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Impact of Digital Ambidexterity on Circular Supply Chain through Sustainable Operational Excellence and Supply Chain Resilience

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ABSTRACT

In today's competitive era, manufacturing firms face pressure to align their supply chain with circularity and sustainability imperatives. Despite the emergent interest in circular supply chain management (CSCM), the mechanisms through which digital capabilities support this transition remain unexplored. This study examines the role of digital ambidexterity to foster sustainability initiatives through supply chain resilience (SCR). Based on the dynamic capabilities view (DCV) and the natural resource-based view (NRBV) theory, a framework was developed. Survey questionnaire data from 159 Pakistani manufacturing firms were gathered and analyzed through a structural equation model. The findings affirmed that digital ambidexterity capabilities significantly promote sustainable operations and SCR. However, the association between SCR and CSCM is insignificant. Theoretically, the study contributes by integrating DCV and NRBV to elucidate circularity and sustainability initiatives as a capability orchestrator. Practically, this study offers strategic insights for firms and policymakers to balance digital capabilities, resilience, circularity, and sustainability outcomes.

Keywords: Digital Ambidexterity, Sustainable Operational Excellence, Circular Economy, Supply Chain Management

1. INTRODUCTION

In today's global competitive era, every firm wants its supply chain to be more sustainable and eco-friendly. Recently, the world has been grappling with a mounting sustainability crisis marked by resource depletion, waste proliferation, and other climate issues (Kaur et al., 2026). According to Statista (2025), more than two billion metric tons of solid trash are created worldwide each year, with a projected four billion tons by 2050. Climate change poses a hazard to future generations since the world's population is anticipated to exceed 10 billion by the end of the century. These concerns have fueled calls for a fundamental overhaul in supply chain management. In response, circular supply chain management (CSCM) incorporates

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circular economy ideas into supply chain management (Le et al., 2025). Farooque et al. (2021) define CSCM as the application of circular thinking to the management of the supply chain and its surrounding industrial and natural ecosystems. It methodically repairs technical materials and regenerates biological materials to achieve a zero-waste goal through system-wide innovation in business models and supply chain operations. CSCM provides a fresh viewpoint on sustainable development and has received scholarly attention, indicating widespread awareness (Polimetla et al., 2025). However, the transition to CSCM creates additional concerns and complications for organizations attempting to combine economic performance and environmental imperatives (Cano et al., 2025; Garcia-Buendia et al., 2024; Le et al., 2025).

At organization levels, manufacturing firms face dual challenges to excel at operational performance while implementing circular economy initiatives. For instance, Sasso et al. (2024) and Nadeem et al. (2025) argued that the integration of CE in lean management (C-Lean) serves as a proactive response strategy to mitigate environmental challenges. Xu et al. (2025) affirmed that manufacturing firm dynamic capabilities and CE practices mutually promote eco-friendly initiatives in digitalization. However, embedding the CE principle into established operations is not a simple process. Traditional operational excellence focuses on quality control, efficiency, and cost reduction. Whereas CE focuses on remanufacturing, reuse, reducing, and broader environmental goals. Likewise, conventional SC focuses on cost and quality, while CSCM emphasizes waste reduction and resource circulation (Cano et al., 2025). Consequently, there is a misalignment between circular principles and other conventional processes and operations. Furthermore, Cotta et al. (2022) argued that supply chain managers face tensions when implementing distinct sets of SC practices. Nevertheless, when managed adroitly, CE can unlock complementary benefits. For instance, Sasso et al. (2024) and Alanezi & Franchetti (2025) argued that the synergy between operational (lean) and CE offers substantial benefits for operational efficiency, environmental performance, and competitive advantage. Alanezi & Franchetti (2025) argued that the integration of CE into operations enables manufacturers to meet cost, quality, and environmental targets concurrently. However, the paradoxical concepts require new capabilities and approaches to navigate the apparent contradictions (Mishra et al. 2022; Albertsen et al. 2023). This organizational challenge underscores the need for ambidexterity, which requires organizations to exploit their existing strengths while exploring CE solutions in tandem (Sahoo et al., 2024; Martinez-Falco et al., 2024; Acquier et al., 2024).

A promising avenue to achieve this balance lies in harnessing digital transformation. Chen et al. (2024) argued that digitalization enables firms with new infrastructure and capabilities to achieve sustainable performance. From this perspective, digital ambidexterity helps firms achieve longevity if they concurrently exploit existing digital technologies and also explore new ones (Jing et al., 2023). Fundamentally, digital ambidexterity consists of digital exploitation and exploration capabilities (Chen et al., 2024; Jing et al., 2023; Wetering, 2022). Moreover, Zahoor et al. (2025) contended that AI capabilities and ambidexterity are the underlying mechanisms to achieve CE practices in public organizations. Likewise, Sahoo et al. (2024) claimed that Industry 4.0 strategies and organizational ambidexterity strengthen firm circularity practices in emerging economies. This highlights that digital ambidexterity helps organizations to streamline their processes to promote CE practices and overcome the trade-off between productivity and sustainability. However, the process by which digital exploits and explores capabilities translates into dual outcomes (operational and CE) remains unexplored, especially in SCM literature. Prior literature studied the role of digital ambidexterity to promote sustainable performance (Chen et al., 2024), transformation performance (Jing et al., 2023), and business value (Wetering, 2022). Moreover, past studies explore the role of AI capabilities and organizational ambidexterity to promote CE practices (Zahoor et al., 2025; Sahoo et al., 2024; Acquier et al., 2024). Against these knowledge gaps, the present study proposes a holistic framework that establishes the association with digital ambidexterity and circular SCM through operational excellence and resilience. As Faggioni et al. (2024) argued, a resilient SC is essential in CE, as the recent global crises have underscored that resilience is essential for long-term viability. Moreover, Le et al. (2025) argued that SC experts warn that integrating circular models without encouraging resilience could leave firms vulnerable to disruption and resource shocks. Thus, the purpose of this research is to examine the role of digital ambidexterity (exploit & explore) to promote circular SCM through operational excellence and resilience. Moreover, this study investigates the mediating role of supply chain resilience and the moderating role of digital leadership on the proposed relationships.

2. THEORETICAL FRAMEWORK AND HYPOTHESIS DEVELOPMENT

2.1 Dynamic capability view (DCV)

In this study, the dynamic capability view (DCV) explains the logical relationship between digital ambidexterity and other constructs (Teece et al., 1997). The DCV posits that organizations have three sets of primary competencies: sensing, seizing, and transforming (Kessler, 2013). The sensing concept highlights the managerial vision, insights, and analytical process to recognize future opportunities (Teece, 2007). Whereas seizing capability highlights the business framework to capture value and satisfy customer needs (Teece, 2007). Finally, transforming capability emphasizes that firms realign their resources with new opportunities (Teece, 2007). Moreover, Kessler (2013) argued that the change process is the focal point of DCV. It is determined that the firm's plans are matched to customer needs and technological advancement (Kessler, 2013). From strategic aspects, O'Reilly and Tushman (2008) contended that the firm's survivability required operational capabilities and competencies in established markets as well as the ability to recombine and reconfigure assets to adapt to emerging technologies and markets. This affirmed that DCV is the heart of a firm's ability to be ambidextrous; to compete concurrently in mature and emerging markets to exploit and explore (Abbas et al., 2025). Moreover, Li et al. (2025) argued that firms can develop and apply DCV in different organizational contexts.

In this study, the DCV is applied in the digitalization context (Li et al., 2025; Sahoo et al., 2024; Zahoor et al., 2025). This study conceptualizes digital ambidexterity as a firm's dynamic capabilities to respond to the ever-evolving technological environment. Acquier et al. (2024) argued that ambidexterity only becomes a DC if the firm's exploit and explore capabilities are strategically integrated. Wetering (2022) claimed that digital ambidexterity is a dual digitalization approach to enhance firm operational processes. Furthermore, Chen et al. (2024) claimed that the driving forces for sustainable performance are the firm's digital capabilities, and it must develop them to adjust to the changing market needs.

2.2 Natural resource-based view (NRBV) theory

In this paper, the NRBV theory illustrates the logical connections between operational excellence, the circular economy, and supply chain management. The NRBV theory is an extension of the RBV theory. The RBV hypothesis emphasizes that important resources and competencies are scarce, precious, and cannot be replicated to achieve a competitive advantage (Barney, 1991). Hart (1995) expands on the RBV hypothesis, arguing that a firm's competitive advantage is determined by its link to the natural environment. According to Hart (1995), the heart of NRBV consists of three interrelated strategies: pollution avoidance, product stewardship, and sustainable development (Johl et al., 2024). According to Graham et al. (2023), these interrelated sustainability-oriented strategies aim to achieve long-term growth inside firms and the larger business ecosystem. Furthermore, Coppola et al. (2023) argued that there is no fixed hierarchy for NRBV tactics, which may be executed in any sequence. Pollution prevention, according to NRBV philosophy, focuses on reducing waste during the manufacturing process rather than at the end of the pipe. Product stewardship is the mitigation of environmental consequences throughout the product's life cycle (McDougall et al., 2019). Finally, sustainable development emphasizes economic, social, and environmental elements at the micro and macro levels (Johl et al., 2024; McDougall et al., 2019).

A strong foundation for explaining the company's support for environmental policies is provided by the combination of DCV and NRBV (Coppola et al., 2023).

Previous research confirmed that DCV is an essential initial step in spreading and maintaining the businesses' CE. Similarly, Achyar (2025) said that DCV adds to and expands upon the NRBV to provide a more comprehensive knowledge of how businesses implement sustainable development plans. According to Borazon et al. (2021), integrating DCV and NRBV provides a thorough insight into how a company moves from static to dynamic capabilities. Haylemariam et al. (2025) contended that DCV and NRBV are interconnected and offer a robust framework to understand how firms can leverage digital technologies to promote CE initiatives. Zhang et al. (2024) argued that the integration of NRBV and DCV is a research paradigm of “resource-capability-performance”. The integration of DCV and NRBV is well supported by past studies. However, past literature reviews emphasize the green dynamic capabilities to promote CE and sustainability initiatives (Zhang et al., 2024; Makhloufi et al., 2023; Borazon et al., 2021; Achyar, 2025; Tanchangya et al., 2025). There is a lack of a framework that highlights how digital ambidexterity as a DCV promotes the CE and sustainable initiatives (NRBV) in supply chain management.

2.3 Hypotheses development

2.4 Relationship between digital ambidexterity capabilities, sustainable operational excellence and SCR

In the digitalization context, the notion of firm ambidexterity has been operationalized through the dynamic capability view (Haylemariam et al., 2025). DCV postulates that firms continuously sense, seize, and reconfirm their resources in the evolving technologies (Borazon et al., 2021). In the digital transformation, organizations have undergone massive capabilities shifts for a resilient future. This highlights that organizations need to exploit existing capabilities as well as explore new avenues. From this perspective, firm digital exploration capabilities (DEIC) have gained dynamic value to deal with the complexity. In OPEX, digital exploration helps firms to sense waste patterns, inefficiencies, and emissions hotspots in their operations (Naik et al., 2022). Then, firms seize opportunities through new digital tools (predictive analysis or digital twins) to optimize process control (Machado et al., 2025). Finally, firms reconfigure capabilities by integrating real-time sustainability key indicators into operational dashboards (Shuvabrata et al., 2020). Whereas in CE implementation, DEIC sense capabilities through product-service systems or reverse logistics models (Johl et al., 2024; Acquier et al., 2024). This also includes customer preferences or new platforms for remanufacturing (Li et al., 2025; Chaudhuri et al., 2022). Then, seizing capabilities focuses on adopting digital platforms for reverse logistics or new CE frameworks like pay-per-use or refurbishment networks (Johl et al., 2024; Acquier et al., 2024). Lastly, the firm reconfirming capabilities includes modifying SC to close loops or CE models (Yu et al., 2025; Borazon et al., 2021; Falco et al., 2024). Prior literature supports that firm exploration capabilities support the firm's sustainable and CE outcomes. For instance, Chen et al. (2024) argued that DEIC supports sustainable as well as long-term business success. Likewise, Haylemariam et al. (2025) contended that AI capabilities and exploratory innovation are mutually responsible for corporate environmental performance. Sahoo et al. (2024) affirmed that Industry 4.0 and explorative capabilities jointly affect the firm's CE performance. Kayikci et al. (2021) argued that firm blockchain technology capabilities promote operational excellence in perishable food SC during outbreaks. Based on the theoretical and literature support, the following hypotheses have been proposed.

H1: *Digital ambidexterity capabilities have a positive impact on sustainable operational excellence.*

The notion of digital ambidexterity also emphasizes that firms need to exploit existing digital resources to gain sustainable performance (Haylemariam et al. 2025). DCV posited that the exploitation capabilities help firms to continuously adapt and optimize their operations for greater efficiency and reliability. In OPEX, the exploitation capabilities help firms to refine current digital tools like ERP to monitor energy usage and waste levels. It helps managers to sense inefficiencies against environmental standards. These inefficiencies can be fixed through AI-enabled scheduling and real-time quality monitoring, which fall under the firm seizing opportunity (Machado et al., 2025). Finally, firm reconfigure capabilities through upgrading existing equipment to digitally compatible models. Whereas organizations sense CE implementation by exploiting existing digital networks and data analysis platforms to track materials and identify CE intervention points (Acquier et al., 2024). Then, existing capabilities support CE implementation through automation and integrating secondary resource flows into production. Finally, firms reconfirm CE initiatives through creating supplier protocols for recycled materials or integrating circular logistics into enterprise systems. Prior literature supports that firm digital exploitation capabilities (DERC) support the firm's sustainable and CE outcomes. Sahoo et al. (2024) affirmed that Industry 4.0 and exploitative capabilities jointly affect the firm's CE performance. Katou et al. (2023) contended that organizational exploiter attributes significantly promote CE and sustainability outcomes. Falco et al. (2024) argued that ambidexterity and CE played a vital role to achieve sustainable in SCM. Haylemariam et al. (2025) contended that AI and exploitative capabilities are mutually responsible for corporate environmental performance. Based on the theoretical support by DCV and literature arguments, the following hypotheses have been proposed.

H2: *Digital ambidexterity capabilities have a positive impact on SCR.*

2.5 Relationship between sustainable operational excellence and supply chain resilience

The Natural resource-based view (NRBV) theory provides the theoretical base to explain the association between sustainable operational excellence and supply chain resilience. NRBV theory extends the resource-based view (RBV) perspective and is based on pollution prevention, product stewardship, and sustainable development aspects (Hart, 1995; McDougall et al., 2019). Kaur et al. (2026) contended that these three resources are the critical strategic capabilities. The concept of pollution prevention is the foundational capability to enhance sustainable performance while improving internal efficiency (Hart, 1995). From the pollution prevention concept, sustainable OPEX refers to streamlining processes, minimizing resources and energy, and eradicating inefficiencies (Naik et al., 2022). Consequently, it minimizes environmental harm and makes operations simple, fast, and more adaptable (Carvalho et al., 2019). Whereas product stewardship extends the firm's responsibility towards environmental responsibility across the entire value chain (McDougall et al., 2019).

Empirical evidence supports the association between sustainable OPEX, CE, and SC resilience. Islam et al. (2025) argued that CE is a vital factor to promote SC resilience from an Industry 4.0 perspective. Guoli et al. (2025) contended that CE is a dynamic resource capability to promote SC resilience in Chinese SMEs. Pellegrino et al. (2025) claimed that adoption of CE practices fosters SC resilience, which can lead to firm overall performance.

H3: *Sustainable operational excellence has a positive and significant effect on Circular Supply Chain Management.*

2.6 Relationship between supply chain resilience and circular supply chain management

The concepts of CE and resilience have been integrated into SCM and conceptualized as SC resilience (SCR) and CSCM. Le et al. (2025) argued that SCR and CSCM are the temporal dynamic capabilities to support broader SC performance. From an NRBV perspective, CSCM is a proactive environmental strategy, like reuse and remanufacturing practices, and perfectly aligns with product stewardship to reduce life-cycle impact. From a DCV perspective, the organization develops adaptive capabilities to sustain these environmental initiatives. Therefore, implementing CSCM entails a radical shift in how materials are reproduced and recovered, which necessitates strong organizational capabilities to manage this change (Cotta et al. 2022). Garcia-Buendia et al. (2024) argued that SCR practices help firms to better accommodate and tackle unforeseen circumstances. Moreover, dynamic and flexible capabilities have emerged as critical attributes in CSCM (Garcia-Buendia et al. 2024). Past literature highlights that the association between SCR and CSCM can generate both synergies and tensions. Le et al. (2025) affirmed that SCR strategies can support circularity by fostering a flexible distribution network. Cotta et al. (2022) claimed that SC managers perceived the SCR and CSCM relationship as conflictive, synergistic, and orthogonal. Gani et al. (2023) concluded that resilience capabilities help organizations to avoid losses and promote SC sustainable performance. Based on the theoretical and literature support, the following hypothesis has been proposed.

H4: *Supply chain resilience has a positive and significant effect on circular supply chain management.*

Figure 1. *Research Framework*

3. RESEARCH METHODOLOGY

In order to accomplish its goals, this study employs the research onion approach recommended by Saunders et al. (2019). A research onion contains six layers, according to Saunders et al. (2019). Because the data gathering was planned and organized, the first layer was founded on the positivist research philosophy. Due to the mono-quantitative method utilized in the second and third levels, this study employed a deductive approach. According to Saunders et al. (2019), positivist philosophy and the deductive method are connected to the quantitative research design. The fourth and fifth levels employed a cross-sectional survey approach. The last layer explains the process of data collection and analysis. For this purpose, the entrepreneurial firm in the manufacturing domain operating in Pakistan was the target population. The minimum sample size was 105 observations calculated through G*power software. The respondents of this research were supply chain and quality managers, and only one questionnaire per organization was included for data analysis.

Pre-testing and pilot testing were done before actual data collection. The survey questionnaire was finally released to the potential respondents in both physical and online forms. A total of 460 potential supply chain and quality managers were given the questionnaire. Following two reminders, 159 questionnaires were analyzed further. The final response rate is 34.56%. This research has used the PLS-SEM analysis tool with SmartPLS software. PLS-SEM is a statistical package that is the second generation and can be used with non-normality assumptions at small sample sizes (Hair et al., 2019).

3.1 Measures

All the study items were adapted from past studies. The digital ambidexterity capabilities construct has been adapted from Chen et al. (2024) and Jing et al. (2023). Sustainable operational excellence (SOE) has been measured through a six-item scale adapted from Prashar and Chaudhuri (2024) and Fernando et al. (2024). Furthermore, a five-item scale of supply chain resilience was adapted from Cheng & Shan (2025) and Al-Naimi et al. (2021). Finally, circular supply chain management was measured through five items adapted from Farooque et al. (2022) and Alghababsheh (2024). All items were measured on a seven-point Likert scale.

4. ANALYSIS AND RESULTS

4.1 Multivariate assumptions and Common method bias

To perform the PLS-SEM, the multivariate assumptions, such as multicollinearity, normality, and outliers, must be satisfied (Hair et al., 2019). For multicollinearity, the inner variance inflation factor (VIF) was used with a threshold value of less than 5 (Hair et al., 2019). To perform the normality, skewness, and kurtosis statistical analysis, a threshold value of ±2 (George & Mallery, 2024) was used. Finally, the outlier analysis, Mahalanobis D2 (D2/df), was applied with a threshold value ≥2.5 for small samples and ≤4 for large samples (Hair et al., 2019). After performing multivariate assumptions, common method bias analysis was performed. Procedural and statistical precautions were proposed to alleviate the problem of CMB by Podsakoff et al. (2003). Statistically, the single-factor test by Harmon was conducted. The results indicate that the maximum variance of one factor was 31, which is not equal to the 50% threshold (Podsakoff et al., 2003).

4.2 Structural equation modeling

4.2.1 Reliability and validity

Reliability and convergent validity tests were performed in the measurement analysis of PLS-SEM. When evaluating the construct's reliability, composite reliability (CR) is superior to Cronbach's alpha, according to Hair et al. (2019). According to Hair et al. (2019), the CR cutoff value is ≥0.70. Table 1 shows that every research variable's reliability analysis value is higher than the cutoff. It shows that variables may be effectively employed in further analysis. Additionally, the average variance extracted (AVE) was used to compute the convergent validity. The cutoff value of ≥0.50 is pretty acceptable, according to Hair et al. (2019). Table 1 shows that every variable in the research has an AVE value that is higher than the cutoff.

Table 1 *Reliability and Validity*

Constructs	Items	Loading	CR	AVE
Digital Ambidexterity capabilities	DAD1	0.696	0.847	0.584
Digital Ambidexterity capabilities	DAD2	0.709	0.847	0.584
Digital Ambidexterity capabilities	DAD3	0.701	0.847	0.584
Digital Ambidexterity capabilities	DAD4	0.739	0.847	0.584
Digital Ambidexterity capabilities	DAD5	0.774	0.847	0.584
Digital Ambidexterity capabilities	DAD6	0.724	0.847	0.584
Sustainable operational excellence (SOE)	SOE1	0.813	0.932	0.696
Sustainable operational excellence (SOE)	SOE2	0.785	0.932	0.696
Sustainable operational excellence (SOE)	SOE3	0.858	0.932	0.696
Sustainable operational excellence (SOE)	SOE4	0.843	0.932	0.696
Sustainable operational excellence (SOE)	SOE5	0.858	0.932	0.696
Sustainable operational excellence (SOE)	SOE6	0.847	0.932	0.696
Supply chain resilience (SCR)	SCR1	0.780	0.897	0.635
Supply chain resilience (SCR)	SCR2	0.767	0.897	0.635
Supply chain resilience (SCR)	SCR3	0.794	0.897	0.635
Supply chain resilience (SCR)	SCR4	0.803	0.897	0.635
Supply chain resilience (SCR)	SCR5	0.840	0.897	0.635
Circular supply chain management (CSCM)	CSCM1	0.732	0.900	0.644
Circular supply chain management (CSCM)	CSCM2	0.854	0.900	0.644

Circular supply chain management (CSCM)	CSCM3	0.809	0.900	0.644
Circular supply chain management (CSCM)	CSCM4	0.806	0.900	0.644
Circular supply chain management (CSCM)	CSCM5	0.806	0.900	0.644

4.2.2 Discernment validity

The assessment included many indicators, including cross-loading, Fornell-Larcker, and the Heterotrait-Monomethod Ratio of Correlation (HTMT), to assess the discriminant validity. According to Hair et al. (2019), HTMT is a more accurate indicator of discriminant validity. HTMT's upper break-even threshold is limited to 0.90. All of the study's variables had values below 0.90, as Table 3 shows.

Table 2 *Discernment validity (HTMT)*

Variable	DAD	SOE	SOR	CSCM
DAD				
SOE	0.474			
SOR	0.464	0.445		
CSCM	0.237	0.162	0.22	

4.2.3 Hypotheses analysis

Analyzing the structural model as suggested by Hair et al. (2019) is the second stage in the PLS-SEM. Furthermore, Hair et al. (2019) recommended using the bootstrapping approach to test the hypotheses with a resample size of 5000 resamples, as shown in Table 3.

Table 3 *Hypotheses analysis*

Relationship	Original sample (O)	Sample mean (M)	S.D	T statistics	P values
H1: DAD -> SOE	0.421	0.433	0.061	6.854	0.000
H2: DAD -> SCR	0.406	0.419	0.058	7.031	0.000
H3: SOE -> CSCM	0.076	0.081	0.097	0.785	0.216

H4: SCR -> CSCM	0.198	0.213	0.085	2.313	0.010

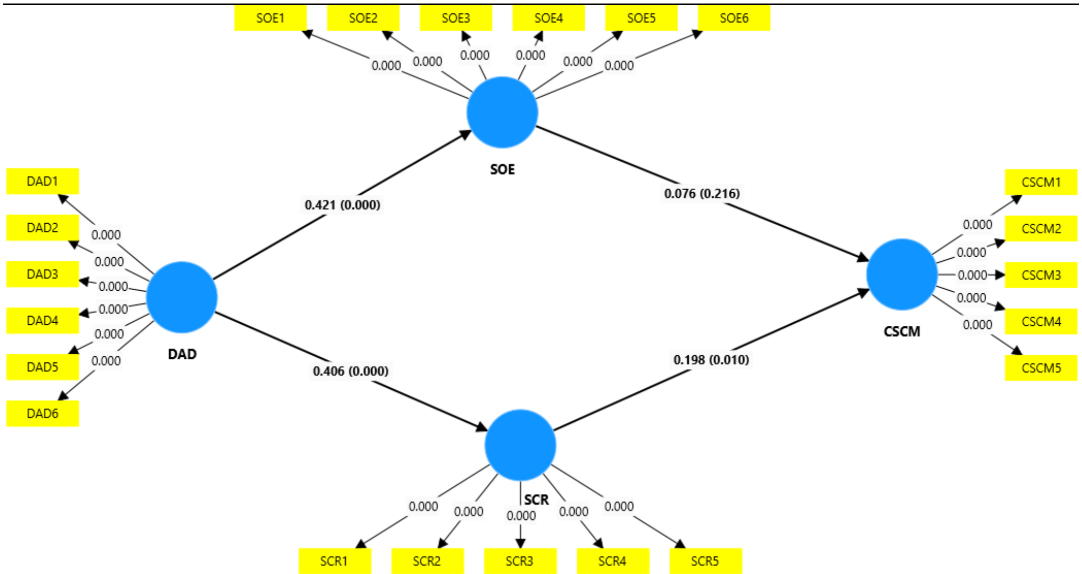

Figure 2. *PLS-SEM Output*

5. DISCUSSION AND CONCLUSION

5.1 Research contributions

The study findings offer multifold theoretical contributions. First, the study offers a novel integration of DCV and NRBV. Although past studies integrate DCV and NRBV, but there focuses on green dynamic capabilities and underscores the digital aspects. Whereas this study positions digital ambidexterity as firm-level digital dynamic capabilities that promote ecological value creation (NRBV), offering a “resource-capabilities-performance” corridor. Second, the study positions digital ambidexterity in the context of SCM and circular economy. Prior studies predominantly explored innovation and digital-enabled performance. This study offers a novel context and positions DA as a dynamic enabler of sustainable operations in SCM. Moreover, this provides a fresh theoretical insight into how firms balance exploration and exploitation of digital initiatives to promote circularity and sustainability goals. Third, the study reconceptualises SCR as a strategic capability that mediates the transition towards CSCM. Previously, SCR has been framed as an outcome of risk management or agility. Grounded in DCV and NRBV, the study demonstrates that SCR enables firms to absorb variability and stabilize SC during the transition from linear to a circular framework. Moreover, the dual-mediating role of SCR highlights it as a proactive and integrative capability critical to long-term sustainability and circularity. Finally, this study reframes digital leadership as a capability orchestrator between digital ambidexterity and sustainability outcomes.

Past studies framed DL as a technology or innovation driver. This research highlights a nuanced role in shaping how firms leverage digital exploit and explore capabilities for CE and sustainable operational excellence. This extends DL from a top-down variable to a multi-level capability enabler that interacts with firm-level resources in a complex, sustainability-driven SCM context.

The study findings have multifold practical implications. First, the outcomes underline the role of dynamic capabilities like digital exploration and exploitation to promote sustainability and circularity goals. The executives and managers may view digital capabilities as a set of dynamic resources for sustainability-led transformation. Consequently, it strengthens the strategic role of digital transformation as well as resource-led sustainability imperatives. Second, the outcome emphasizes that managers should embed CE principles into the core operational systems rather than compliance-driven activities. Such reframing is essential for ecological outcomes as well as to achieve resilience and competitiveness in a volatile and resource-constrained environment. Third, the findings highlight that leaders in digital transformation should position themselves as an organizational integrator to foster digital exploration and exploit capabilities concurrently towards sustainable goals.

5.2 Limitations and future research directions

Despite its contributions and practical implications, this study has several limitations that suggest prolific avenues for future research. From a theoretical standpoint, future studies could examine other enablers like AI-driven capabilities, mediators like digital innovation orientation, and moderators like cultural orientation. Furthermore, alternative theoretical lenses like resource orchestration theory may also enrich understanding. In terms of knowledge domains, future research could explore resilience and circular economy in the new context of Industry 5.0, such as digital twin-enabled sustainability, green innovation, and AI-driven ecosystems. Methodologically, the cross-sectional design limits causal inference. Future research should employ longitudinal or mixed-methods approaches to capture the evolution of resilience and CE over time. Comparative studies across developed and emerging economies, or across industries beyond manufacturing, would enhance generalizability. Finally, expanding the sample to other GCC countries or diverse global contexts could yield comparative insights into how digital ambidexterity, resilience, and SCM interact in different institutional environments.

REFERENCES

Abbas, J., Bresciani, S., Subhani, G., & De Bernardi, P. (2024). Nexus of ambidexterity and frugal innovation for enhanced ESG performance of entrepreneurial firms. The role of organizational capabilities. International Entrepreneurship and Management Journal, 21(1). https://doi.org/10.1007/s11365-024-01062-5

Achyar, D. H. (2025). Islamic finance for sustainable development in clean technology: dynamic capabilities and natural resource-based view. Sustainability Accounting Management and Policy Journal. https://doi.org/10.1108/sampj-10-2024-1119

Acquier, A., Carbone, V., & Ezvan, C. (2024). Scaling circular economy business models: A capability perspective. Business Ethics the Environment & Responsibility, 34(2), 377–389. https://doi.org/10.1111/beer.12658

Ahmed, B., Ali, R. F., Alwadain, A., Almerri, K. A., Ahmad, W., & Ali, K. (2025). How institutional pressures shape human-centric Industry 5.0 and ESG: insights from the China–Pakistan economic corridor. International Journal of Productivity and Performance Management, 74(9), 3287–3305. https://doi.org/10.1108/ijppm-05-2025-0387

Alanezi, W., & Franchetti, M. (2025). Integrating Lean Six Sigma with Sustainable Manufacturing: A Framework for Optimized Efficiency and Environmental Performance. Journal of Manufacturing Science and Engineering, 147(12). https://doi.org/10.1115/1.4069878

Albertsen, R. R., Ansari, S., Heucher, K., Krautzberger, M., Langley, A., Reinecke, P. C., ... & Vaara, E. (2024). Strategizing together for a better world: Institutional, paradox and practice theories in conversation. Journal of Management Inquiry, 33(2), 115-130.

Aldhi, I. F., Suhariadi, F., Rahmawati, E., Supriharyanti, E., Hardaningtyas, D., Sugiarti, R., & Abbas, A. (2025). Bridging digital gaps in smart city governance: the mediating role of managerial digital readiness and the moderating role of digital leadership. Smart Cities, 8(4), 117. https://doi.org/10.3390/smartcities8040117

Alghababsheh, M. (2024). Understanding whether, how and when circular supply chain management influences firm performance. Business Strategy and the Environment, 33(7), 7139–7161. https://doi.org/10.1002/bse.3865

Ali, K., & Johl, S. K. (2023). Driving forces for Industry 4.0 readiness, sustainable manufacturing practices and circular economy capabilities: does firm size matter? Journal of Manufacturing Technology Management, 34(5), 838–871. https://doi.org/10.1108/jmtm-07-2022-0254

Aljaaidi, K. S. (2024). Corporate entrepreneurship, supply chain management strategies and performance in the setting of Saudi Arabia: Empirical investigation. Journal of Project Management, 10(1), 129–142. https://doi.org/10.5267/j.jpm.2024.10.002

Al-Kahtib, A., Alghababsheh, M., & Khattab, M. (2024). The role of organizational ambidexterity and frugal innovation in enhancing circular supply chains: The effect of artificial intelligence capabilities. Technological Forecasting and Social Change, 210, 123905. https://doi.org/10.1016/j.techfore.2024.123905

Barney, J. (1991). Firm resources and sustained competitive advantage. Journal of Management, 17(1), 99–120. https://doi.org/10.1177/014920639101700108

Borazon, E. Q., Huang, Y., & Liu, J. (2021). Green market orientation and organizational performance in Taiwan's electric and electronic industry: the mediating role of green supply chain management capability. Journal of Business and Industrial Marketing, 37(7), 1475–1496. https://doi.org/10.1108/jbim-07-2020-0321

Cano, J. A., Londoño-Pineda, A., Campo, E. A., Gruchmann, T., & Weyers, S. (2025). Circular Supply Chain Management Assessment: A Systematic Literature Review. Environments, 12(10), 374. https://doi.org/10.3390/environments12100374

Carvalho, A. M., Sampaio, P., Rebentisch, E., Carvalho, J. Á., & Saraiva, P. (2017). Operational excellence, organisational culture and agility: the missing link? Total Quality Management & Business Excellence, 30(13–14), 1495–1514. https://doi.org/10.1080/14783363.2017.1374833

Chakraborty, S., Sharma, A., & Vaidya, O. S. (2019). Achieving sustainable operational excellence through IT implementation in Indian logistics sector: An analysis of barriers. Resources Conservation and Recycling, 152, 104506. https://doi.org/10.1016/j.resconrec.2019.104506

Chatterjee, S., Chaudhuri, R., Vrontis, D., & Giovando, G. (2023). Digital workplace and organization performance: Moderating role of digital leadership capability. Journal of Innovation & Knowledge, 8(1), 100334. https://doi.org/10.1016/j.jik.2023.100334

Chaudhuri, A., Subramanian, N., & Dora, M. (2021). Circular economy and digital capabilities of SMEs for providing value to customers: Combined resource-based view and ambidexterity perspective. Journal of Business Research, 142, 32–44. https://doi.org/10.1016/j.jbusres.2021.12.039

Chen, A., Li, L., & Shahid, W. (2024). Digital transformation as the driving force for sustainable business performance: A moderated mediation model of market-driven business model innovation and digital leadership capabilities. Heliyon, 10(8), e29509. https://doi.org/10.1016/j.heliyon.2024.e29509

Cheng, J., & Shan, P. (2025). Configuring supply chain resilience under natural disaster risk. Sustainability, 17(14), 6346. https://doi.org/10.3390/su17146346

Coppola, C., Vollero, A., & Siano, A. (2023). Developing dynamic capabilities for the circular economy in the textile and clothing industry in Italy: A natural-resource-based view. Business Strategy and the Environment, 32(7), 4798–4820. https://doi.org/10.1002/bse.3394

Cotta, D., Klink, L., Alten, T., & Madhoon, B. A. (2022). How do supply chain managers perceive the relationship between resilience and sustainability practices? An exploratory study. Business Strategy and the Environment, 32(6), 3737–3751. https://doi.org/10.1002/bse.3325

Faggioni, F., Rossi, M. V., & Sestino, A. (2024). Conceptualizing supply chain resilience in exogenous crisis Times: Toward a Holistic definition. Journal of the Knowledge Economy, 15(4), 17308–17332. https://doi.org/10.1007/s13132-024-01816-0

Farooque, M., Zhang, A., Liu, Y., & Hartley, J. L. (2021). Circular supply chain management: Performance outcomes and the role of eco-industrial parks in China. Transportation Research Part E Logistics and Transportation Review, 157, 102596. https://doi.org/10.1016/j.tre.2021.102596

Fernando, Y., Mergeresa, F., Wahyuni-Td, I. S., & Hazarasim, N. S. (2024). Halal beauty supply chain and sustainable operational excellence: a moderator of the post-SARS-CoV-2 mitigation strategy. Journal of Islamic Marketing, 15(12), 3748–3777. https://doi.org/10.1108/jima-07-2023-0205

Gani, M. O., Yoshi, T., & Rahman, M. S. (2022). Optimizing firm's supply chain resilience in a data-driven business environment. Journal of Global Operations and Strategic Sourcing, 16(2), 258–281. https://doi.org/10.1108/jgoss-02-2022-0013

García-Buendía, N., Núñez-Merino, M., Moyano-Fuentes, J., & Maqueira-Marín, J. M. (2024). Squaring circular supply chain management: A comprehensive overview of emerging themes and trends. Business Strategy and the Environment, 33(8), 8190–8210. https://doi.org/10.1002/bse.3932

George, D., & Mallery, P. (2024). IBM SPSS Statistics 29 step by step: A simple guide and reference. Routledge.

Graham, S., Cadden, T., & Treacy, R. (2023). Examining the influence of employee engagement in supporting the implementation of green supply chain management practices: A green human resource management perspective. Business Strategy and the Environment, 32(7), 4750–4766. https://doi.org/10.1002/bse.3391

Guoli, P., Mengqing, L., & Jianqi, Q. (2025). The impact of circular economy practices of Chinese SMEs on supply chain resilience: the moderating role of the blockchain adoption. Asia Pacific Business Review, 1–29. https://doi.org/10.1080/13602381.2025.2568857

Hair, J. F., Sarstedt, M., & Ringle, C. M. (2019). Rethinking some of the rethinking of partial least squares. European Journal of Marketing, 53(4), 566–584. https://doi.org/10.1108/ejm-10-2018-0665

Hart, S. L. (1995). A Natural-Resource-Based view of the firm. Academy of Management Review, 20(4), 986. https://doi.org/10.2307/258963

Haylemariam, L. G., Umar, R. M., & Oduro, S. (2025). Modeling the role of big data analytics capabilities in impacting corporate environmental performance: A Serial Mediation analysis. Business Strategy and the Environment, 34(6), 7791–7815. https://doi.org/10.1002/bse.4373

Henriquez-Machado, R., Muñoz-Villamizar, A., & Santos, J. (2025). Advancing sustainable operational excellence: a machine learning approach for emerging economies. International Journal of Productivity and Performance

Management, 74(8), 2730–2753. https://doi.org/10.1108/ijppm-05-2024-0332

Islam, S., Hassan, S., Hossain, S., Ahmed, T., Karmaker, C. L., & Bari, A. M. (2025). Exploring the influence of circular economy on big data analytics and supply chain resilience nexus: A structural equation modeling approach. Green Technologies and Sustainability, 3(3), 100219. https://doi.org/10.1016/j.grets.2025.100219

Jing, H., Zhang, Y., & Ma, J. (2023). Influence of digital ambidextrous capabilities on SMEs' transformation performance: The mediating effect of business model innovation. Heliyon, 9(11), e21020. https://doi.org/10.1016/j.heliyon.2023.e21020

Johl, S. K., Ali, K., Shirahada, K., & Oyewale, O. I. (2024). Green servitization, circular economy, and sustainability: a winning combination analysis through hybrid SEM-ANN approach. Business Strategy and the Environment, 33(8), 8978–8993. https://doi.org/10.1002/bse.3950

Katou, A. A., Kafetzopoulos, D., & Vayona, A. (2023). Investigating the Serially Mediating Mechanisms of Organizational Ambidexterity and the Circular Economy in the Relationship between Ambidextrous Leadership and Sustainability Performance. Sustainability, 15(10), 7937. https://doi.org/10.3390/su15107937

Kaur, S., Ali, K., & Shirahada, K. (2026). Redefining sustainability through dual-servitization and circular economy in Industry 5.0. Total Quality Management & Business Excellence, 1-24.

Kayikci, Y., Durak, D., USAR, & Aylak, B. L. (2021). Using blockchain technology to drive operational excellence in perishable food supply chains during outbreaks. The International Journal of Logistics Management, 33(3), 836–876. https://doi.org/10.1108/ijlm-01-2021-0027

Kessler, E.H. (2013), Encyclopedia of Management Theory, Sage Publications

Le, H. M., Wood, L. C., & Duong, L. N. K. (2025). The Integration of Circular Economy and resilience Principles in Modern Supply Chain Management: A Systematic Literature review. Process Integration and Optimization for Sustainability. https://doi.org/10.1007/s41660-025-00609-5

Liao, M., Li, S., & Liu, H. (2024). The impact mechanism of telework on job performance: a cross-level moderation model of digital leadership. Scientific Reports, 14(1), 12520. https://doi.org/10.1038/s41598-024-63518-6

Makhloufi, L., Zhou, J., & Siddik, A. B. (2023). Why green absorptive capacity and managerial environmental concerns matter for corporate environmental entrepreneurship? Environmental Science and Pollution Research, 30(46), 102295–102312. https://doi.org/10.1007/s11356-023-29583-6

Martínez-Falcó, J., Sánchez-García, E., Marco-Lajara, B., & Andreu, R. (2024a). Green supply chain management and sustainable performance: exploring the role of circular economy capability and green ambidexterity innovation.

British Food Journal, 126(11), 3985–4011. https://doi.org/10.1108/bfj-01-2024-0062

Martínez-Falcó, J., Sánchez-García, E., Marco-Lajara, B., & Andreu, R. (2024b). Green supply chain management and sustainable performance: exploring the role of circular economy capability and green ambidexterity innovation. British Food Journal, 126(11), 3985–4011. https://doi.org/10.1108/bfj-01-2024-0062

McDougall, N., Wagner, B., & MacBryde, J. (2019). An empirical explanation of the natural-resource-based view of the firm. Production Planning & Control, 30(16), 1366–1382. https://doi.org/10.1080/09537287.2019.1620361

Mishra, R., Singh, R. K., & Song, M. (2025). Managing tensions in resilience development: a paradox theory perspective on the role of digital transformation. Journal of Enterprise Information Management, 38(1), 127-151.

Nadeem, S. P., Garza-Reyes, J. A., & Anosike, A. I. (2025). A C-Lean framework for deploying Circular Economy in manufacturing SMEs. Production Planning & Control, 36(5), 650-670.

Naik, S., Sony, M., Antony, J., McDermott, O., Tortorella, G. L., & Jayaraman, R. (2023). Operational excellence framework for sustainability in the organisation: a design science approach. Production Planning & Control, 35(11), 1215–1231. https://doi.org/10.1080/09537287.2023.2165188

Naimi, M. A., Faisal, M. N., Sobh, R., & Uddin, S. F. (2020). Antecedents and consequences of supply chain resilience and reconfiguration: an empirical study in an emerging economy. Journal of Enterprise Information Management, 34(6), 1722–1745. https://doi.org/10.1108/jeim-04-2020-0166

Niu, S., Park, B. I., & Jung, J. S. (2022). The effects of digital leadership and ESG management on organizational innovation and sustainability. Sustainability, 14(23), 15639. https://doi.org/10.3390/su142315639

O'Reilly, C. A., & Tushman, M. L. (2008). Ambidexterity as a dynamic capability: Resolving the innovator's dilemma. Research in Organizational Behavior, 28, 185–206. https://doi.org/10.1016/j.riob.2008.06.002

Pellegrino, R., Gaudenzi, B., Fraccascia, L., Genovese, A., & Basile, L. J. (2025). Can the Adoption of Circular Economy Practices Foster Supply Chain Resilience and Performance Improvements? Business Strategy and the Environment. https://doi.org/10.1002/bse.70193

Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: a critical review of the literature and recommended remedies. Journal of applied psychology, 88(5), 879

Polimetla, J. S., Sindhwani, R., & Bag, S. (2025). A Systematic Literature Review on Digital twins in circular Supply Chain Management. Business Strategy and the Environment, 34(7), 8870–8898. https://doi.org/10.1002/bse.70038

Prashar, A., & Chaudhuri, A. (2024). Digitalization for circular economy and operational excellence practices: A paradox theory perspective on performance improvement in manufacturing firms. Business Strategy and the Environment, 34(1), 1154–1170. https://doi.org/10.1002/bse.4031

Sahoo, S., Kumar, A., Mangla, S. K., & Ishizaka, A. (2024). Examining the effects of Industry 4.0 adoption, information acquisition capability, and organizational ambidexterity on innovation and circular economy performance. Business Strategy and the Environment, 34(2), 1590–1606. https://doi.org/10.1002/bse.4067

Sasso, R. A., Filho, M. G., & Ganga, G. M. D. (2025). Synergizing lean management and circular economy: Pathways to sustainable manufacturing. Corporate Social Responsibility and Environmental Management, 32(1), 543-562.

Saudi Central Bank. (2017, February 17). Definition of Small and Medium Enterprises | SAMA Rulebook. Retrieved July 1, 2025, from https://rulebook.sama.gov.sa/en/definition-small-and-medium-enterprises

Saunders, M., Lewis, P. and Thornhill, A. (2019), Research methods for business students.

Shin, J., Mollah, M. A., & Choi, J. (2023). Sustainability and Organizational performance in South Korea: The effect of digital leadership on digital culture and employees' digital capabilities. Sustainability, 15(3), 2027. https://doi.org/10.3390/su15032027

Statista. (2025, October 28). Global waste Generation - Statistics & Facts. Retrieved December 28, 2025, from https://www.statista.com/topics/4983/waste-generation-worldwide/?srsltid=AfmBOop4krnKouz3O95RHTnAYvejtbl9zODMJjvn-n1W7g1bg7YF4L5l#topicOverview

Statista. (2025, October 28). Global waste Generation - Statistics & Facts. Retrieved December 28, 2025, from https://www.statista.com/topics/4983/waste-generation-worldwide/?srsltid=AfmBOop4krnKouz3O95RHTnAYvejtbl9zODMJjvn-n1W7g1bg7YF4L5l#topicOverview

Tanchangya, T., Siddiqi, K. O., Dhar, B. K., Rahman, J., Islam, N., & Das, S. (2025). Leveraging green capabilities and digital accounting under ESG pressure: Strategic insights from an emerging market's global value chains. Thunderbird International Business Review. https://doi.org/10.1002/tie.70058

Teece, D. J. (2007). Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance. Strategic Management Journal, 28(13), 1319–1350. https://doi.org/10.1002/smj.640

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. Strategic Management Journal, 18(7), 509–533. https://doi.org/10.1002/(sici)1097-0266(199708)18:7

Van De Wetering, R. (2022). The role of enterprise architecture-driven dynamic capabilities and operational digital ambidexterity in driving business value under the COVID-19 shock. Heliyon, 8(11), e11484. https://doi.org/10.1016/j.heliyon.2022.e11484

Xu, N., Shahzad, F., & Hu, R. (2025). Unveiling environmental excellence: the confluence of green Industrial Internet of Things, circular economy practices and dynamic capabilities in manufacturing firms. Journal of Manufacturing Technology Management, 36(2), 479-503.

Yu, P., Hamid, R. A., Osman, L. H., & Liao, J. (2025). Bridging the digital gap: Empirical insights into agri-food supply chain transformation. Sustainable Futures, 10, 100810. https://doi.org/10.1016/j.sftr.2025.100810

Zahoor, N., Usman, M., Khalid, A., Aboelmaged, M. G., & Yasin, N. (2025). Green strategic intent, artificial intelligence capability and behavioral dynamics of achieving circular economy goals in the public sector. Technological Forecasting and Social Change, 221, 124362. https://doi.org/10.1016/j.techfore.2025.124362

Zhang, X., Li, Y., & Teng, X. (2024). How does green entrepreneurial orientation improve enterprises' sustainable performance? Evidence from the agricultural sector in China. Business Ethics the Environment & Responsibility, 34(4), 1255–1277. https://doi.org/10.1111/beer.12706