conducted using the multi-grounded theory logic, in which theoretical evidence, empirical interview data, and internal analytical comparison were combined to identify the main components of environmental innovation, green supply chain management, circular economy capabilities, and financial performance. The coding process led to the extraction of causal conditions, the central category, contextual conditions, intervening/enabling conditions, strategies, and consequences. The final qualitative model indicates that environmental innovation functions as the central mechanism through which institutional pressures, green capabilities, technological infrastructure, and circular economy practices are translated into green supply chain transformation and improved financial, competitive, social, and environmental outcomes.

Table 1

Final Qualitative Findings of the Study

Main Category	Subcategory	Extracted Concepts	Open Codes
Causal conditions: green transformation and innovation drivers in the supply chain	Institutional sustainability requirements	International green compliance frameworks; national sustainability governance; macro-level environmental monitoring; multi-level policy interactions	Paris Agreement requirements, ISO 14001, carbon taxation, clean energy certification, national sustainability policy, environmental regulation, green performance reports, inter-ministerial coordination
Causal conditions: green transformation and innovation drivers in the supply chain	Organizational responsibility and green support policies	Social-environmental accountability; green economic incentives	CSR commitment, ESG reporting, sustainability disclosure, green taxation, clean production incentives, industry-environment communication institutions

Causal conditions: green transformation and innovation drivers in the supply chain	Competitive and market pressures	Global supply chain alignment; green consumer preferences	Supplier pressure, global chain requirements, environmental benchmarking, clean technology pressure, green customer demand, green brand sensitivity
Central category: environmental innovation in the context of green supply chain management	Technological innovation and product life cycle	Sustainable design; waste reduction; clean technology	Low-carbon product design, energy-saving innovation, clean technologies, green product life-cycle planning
Central category: environmental innovation in the context of green supply chain management	Green organizational and process innovation	Process reengineering; digital operations; smart automation	Green automation, digital tracking, pollution control, green process redesign
Central category: environmental innovation in the context of green supply chain management	Open innovation and green collaboration networks	Knowledge sharing; open innovation networks; technological cooperation	Joint learning networks, green technology sharing, inter-firm collaboration, university–industry cooperation
Central category: environmental innovation in the context of green supply chain management	Green business model innovation	Circular business models; return services; life-cycle value creation	Circular business model, product return flow, resource maintenance, energy efficiency
Contextual conditions: institutional and organizational context for circular economy and GSCM	Institutional capacity-building and green human capital	Green governance; institutional training and empowerment	Governance structure, regulatory institutions, data transparency, environmental education, green literacy, employee learning
Contextual conditions: institutional and organizational context for circular economy and GSCM	Culture, values, and socio-environmental justice	Environmental justice; green organizational and social values	Media–industry communication, environmental information disclosure, green culture, environmental ethics, civic participation
Contextual conditions: institutional and organizational context for circular economy and GSCM	Green policy and governance frameworks	Legal framework of green economy; macro-level support policies; participatory governance	Green trade law, environmental export standards, green budget, clean energy subsidies, national circular transition programs, government–industry–university cooperation
Contextual conditions: institutional and organizational context for circular economy and GSCM	Structural and technological infrastructure	Green technological infrastructure; structural characteristics of green organizations	Clean energy infrastructure, environmental data systems, innovation networks, organizational size, ownership structure, sustainable business model
Intervening/enabling conditions: knowledge, technological, and financial enablers	Knowledge and educational enablers	Green knowledge management; absorptive capacity; open learning networks	Employee knowledge competencies, knowledge sharing, green organizational learning, environmental knowledge absorption, technological creativity
Intervening/enabling conditions: knowledge, technological, and financial enablers	Technological and digital enablers	Digital sustainability infrastructure; smart optimization technologies; green R&D	IT infrastructure, environmental big data, AI-based environmental monitoring, energy and waste sensors, green R&D, clean technology
Intervening/enabling conditions: knowledge, technological, and financial enablers	Financial and economic enablers	Sustainable financing; green finance instruments; fiscal support for green R&D	Green investment, green venture capital, public research budgets, green banking, green bonds, tax incentives for clean technology
Strategies: implementation of GSCM and circular economy	Green design and engineering strategies	Life-cycle design; clean production engineering; green product innovation	Life-cycle design, low-carbon product design, biodegradable packaging, green product development, clean process engineering, waste reduction
Strategies: implementation of GSCM and circular economy	Green supply chain and logistics strategies	Reverse logistics; green purchasing; regional green supply networks	Reverse logistics, remanufacturing, material reuse, recycling, green supplier selection, supplier participation, regional circular networks
Strategies: implementation of GSCM and circular economy	Technology- and data-driven strategies	Digital green chain; intelligent environmental monitoring	Material tracking, digital pollution control, digital twins, smart logistics, water and energy consumption monitoring, environmental decision-support systems
Strategies: implementation of GSCM and circular economy	Green policy and executive strategies	Green organizational policies; green auditing; green branding and CSR	Green contracts, sustainability reporting, sustainability committees, CSR implementation, green export branding
Consequences: financial, competitive, sustainability, and institutional outcomes	Green financial returns	Improved return on green capital; cost and energy reduction; resource productivity	Increased profitability, improved financial performance, green investment attraction, investor trust, energy saving, production cost reduction, reduced resource waste
Consequences: financial, competitive, sustainability, and institutional outcomes	Competitive outcomes	Green market share; international brand position; customer and employee loyalty	Green export development, improved brand image, sustainable competitive advantage, customer satisfaction, employee participation in green programs
Consequences: financial, competitive, sustainability, and institutional outcomes	Social and environmental sustainability outcomes	Social capital; environmental justice; carbon and waste reduction; ESG improvement	Community participation, social trust, quality of local life, reduced carbon footprint, reduced pollution, ESG improvement, alignment with SDGs
Consequences: financial, competitive, sustainability, and institutional outcomes	Knowledge and institutional outcomes	Green knowledge growth; technological capability; green decision infrastructure	Green learning capabilities, decision-support systems, stronger green innovation capacity, institutionalization of environmental knowledge

The results presented in Table 1 show that the final qualitative model is structured around a central category: environmental innovation in the context of green supply chain management. This category connects institutional and

market pressures to practical green strategies and organizational outcomes. The causal conditions reveal that green transformation is driven by international standards, national regulations, stakeholder expectations, CSR pressures, ESG reporting, and market demand for green services. The contextual conditions show that green supply chain development requires supportive governance, green culture, environmental justice, legal frameworks, clean energy infrastructure, and organizational readiness. The enabling conditions emphasize that knowledge management, digital technologies, green finance, and R&D

capacity are essential foundations for implementing circular economy practices. The strategic categories show that organizations must operationalize green transformation through life-cycle design, reverse logistics, green purchasing, smart monitoring, sustainability reporting, and green branding. Finally, the consequence categories indicate that these strategies generate financial, competitive, environmental, social, and institutional outcomes, including improved profitability, lower operating costs, enhanced brand position, reduced carbon footprint, ESG improvement, and stronger green innovation capability.

Table 2

Validation of Qualitative Findings Based on Trustworthiness Criteria

Trustworthiness Criterion	Validation Procedure Used in the Study	Evidence of Validation
Credibility	Member checking with selected participants	Extracted codes and categories were returned to several experts, and their feedback was used to confirm or refine the concepts.
Credibility	Continuous comparison between interviews and literature	Concepts derived from interviews were compared with the findings of selected studies from 2015 to 2025.
Transferability	Rich description of participants, context, and procedures	The research context, expert characteristics, sampling logic, and qualitative analysis procedures were described in detail.
Dependability	Peer review and expert supervision	The coding process and category formation were reviewed by qualitative research specialists and academic supervisors.
Confirmability	Documentation of coding decisions	Interview transcripts, extracted codes, analytical notes, and category-building decisions were systematically recorded.
Internal coherence	Integration through multi-grounded theory	The final categories were compared across theoretical evidence, empirical data, and researcher interpretation.
Analytical validity	Conceptual refinement through repeated coding	Initial codes were merged, revised, and reorganized into subcategories and main categories through several rounds of analysis.

Table 2 confirms that the qualitative findings were validated through several trustworthiness procedures. Credibility was strengthened by member checking and continuous comparison between interview evidence and theoretical sources. Transferability was supported through detailed description of the research setting, participants, and analytical process. Dependability was enhanced through

peer review and expert supervision of the coding procedure. Confirmability was ensured by documenting the coding path and maintaining a clear audit trail of analytical decisions. Overall, these procedures indicate that the extracted model was not based on isolated interpretation, but on systematic triangulation between expert views, theoretical evidence, and repeated qualitative analysis.

Table 3

Inter-Coder Reliability Based on Cohen's Kappa

Coding Agreement Matrix	Second Coder: Agree	Second Coder: Disagree	Total
First Coder: Agree	15	1	16
First Coder: Disagree	1	4	5
Total	16	5	21

Reliability Index	Value
Observed agreement (Po)	0.9047
Expected agreement (Pe)	0.637
Cohen's Kappa (K)	0.737
Interpretation	Valid/substantial agreement

Table 3 shows the results of inter-coder reliability analysis. Out of 21 coded units, the two coders agreed on 19

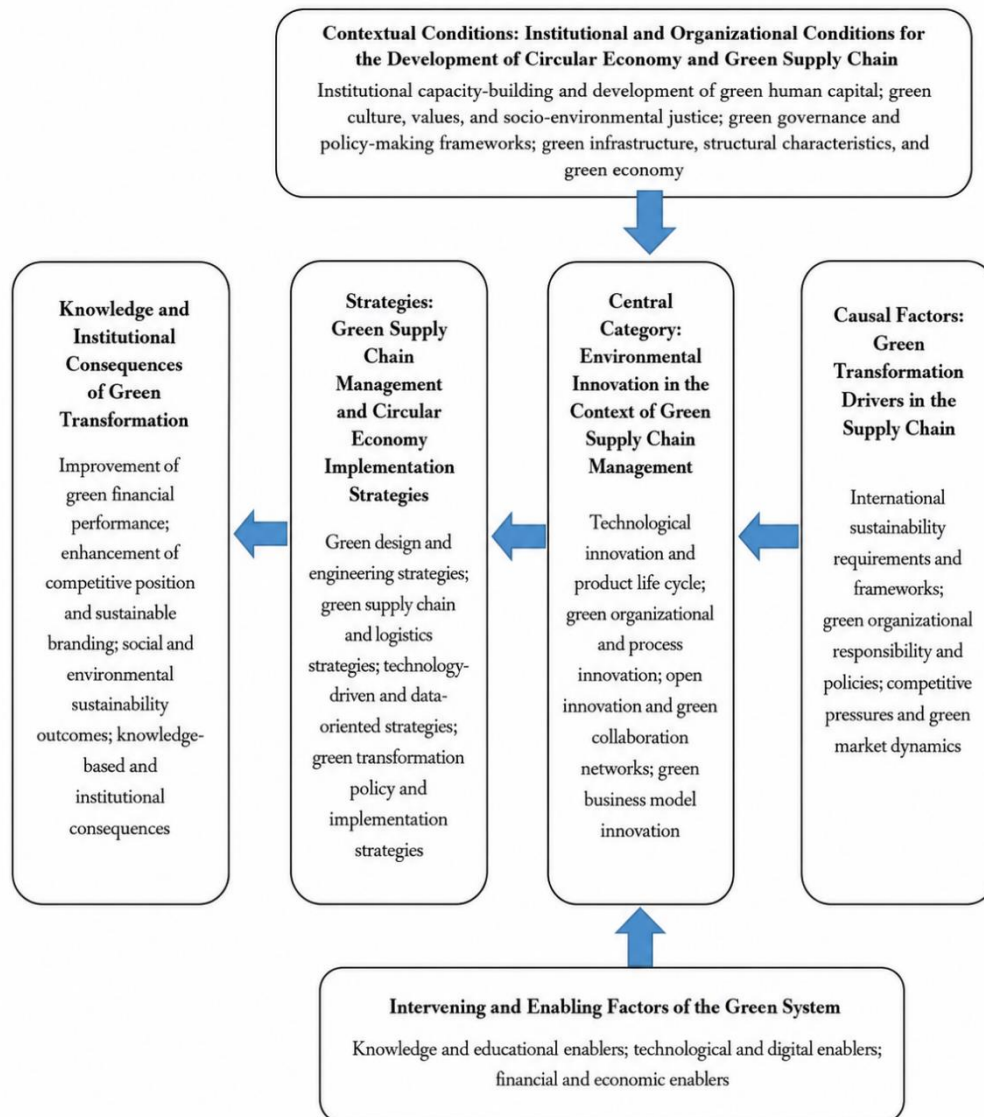
cases, producing an observed agreement of 0.9047. After controlling for chance agreement, Cohen's Kappa was

calculated as 0.737. This value falls within the valid or substantial agreement range and confirms that the coding process had acceptable reliability. Therefore, the extracted

open codes, subcategories, and main categories can be considered sufficiently stable and dependable for use in the final qualitative model.

Figure 1

Final Conceptual Model



4. Discussion and Conclusion

The present study aimed to identify the components of environmental innovation, green supply chain management, circular economy capabilities, and financial performance through qualitative content analysis using the multi-grounded theory approach. The findings demonstrated that environmental innovation functions as the central category connecting institutional pressures, technological

capabilities, organizational readiness, circular economy practices, and sustainable financial outcomes. The extracted model revealed that green transformation within organizations emerges through the interaction of causal conditions, contextual and enabling factors, strategic organizational responses, and multidimensional consequences. Overall, the findings indicate that environmental innovation is not merely a technological process, but rather a systemic and multidimensional transformation involving governance structures, knowledge

systems, digital infrastructures, stakeholder collaboration, and sustainability-oriented strategies.

One of the most important findings of the study was the identification of institutional and regulatory pressures as primary causal drivers of green transformation within supply chains. The findings showed that international environmental standards, national sustainability policies, ESG requirements, carbon reduction commitments, and stakeholder expectations strongly influence organizations' movement toward green innovation and circular supply chain implementation. This finding aligns with prior studies emphasizing the importance of environmental governance, institutional pressure, and stakeholder demands in motivating sustainable organizational behavior (Agyabeng-Mensah et al., 2024; Wang & Guocheng, 2023). Similarly, Singh et al. argued that environmental collaboration and sustainability-oriented supply chain management increasingly depend on institutional alignment and stakeholder engagement (Singh et al., 2025). The present findings further extend this perspective by demonstrating that institutional forces operate simultaneously at global, national, and organizational levels and collectively shape firms' strategic orientation toward sustainability.

Another significant finding concerned the central role of environmental innovation within green supply chain transformation. The study revealed that environmental innovation encompasses technological innovation, green organizational redesign, digital process transformation, open innovation networks, and green business model innovation. This finding is consistent with studies emphasizing the strategic role of green innovation in enhancing environmental and organizational performance (Li et al., 2022; Liu & Wang, 2022). The findings also support the argument proposed by Chishty that technological advancement and circular economy practices are deeply interconnected with environmental and economic efficiency (Chishty, 2023). Moreover, the extracted model demonstrated that green innovation is not limited to operational optimization but extends to the redesign of organizational structures and value creation systems. This interpretation aligns with research suggesting that circular economy transformation requires changes in products, processes, networks, and business models simultaneously (Mondal, 2025; Pasca et al., 2023).

The findings also highlighted the importance of contextual conditions and organizational infrastructure in enabling green transformation. Institutional capacity-building, green governance, environmental culture, socio-

environmental justice, and technological infrastructure emerged as critical contextual elements shaping organizations' readiness for circular economy implementation. These results are consistent with prior studies demonstrating that environmental orientation, ethical leadership, and sustainability culture significantly influence circular supply chain performance (Agyabeng-Mensah et al., 2023; Le, 2024). The findings also support the work of Marrucci et al., who emphasized the role of dynamic organizational capabilities in improving environmental performance and enabling circular economy adoption (Marrucci et al., 2022). In the present study, contextual factors were found to operate as foundational mechanisms that either facilitate or constrain the implementation of green strategies. This suggests that sustainability transformation cannot succeed solely through technological investments without supportive governance systems, organizational learning, and cultural alignment.

Another important contribution of the study lies in identifying knowledge-based, technological, and financial enablers of sustainable transformation. The results demonstrated that organizations require green knowledge management systems, absorptive learning capacities, digital infrastructures, artificial intelligence applications, environmental data systems, and green financing mechanisms to successfully implement circular supply chain practices. These findings strongly align with previous research emphasizing the role of Industry 4.0 technologies and digital transformation in sustainable supply chain development (Govardhan et al., 2025; Shahzad et al., 2024). The present findings also correspond with studies indicating that big data analytics, blockchain systems, IoT technologies, and digital monitoring platforms improve traceability, environmental control, and operational sustainability (Bułkowska et al., 2023; Giudice et al., 2020). Furthermore, the study supports the argument that green financing and sustainable investment systems are essential for supporting environmental innovation initiatives, particularly because green technologies often involve substantial initial costs and long-term investment horizons (Beatriz de Souza Mello et al., 2022; Siddik et al., 2023).

The findings related to strategic organizational responses revealed that green supply chain management and circular economy implementation depend on four interconnected strategic dimensions: green design and engineering, green logistics and supply chain restructuring, technology-driven environmental management, and green policy and governance strategies. These findings are consistent with

studies emphasizing reverse logistics, sustainable procurement, lifecycle management, and digital logistics optimization as key mechanisms of circular supply chains (Fernando et al., 2022; Shaharudin et al., 2023). Similarly, Schöggl et al. argued that interorganizational collaboration and digital technologies are essential for successful circular economy implementation (Schöggl et al., 2023). The present study extends this literature by illustrating how these strategies collectively form a coherent organizational response system rather than isolated sustainability initiatives. In particular, the findings demonstrate that green transformation requires simultaneous integration of operational, technological, and governance-oriented strategies.

The role of collaboration networks and open innovation also emerged as a central theme in the findings. Organizations implementing green transformation strategies were found to rely heavily on interorganizational cooperation, knowledge sharing, technological partnerships, and collaborative learning ecosystems. This finding is consistent with previous research emphasizing the importance of environmental information exchange capability and collaborative green innovation in circular supply chain performance (Agyabeng-Mensah et al., 2024; Schöggl et al., 2023). The findings also support the perspective proposed by Mondal et al., who argued that dynamic capabilities and collaborative green strategies significantly contribute to successful circular economy transformation (Mondal, 2025). This indicates that environmental innovation is increasingly network-oriented and ecosystem-based rather than organization-centered.

The consequences identified in the study further demonstrate the multidimensional value of environmental innovation and green supply chain management. The findings revealed that green transformation produces financial, competitive, social, environmental, and institutional outcomes simultaneously. Financial outcomes included improved profitability, operational efficiency, resource productivity, and access to green investment. These results align with previous studies reporting positive relationships between circular economy implementation and financial performance (Fernando et al., 2022; Le, 2024). Additionally, the findings support research suggesting that sustainability-oriented strategies reduce waste, optimize resource utilization, and improve long-term organizational resilience (Liu & Wang, 2022; Malhotra, 2023).

Competitive consequences identified in the study included improved green branding, enhanced customer trust,

increased market share, stronger international positioning, and sustainable competitive advantage. These findings are highly consistent with the literature emphasizing that environmental innovation strengthens organizational legitimacy and market differentiation (Agyabeng-Mensah et al., 2023; Wang & Guocheng, 2023). The study also found that green transformation improves employee engagement and organizational identity, indicating that sustainability strategies contribute to both external and internal stakeholder satisfaction. This supports prior research demonstrating that sustainability-oriented organizations are more capable of attracting environmentally conscious customers, investors, and employees (Singh et al., 2025; Ting et al., 2023).

The findings concerning environmental and social sustainability consequences also deserve particular attention. The study demonstrated that environmental innovation and circular supply chain practices contribute to carbon reduction, waste minimization, ESG improvement, environmental justice, and social sustainability. These findings align with studies emphasizing the contribution of circular economy practices to Agenda 2030 and sustainable development goals (Pasca et al., 2023; Sadaa et al., 2024). Moreover, the study revealed that sustainability transformation improves organizational legitimacy and strengthens relationships with local communities and social stakeholders. This finding supports the argument that sustainable supply chains generate not only economic value but also broader societal and environmental benefits (Le, 2024; Mondal et al., 2025).

Another important implication of the findings relates to the systemic and integrated nature of green transformation. The extracted model demonstrates that environmental innovation, circular economy capabilities, digital technologies, green governance, and financial performance are not independent constructs but rather interdependent dimensions within a broader sustainability ecosystem. This systemic interpretation aligns with recent scholarship arguing that sustainability transformation requires integrated and multidimensional organizational change rather than fragmented environmental initiatives (Govardhan et al., 2025; Shafique et al., 2023). The study therefore contributes theoretically by offering a comprehensive qualitative framework capable of explaining the interactions among institutional pressures, organizational capabilities, technological enablers, strategic responses, and sustainability outcomes.

Overall, the findings indicate that successful implementation of environmental innovation and circular supply chain systems depends on the simultaneous alignment of institutional support, technological readiness, organizational learning capability, collaborative governance, and sustainability-oriented strategic management. The study demonstrates that organizations capable of integrating these dimensions are more likely to achieve sustainable financial performance, environmental legitimacy, operational resilience, and long-term competitive advantage. Consequently, environmental innovation should not be viewed merely as a compliance-oriented environmental activity but rather as a strategic transformation mechanism shaping the future of sustainable organizational development.

One limitation of the present study relates to its qualitative nature and reliance on expert perceptions within a specific organizational and industrial context. Although the use of multi-grounded theory provided rich conceptual insights, the findings were derived primarily from experts associated with airport and sustainability-related sectors, which may limit the generalizability of the results to other industries and national contexts. In addition, the study focused mainly on conceptual and interpretive dimensions rather than measuring the actual quantitative effects of environmental innovation and circular economy implementation on organizational performance indicators.

Future research may extend the present study by empirically testing the proposed conceptual framework using quantitative methods such as structural equation modeling, fuzzy systems analysis, or longitudinal sustainability assessment. Researchers may also investigate the moderating role of organizational culture, technological readiness, digital maturity, or governmental support within the relationship between environmental innovation and financial performance. Comparative studies across industries or countries could further clarify how institutional environments influence circular supply chain transformation and sustainability outcomes.

From a practical perspective, organizations seeking sustainable competitiveness should adopt integrated green transformation strategies that combine environmental innovation, circular economy practices, digital technologies, and collaborative governance systems. Managers should invest in green knowledge development, environmental data infrastructure, reverse logistics systems, and sustainable financing mechanisms while simultaneously strengthening partnerships with suppliers, regulators, universities, and

technology providers. Policymakers should also establish supportive legal frameworks, green investment incentives, and environmental standards capable of accelerating sustainable supply chain transformation and encouraging long-term environmental innovation across industries.

Authors' Contributions

Authors contributed equally to this article.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethics Considerations

In this research, ethical standards including obtaining informed consent, ensuring privacy and confidentiality were considered.

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