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GREENING COMPLIANCE WHEELS: LINKING ENVIRONMENTAL LAWS, CIRCULAR ECONOMY, AND DIGITAL INNOVATION TO SAUDI ORGANIZATIONS' PERFORMANCE

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Abstract
This study explores how environmental regulations, circular economy principles, and digital green innovation synergistically improve ecological performance by enhancing sustainability integration within Saudi organizations. Conceptually rooted in the Resource-Based View and Institutional Theory, the model was empirically tested with 418 valid response data sets collected from managers and sustainability officers in different sectors of Saudi Arabia. The hypothesized model was tested using PLS-SEM. The results testified that the legal environment, circular economy principles, and digital green innovation positively fuel sustainability integration, while the environment's performance was positively impacted. In addition, sustainability integration partially mediated the collaboration of the legal environment, circular economy, and digital green innovation, citing the importance of internal core sustainability. The study amplified the understanding of implemented regulations and the digital shift toward the sustainable performance of the environment while providing considerable guidance toward the environmental aspects of Saudi Vision 2030.

Keywords: Environmental laws, circular economy orientation, digital green innovation, sustainability integration, environmental performance

1 Introduction

Sustainability and environmental performance have become vital parts of corporate strategy in developing economies (Xi et al., 2025). Sustainability, digital innovation, and environmental compliance have become key features in the KSA's Vision 2030 plan (Mani & Goniewicz, 2024; Elgammal & Bokhari, 2026). The environmental problems of carbon emissions, waste, and overconsumption of resources have raised the attention of policymakers and industry leaders (Xiao, 2025). Thus, this leads to the development of environmental laws and regulations to maintain long-term ecological balance. The principles of the circular economy and digital green innovation provide new means for organizations to gain efficiency, compliance, and competitiveness (Awad et al., 2025). Although there is considerable institutional and policy support, there is still the challenge of translating regulatory mandates, new technologies, and environmental performance (Al Amosh & Khatib, 2025). The interaction of environmental laws, circular economy, and digital innovation is crucial for practitioners to integrate environmental governance with the organizational effectiveness regarding sustainability (Ul-Durar et al., 2023).

Despite previous attempts to understand the various drivers of environmental performance, considerable gaps still exist in unpacking the complex drivers of sustainability in developing economies (Doan & Vu, 2024; Xi et al., 2025; Zhang et al., 2025). Most previous studies emphasized the role of environmental awareness, social responsibility, or green HRM on environmental performance (Basheer et al., 2025; Zhou et al., 2024). There is a considerable gap in the literature examining the

integration of environmental legislation, circular economy, and digital green innovation as a cohesive set of drivers (Al Halbusi et al., 2025; Ostic et al., 2025). Also, much of the prior work has been focused on developed economies, where regulations and techno-structures are much more developed and advanced (Rashid et al., 2025; Vijayagopal et al., 2024). In contrast, there is a paucity of literature on developing economies in the Gulf nations (Mani & Goniewicz, 2024). In this regard, the dynamic policy change in Saudi Arabia provides interesting opportunities to examine the interplay between state-imposed environmental regulations and firm innovation and sustainability (Tang, 2024). The present gap in the literature on integrated models of the combination of institutional, technological, and operational facets of environmental performance in changing economies is the focus of this paper.

More unexplored areas in the literature relate to the lack of understanding of the mediation mechanisms determining how external pressures and internal capacities add value to the environmental outcome (Ullah et al., 2024). Although research indicates that strong environmental regulations motivate companies to practice sustainability (Faeni et al., 2025; Shahzad et al., 2024), the pathways through which these external pressures are internalized within firms are still unexplored. The degree to which a business's strategy and operations incorporate sustainability principles (Roche & Baumgartner, 2025) has been noted as an essential missing link. There is, however, little research in the context of the Middle East measuring this missing link as a potential mediator between environmental drivers and the resulting outcomes (Tang, 2024). Also, the theory within the intersection of circular economy and digital innovation is still developing (Awad et al., 2025). Conversely, ample research shows that digital resources (AI, IoT, and data analytics) improve resource efficiency and support circular business models (Turskis & Šniokienė, 2024). Therefore, a clear gap in the literature seeks to study the mediation role of sustainability integration on the interplay of environmental regulation, circular economy, digitalization, and environmental outcomes in developing countries.

This research draws its theoretical foundations on Institutional Theory (INT) (Risi et al., 2023) and the Resource-Based View (RBV) (Chaudhuri et al., 2022). INT focuses on the organization's response to outside pressures such as government policies and societal expectations to achieve legitimacy and survive in the long run (Stupak et al., 2021). In Saudi Arabia, the growing enforcement of environmental law as a coercive institutional force pushes companies to adopt compliant sustainable practices to gain legitimacy and integrate with the top of the national development (Mani & Goniewicz, 2024). In contrast, the RBV focuses on the organization’s internal skills and ability to harness and exploit organizational resources such as digital green innovation and circular economy capabilities to gain and maintain a sustainable competitive edge (Abbasi Kamardi et al., 2025). While INT and RBV reconcile the internal and external aspects of sustainability, it should be noted that, when sustainability shifts solely based on compliance regulation, the organization relies on internal innovation and strategic integration to achieve compliance and convert it to environmental performance. Therefore, this paper treats sustainability integration as the primary mediating construct on the impacts of institutional forces and firm capabilities on environmental performance.

This paper, through this dual-theoretical lens, has three main goals. The first is to analyze the impacts of environmental regulations, the circular economy orientation, and the digital green innovation on the sustainability integration in the Saudi organizations. The second goal is to evaluate the impact of sustainability integration on the environmental performance, which connects the internal practices of sustainability with

the real environmental outcomes. The last objective is to examine the role of sustainability integration from the three antecedent variables to the environmental performance. With this in mind, the paper aims to address the notable gaps in the literature surrounding sustainability governance, technological innovation, and circular transformation in developing economies. From a practical standpoint, the current paper provides evidence to policymakers on the impact of regulatory frameworks on sustainability integration across sectors and to managers on the potential of the digital and circular economy for performance improvement. The paper highlights the congruence of organizational strategy with the sustainability objectives outlined in Saudi Vision 2030. Accordingly, it can be inferred that enforcing regulations, accompanied by the internal adoption of sustainability practices in organizations, is a vital component of any strategy.

2 Literature overview

2.1. Underpinned theories

Institutional Theory (INT) informs this research. INT describes how organizations adjust to external expectations, rules, and social perspectives to achieve legitimacy and consolidate enduring stability (Risi et al., 2023). Coercive environmental regulations and legislation are organizational prisms to evaluate sustainable practice adoption (Alhejaili, 2024). Sustainability goals become part of organizational strategies in response to institutional pressures to achieve trust and legitimacy within social systems (Stupak et al., 2021). Therefore, INT is a valid approach toward the environmental laws' external drivers that push organizations to sustain the practice adoption at the operational and governance levels (Bhuiyan et al., 2023). In addition to INT, the Resource-Based View (RBV) articulates another strategic approach concerned with how adopting sustainability alters an organization's internal capabilities and resources (Nayak et al., 2023). As identified within RBV, the competitive advantage is achieved through the possession of valuable, rare, inimitable, and non-substitutable resources (e.g., digital green innovation and circular economy practices), which result in high environmental performance (Chaudhuri et al., 2022).

In this situation, digital innovation encompasses technological capabilities, while the circular economy approach focuses on optimizing resource efficiency, essential for establishing a sustainable competitive advantage. Organizations achieve this by embedding sustainability into their day-to-day activities, thus transforming resources into long-term performance returns. Thus, this substantiates RBV, which states that strategic sustainability is a matter of ethical responsibility and a competitive advantage (Liu, 2025). Integrating INT and RBV provides a dual-theoretical framework that addresses sustainability's external and internal aspects. The former explains external motivations (regulatory and societal pressures) to which organizations respond (Risi et al., 2023). Conversely, the latter provides the means and explains the internal resources to achieve the desired environmental (and social) results (Chaudhuri et al., 2022).

This integration provides a complete picture of Saudi organizations' means to balance compliance with the law and innovation. It captures the sustainability integration, which reacts to environmental regulation and transforms purposeful green innovation and circular activities into quantifiable environmental performance measures. The proposed structural model in Figure 1 shows and explains the assumed relationships of environmental laws and regulations, circular economy approach, and digital green innovation as independent variables that affect sustainability integration, affecting the organization's environmental performance. It also captures sustainability integration as a mediating element to the performance of the aforementioned variables.

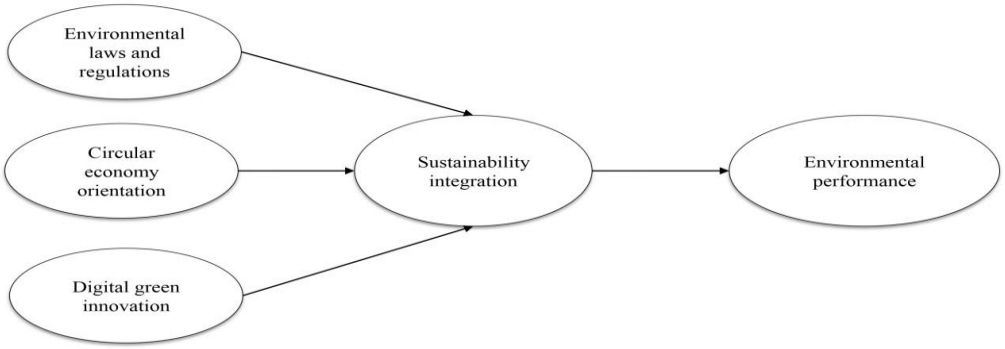

Figure 1. Research model
Source: Author preparation

2.2. Environmental laws and regulations and sustainability integration

Governments impose environmental regulations and laws that require organizations to implement ecologically sustainable practices and adopt precautions to reduce environmental harm (Daramola et al., 2024). As per institutional theory, legal requirements also push companies to adjust their strategies to attain societal approval and strengthen their legitimacy (Risi et al., 2023). Prior research has documented evidence in many situations (Gomez-Trujillo et al., 2024; Park, 2021) where organizations respond to legal requirements in a predominantly reactive fashion, viewing sustainability primarily as a legal obligation and compliance rather than an opportunity for innovation. Thus, this is also the case in Saudi Arabia, where Vision 2030 and the Saudi Green Initiative focus on environmental transformation (Alsulamy et al., 2025; Selim & Alshareef, 2025), and where laws as constraints and catalysts shape sustainability integration. The literature still has a gap regarding how compliance with regulations in developing countries is linked with internalizing sustainability instead of merely symbolic adoption (Daramola et al., 2024; Gomez-Trujillo et al., 2024). Therefore, this study proposes that:

H1. Environmental laws and regulations positively affect sustainability integration.

2.3. Circular economy orientation and sustainability integration

Firms adopting circular economy principles demonstrate strategic intent in waste reduction, product lifecycle extension (Osei et al., 2024), and practical resource use via reuse, recycling, and regeneration (Khan et al., 2024). From the resource-based view (RBV), such disposition is an invaluable and inimitable capability uplifting sustainability performance (El Nemar et al., 2025). Although much literature classifies the circular economy as a macroeconomic or policy-driven approach (Boonman et al., 2023; Osei et al., 2024), micro-level, empirical studies on how organizations' circular

practices enable sustainability integration into business practices are still lacking (Munonye, 2025). Past research prioritizes technical efficiency instead of the holistic sustainability integration into a business model (Khan et al., 2024; Turskis & Šniokienė, 2024). In Saudi Arabia's transitional industrial environment, organizations with a circular economy mindset will likely adopt sustainability principles into their decision-making, supply chain, and innovation (Abu-Baka & Almutairi, 2024). This research seeks to address this gap by investigating whether integrating a circular economy framework in its processes and operations concerning the other strategic antecedents aligns with organizational goals of sustainability integration in corporate structures and culture. Hence, this paper hypothesizes that:

H2. Circular economy orientation positively affects sustainability integration.

2.4. Digital green innovation and sustainability integration

Digital green innovation involves incorporating new technologies into green innovations in products, processes, and services, as defined by Yin et al. (2024). Based on the RBV, digital green innovation shows how an organization's technological agility allows it to devise adaptive solutions to environmental challenges (Patwary et al., 2024). Much of the literature has treated digital transformation as distinct from environmental innovation, thereby missing opportunities for systemic sustainability integration through digitalization (Pricopoaia et al., 2025; Ul-Durar et al., 2023). In developing economies, where technological diffusion and the maturity of regulations are still unfolding, the link between green innovation and digital capability is minimal (Yin et al., 2024). According to Khan et al. (2024), digital green innovations provide firms with the capability for real-time monitoring, resource optimization, eco-efficient design, and other functionalities that strengthen the embeddedness of sustainability within firms. Thus, this study hypothesizes that:

H3. Digital green innovation positively affects sustainability integration.

2.5. Sustainability integration and environmental performance

Sustainability integration is the incorporation of environmental and social issues into the missions and strategies of firms and their day-to-day activities (Roche & Baumgartner, 2025). From the Resource-Based View (RBV) perspective, firms that achieve environmental integration with their core business processes develop capabilities to improve their environmental performance and resilience in the long run (Liu, 2025). Previous works recognized that the outcome of integration of sustainability processes was improved environmental performance (Munonye, 2025; Roche & Baumgartner, 2025), but integration itself has been considered a construct on the margins rather than a central thrust of strategy in Montesano et al. (2023). The lack of empirical evidence in the case of emerging markets is cited as the reason integrated sustainability efforts have failed to achieve measurable improvements environmentally (Cezarino et al., 2022). This paper assumes that proper integration of sustainability goes beyond mere compliance (or standalone CSR), and enables the organization to achieve significant and continuous declines in emissions, waste, and resource use, and consequently posits the anticipated effect of integration of sustainability on environmental performance to be positive and strong (Liu, 2025). Hence, this paper assumes that:

H4. Sustainability integration positively affects environmental performance.

2.6. Mediating effect of sustainability integration

Although environmental laws form the legal bedrock for sustainably conducting business, the ultimate effectiveness of these laws relies on the organization's internal acceptance of sustainability principles (Al Halbusi et al., 2025). Building on INT, external pressures alone will not result in better environmental outcomes (Risi et al., 2023) unless these pressures are routinized within the organizational culture (Stupak et al., 2021). Numerous previous studies, such as Ostic et al. (2025) and Tang (2024), have noted a lack of long-term strategic alignment in sustainability resulting from mere regulatory compliance. Hence, this study proposes that sustainability integration is a mediating construct to convert legal compliance on the outer surface into actual environmental performance. More specifically, and inspired by the work of Aguilera et al. (2021), such firms, which adopt a holistic integration of sustainability within a firm's structures vis-à-vis eco laws, would be more likely to attain operational efficiency in tandem with the ecological enhancement described by Selim & Alshareef (2025). Hence, this paper hypothesizes that:

H5a. Sustainability integration mediates the relationship between environmental laws and regulations and environmental performance.

Adopting a circular economy orientation helps anchor strategic approaches to achieving sustainable production and consumption systems (Abu-Bakar & Almutairi, 2024). However, a strategic orientation, on its own, does not guarantee positive outcomes for the environment. From RBV and INT perspectives, the silo of sustainability integration is the organizational functionality that operationalizes the circular values as environmental outcomes (Setyadi et al., 2025). As literature points out, integrating circularity in production processes greatly enhances efficiency and waste reduction (Daramola et al., 2024; Munonye, 2025). However, sustainability integration has been largely disregarded in the literature as a possible mediator in the alignment of circular approaches to net positive results (Roche & Baumgartner, 2025). In the Saudi context, which has been described as transitioning from linear to circular industrial models (Cezarino et al., 2022), the embedding of sustainability aims to guarantee the orderly and systematic implementation of circular strategies as opposed to patchwork or uninformed circular strategies (Setyadi et al., 2025). As such, this study posits that:

H5b. Sustainability integration mediates the relationship between circular economy orientation and environmental performance.

Digital green innovation entails providing technology focused on improving the environmental efficiency of various processes. The consequent efficiency gains or losses largely depend on incorporating the tenets of environmental sustainability within the business (Abbasi Kamardi et al., 2025; Elgammal & Jones, 2007). Past research has focused on operational transformations brought about by digitalization, and little attention has been paid to aligning digitalization with the business's environmental objectives for tangible environmental improvements (Henderson & Loreau, 2023; Yin et al., 2024). Integrating these two agendas becomes crucial for Saudi industrial ecosystems (Zaki et al., 2025). Environmentally sustainable businesses can harness digital technology to more efficiently transform resource optimization, emission

reduction, and waste disposal processes (Martínez-Peláez et al., 2023). Considering these insights, this paper asserts that:

H5c. Sustainability integration mediates the relationship between digital green innovation and environmental performance.

3 Research methodology

3.1. Research rationale

This research is situated in Saudi Arabia's dynamic environmental and industrial landscape, especially with the recent Vision 2030 developments and the Saudi Green Initiative, which centers on digital transformation, circular economy, and sustainability (Alsulamy, & Elgammal, 2025). Elgammal & Bokhari, 2026). According to Alhejaili (2024), Saudi manufacturing, energy, and service organizations experience intensified normative and institutional pressure to implement sustainable developments. Moreover, the Saudi Arabia Vision 2030 seeks to attain carbon neutrality within the established deadlines (Awad et al., 2025). Although institutional pressures have led to heightened awareness, several organizations in these sectors are still at different levels of integrating sustainability, Elgammal & Jones, 2007 which provides an interesting opportunity for empirical research. Hence, the current study seeks to investigate the interplay of environmental regulations, circular economy focus, and digital green innovation on the extent of sustainability integration and environmental performance, capturing the country's strategic industrial development focus on sustainability and advanced technology.

3.2. Pretest and procedure

Before the primary data collection, a pretest assessed the measurement items for clarity, reliability, and contextual relevance. The survey instrument, which was first designed in English, was sent to a selected small pilot sample of 75 participants via Google Form, which included academic experts in sustainability management and managers from manufacturing and service organizations in Saudi Arabia. Piloted survey participants were asked to assess each item for clarity of language, contextual relevance, and correctness of the idea. Their suggestions for changes in wording, sequencing of items, and the phrases used were adopted to improve the text and fit it to the context. The pretest results also showed good internal consistency with all Cronbach's alpha values well above the 0.70 threshold. This stage confirmed that the instrument captured the intended theoretical meanings while aligned with the Saudi context of business and regulations.

In addition to establishing measurement equivalence and accuracy of translation, the reverse translation method was also used. The Arabic version of the instrument was first produced by a professional translator who is bilingual and conversant with the environmental management domain. At the same time, the original questionnaire in English was then translated back by three bilingual experts who were isolated from the original text and the context. In comparing English versions, any discrepancies were identified and reconciled, and it was ensured that all were conceptually and semantically aligned. Disciplinary terms like "circular economy orientation" and "digital green innovation" were used for precision in theory and cultural comprehension. The thorough validation of these linguistic components ensured that respondents understood the constructs regardless of the language. Thus, this enhanced the instrument's measurement reliability and validity. The instrument's validation for the pretests and reverse translations demonstrated that the study's methodological rigor was enhanced

and that the psychometric properties of the survey instrument were applicable and relevant to the Saudi Arabian context.

3.3. Instruments

All constructs were measured using established multi-item scales adapted from prior validated studies (Appendix A). Environmental laws and regulations were measured using four items adapted from Cai and Ye (2020). Circular economy orientation was captured with four items from Gallardo-Vázquez et al. (2024). Digital green innovation was assessed using four items from Bhatia (2021). Sustainability integration employed four items from Fekpe and Delaporte (2019). Lastly, environmental performance was measured using four items from Chiou et al. (2011). All items were rated on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

3.4. Data gathering process

A quantitative cross-sectional survey design was employed for this study. The target organizations were those from the industrial, energy, and service sectors in Saudi Arabia, where the national strategies prioritize digital transformation and environmental sustainability (Elgammal et al., 2022). The study population consisted of middle and senior managers in charge of sustainability, operations, and innovation, who understand how environmental integration and digital transformation practices interact. Purposive sampling was used to identify respondents from environmental regulation-impacted organizations and organizations involved in sustainability activities. The sampling frame comprised the Saudi Green Initiative database, sustainability reports, Chamber of Commerce, and corporate sustainability reports. To address the geographic diversity, Riyadh, Jeddah, Dammam, and Jubal are home to the primary industrial and economic centers of Saudi Arabia.

Data collection occurred from January to April 2025 after pretesting and translation validation were completed. We sent 750 online surveys via official email invitations and through LinkedIn professional groups, along with a cover letter detailing the purpose of the study, the promise of confidentiality, and the voluntary nature of participation. In order to reach respondents from different geographic areas, the survey was conducted using a secure online system. To increase participation, we sent two reminder emails at three-week intervals. Out of the 750 distributed questionnaires, we received 463 completed surveys, resulting in a 61.7% response rate. After removal of responses with missing data, inconsistencies, and uncompleted entries, we held 418 responses to use in the final analysis. This number is above the suggested minimum for PLS-SEM and will provide adequate statistical power. Thus, this provides the analysis with the necessary robustness.

The respondent profile reflected balanced representation across industries, firm sizes, and managerial levels, providing rich and diverse insights into sustainability integration practices (see Appendix B). Ethical approval was obtained from the researchers' affiliated university, and all participants provided informed consent before participation. Anonymity was ensured during data collection to mitigate social desirability bias and promote candor. With this, the systematic and structured sampling aligned with the best practices to provide reliability, context relevance, and representativeness within the context of the research in sustainability and environmental management in the Saudi Arabian industrial context.

3.5. Common method bias (CMB)

To minimize CMB issues, some procedural and statistical actions have been taken. On the procedural side, respondents' evaluation apprehension and social desirability bias were lessened when respondents were told they would be kept anonymous and everything would be confidential. Different scale anchors were used in the survey design, and items were randomized to avoid patterned responses. From the statistical side, we first carried out Harman's single-factor test and found that no single factor was responsible for more than 40% of the total variance, meaning CMB was not a critical issue. Further, a complete collinearity test was conducted in the form of VIF, whose results were all below the conservative threshold of 3.3, proving there were no issues with multicollinearity or CMB. These types of diagnostics prove that the relationships among the constructs in question have not been altered primarily by measurement bias.

3.6. Analytic strategy

Data analysis was conducted using ADANCO 2.4, a comprehensive software PLS-SEM tool (Jhantasana, 2023). ADANCO was selected because it can handle complex models consisting of several constructs and mediating relationships under the assumption of some violation of the normal distribution (Legate et al., 2024; Tan et al., 2025). PLS-SEM techniques simultaneously estimate measurement and structural models, thus guaranteeing reliability and predictive validity (Shoukat et al., 2025; Vaithilingam et al., 2024). The software was executed in two stages. In the first stage, the measurement model was assessed. Internal consistency, convergent validity, and discriminant validity were evaluated using various indicators, such as Cronbach's alpha, composite reliability, and average variance extracted (AVE). The structural model was tested for the hypothesized relationships and mediation effects in the second stage. The significance of path coefficients was assessed using 5,000 resamples in a bootstrapping procedure (Cepeda et al., 2024).

4. Results

4.1. Outer model estimation

The outer model estimation evaluated the measurement model's reliability and validity before examining the hypothesized structural relationships (Legate et al., 2024). As shown in Table 1, internal consistency reliability was measured by the trustworthiness of the Cronbach's alpha and composite reliability (Vaithilingam et al., 2024). Reliability was confirmed as all constructs exceeded the minimum threshold of 0.70. Convergent validity was confirmed by the average variance extracted (AVE). All constructs harnessed values in excess of 0.5 (Tan et al., 2025), showing that the indicators' latent constructs captured more than half the variance in the indicators. The indicator loadings were evaluated, and all items had significant loadings over the 0.70 threshold (Legate et al., 2024), affirming the adequacy of the individual indicators representing their constructs.

For discriminant validity assessment, the Fornell–Larcker criterion and the heterotrait–monotrait (HTMT) ratio were evaluated (Appendix C). The square roots of the AVE values were greater than the inter-construct correlations, confirming the distinctiveness of the constructs (Vaithilingam et al., 2024). Moreover, HTMT ratios were also under the conservative threshold of 0.85, which added to the support for discriminant validity (Cepeda et al., 2024; Legate et al., 2024). These results showed that the outer model had strong psychometric properties. Thus, the measurement indicators were shown to reliably and validly represent their respective latent constructs before estimating the structural model.

Table 1. Construct reliability and validity

Constructs	Codes	Factor loadings	Alpha	CR	AVE
Environmental laws and regulations	ELR1	0.842	0.883	0.917	0.687
	ELR2	0.869			
	ELR3	0.801			
	ELR4	0.826			
Circular economy orientation	CEO1	0.854	0.876	0.912	0.677
	CEO2	0.871			
	CEO3	0.789			
	CEO4	0.816			
Digital green innovation	DGI1	0.868	0.892	0.924	0.709
	DGI2	0.872			
	DGI3	0.841			
	DGI4	0.820			
Sustainability integration	SIN1	0.861	0.901	0.933	0.736
	SIN2	0.876			
	SIN3	0.857			
	SIN4	0.849			
Environmental performance	ENP1	0.832	0.887	0.919	0.692
	ENP2	0.861			
	ENP3	0.845			
	ENP4	0.810			

Source: Author preparation

4.2. Model fit indices

As presented in Table 2 and according to PLS-SEM analysis guidelines, overall model fit is assessed using the standardized root mean square residual (SRMR) and the normed fit index (NFI). An SRMR value of 0.061 indicates satisfactory fit and minor differences between the observed and predicted correlations, since the value is below the 0.08 threshold (Vaithilingam et al., 2024). An NFI value of 0.910 is well over the acceptable range of 0.90 and confirms strong model adequacy (Legate et al., 2024). These outcomes indicate that the proposed measurement and structural models are a good fit for the observable data (Jhantasana, 2023). Furthermore, the R^2 value for sustainability integration, explained by environmental laws and regulations, circular economy orientation, and digital green innovation, is 0.642. Therefore, 64.2% of the variance in sustainability integration is explained. The R^2 relating to environmental performance is 0.473, meaning that sustainability integration explains 47.3% of the variance in environmental performance. The explanatory power of these coefficients is significant, confirming the strength of the proposed structural model (Vaithilingam et al., 2024).

4.3. Hypothesis testing

Table 2 results demonstrated strong support for all hypothesized relationships. Environmental laws and regulations positively affected sustainability integration ($\beta = 0.271$, $t = 5.864$, $p < 0.001$, $f^2 = 0.082$), confirming H1. Results also confirmed that circular economy orientation positively affected sustainability integration ($\beta = 0.314$, $t = 6.231$, $p < 0.001$, $f^2 = 0.097$), supporting H2. Similarly, digital green innovation

positively affected sustainability integration (β = 0.357, t = 7.118, p < 0.001, f^2 = 0.114), validating H3. Further, sustainability integration positively affected environmental performance (β = 0.493, t = 9.021, p < 0.001, f^2 = 0.185), supporting H4. Such findings demonstrate that organizational compliance with environmental laws, circular economy adoption, and digital green innovation strengthens sustainability integration, driving environmental performance in Saudi organizations.

Next, Table 2 results further confirmed the mediating role of sustainability integration. The indirect effect of environmental laws and regulations on environmental performance through sustainability integration was positive and significant (β = 0.134, t = 4.267, p < 0.05, CI = [0.081, 0.196]), supporting H5a. Similarly, circular economy orientation positively affected environmental performance via sustainability integration (β = 0.155, t = 4.588, p < 0.01, CIs = [0.097, 0.217]), validating H5b. Lastly, digital green innovation demonstrated a positive effect on environmental performance through sustainability integration (β = 0.176, t = 4.993, p < 0.01, CIs = [0.113, 0.248]), confirming H5c. Accordingly, results underscore sustainability integration as a crucial mechanism linking environmental regulations, circular economy orientation, and digital green innovation to enhanced environmental performance in Saudi organizations.

Table 2. Structural model assessment

H	Structural paths	β	*t*-value	p-value	f^2	Decision
Direct effects						
H1	Environmental laws and regulations → Sustainability integration	0.271***	5.864	0.000	0.082	Supported
H2	Circular economy orientation → Sustainability integration	0.314***	6.231	0.000	0.097	Supported
H3	Digital green innovation → Sustainability integration	0.357***	7.118	0.000	0.114	Supported
H4	Sustainability integration → Environmental performance	0.493***	9.021	0.000	0.185	Supported
Indirect effects						
H	Structural paths	β	*t*-value	p-value	97.5%CIs	Decision
H5a	Environmental laws and regulations → Sustainability integration → Environmental performance	0.134*	4.267	0.013	[0.081, 0.196]	Mediation
H5b	Circular economy orientation → Sustainability integration → Environmental performance	0.155**	4.588	0.009	[0.097, 0.217]	Mediation
H5c	Digital green innovation → Sustainability integration → Environmental performance	0.176**	4.993	0.007	[0.113, 0.248]	Mediation
Quality indicators						
R^2 for Sustainability integration		0.642	R^2 for Environmental performance			0.473
SRMR		0.061	NFI			0.910

Note: 2-tailed test; ***p < 0.001, **p < 0.01

Source: Author preparation

4 Discussion

5.1. General discussion

Our results show strong empirical evidence in the Saudi context regarding the positive impact of environmental regulations, circular economy, and the adoption of digital green innovations on sustainability integration, which in turn enhances the environmental performance of these organizations. The magnitude of our path coefficients demonstrates that sustainability integration is compliance outcomes and a strategic facilitator of converting external pressures and innovations into considerable environmental results (Munonye, 2025; Roche & Baumgartner, 2025). Tyler et al. (2024) illustrated the same phenomenon in the context of European firms, where enforcing strict environmental regulations resulted in the adoption of internal sustainability practices. Unlike the Saudi context, many prior studies framed environmental compliance as a reactive response (Awad et al., 2025; Mani & Goniewicz, 2024). Thus, the current results suggest an accomplishment of proactive sustainability and the continuing institutional development regarding the Saudi Vision 2030. Thus, this promotes the discourse of INT, illustrating that coercive elements in developing countries can transform into motivational elements if combined with a robust national sustainability vision, as demonstrated in Tetteh et al. (2024).

In addition, Al Halbusi et al. (2025) and Ostic et al. (2025) argue that adopting circular strategies enables firms to strengthen their internalization of sustainability frameworks. However, this is the first study to contribute to the literature by offering evidence of this phenomenon occurring in Saudi Arabia, where circular practices are just beginning to take shape due to efforts in industrial diversification. Instead of studies that emphasize circularity from the consumer side (e.g., Abu-Bakar & Almutairi, 2024; Daramola et al., 2024), this study demonstrates that Saudi firms are beginning to adopt circular economy principles at the organizational level by focusing on the reduction of waste, the reuse of resources, and the eco-efficient production of goods. This finding illustrates the resource-based view (RBV) of strategic management that states the possession of specific unique resource capabilities (e.g., circular orientation) enables organizations to achieve and maintain competitive advantage when integrated with other resources in the organization (Chaudhuri et al., 2022). Thus, this illustrates the RBV logic of sustainability when an environmental orientation is integrated and internalized to become a source of organizational resilience and sustained competitive advantage.

In addition, the connection between digital green innovation and the integration of other sustainability dimensions supports the need for organizations to acquire all four components of the technological capability in order to obtain sustainability transformation. Consistent with Martínez-Peláez et al. (2023), who indicated that firms' environmental responsiveness strengthened due to digital innovation through efficient use of data, our understanding of the phenomenon remained the same. However, the current study adds new insights to the literature by demonstrating that digital innovation by itself, in the absence of integration with other dimensions of sustainability, will not suffice in the Saudi Arabian context, where, according to Alhejaili (2024), the convergence of digital transformation as a top priority with technology- environmental innovation illustrates how organizations could use digital innovation to embed environmental sustainability in the organization's integrated strategic decision-making (Abu-Bakar & Almutairi, 2024). The results also reinforce elements of the RBV and INT, which explain how organizations reconfigure digital resources and deal with environmental issues to gain technological agility and sustained ecological advantage.

Finally, sustainability integration as a mediating mechanism advances the three antecedents to achieve desired environmental performance outcomes, a meaningful contribution to theory and practice. Although some of the literature has recognized the importance of integration (e.g., Roche & Baumgartner, 2025; Turskis & Šniokienė, 2024), few have empirically documented it as a bridging mechanism, especially in emerging economies (Khan et al., 2024). Our findings demonstrate that sustainability integration mediates the conversion of external institutional pressures, internal circular strategies, and digital capabilities to achieve specific environmental performance outcomes, such as emission reductions and energy efficiency. Hence, this contributes to theory by corroborating the simultaneous use of INT and RBV, as it suggests that legitimacy-seeking behavior and internal resource consolidation must coexist to drive superior environmental performance. Therefore, this also suggests a practical contribution that organizations in Saudi Arabia need to institutionalize sustainability at the strategic and operational planning level to convert compliance and innovation on a regulatory level into an environmental impact.

5 Conclusions

5.1. Theoretical implications

This research presents important theoretical contributions to the literature on integrating sustainability in emerging economies' green transitions. First, within the limits of the INT application, results show that in the case of Saudi Arabia's laws and regulations, coercive pressures are also enabling forces that engage internal sustainability integration (Tetteh et al., 2024). Previous works in Western economies highlighted dominant compliance pressures within the institutions (Bhuiyan et al., 2023; Stupak et al., 2021). Our research, however, finds that in contexts, such as Saudi Arabia's Vision 2030 framework, which are undergoing significant reforms, the legal framework can foster creativity in strategic and long-term sustainable initiatives. Thus, this enhances the understanding of INT by showing that the nature and intensity of institutional pressures are contextually dependent on the developmental stage of the country and the state of governance. Our results demonstrate that genuine sustainability commitment can coincide with legitimizing behavior if institutional pressures result from transformational agendas. Accordingly, this paper makes a theoretical contribution by explaining the paradox of institutional pressures as compliance and innovation facilitators.

This study builds on the RBV perspective by empirically testing the mediating role of sustainability integration as the mechanism through which organizational resources and capabilities are transformed into outstanding environmental performance. While RBV argues that competitive advantage is attained through valuable and scarce resources (Abbasi Kamardi et al., 2025; Nayak et al., 2023), this study contributes to the theory by demonstrating that sustainability integration constitutes the strategic approach through which these resources are mobilized and operationalized for profit. By demonstrating the important contribution of digital green innovation, this study extends the RBV by showing that the ability to adapt and reshape technology is a necessary and important resource for connecting innovation and sustainable profit. Previous research has tended to study circularity, digitalization, and sustainability as separate phenomena (Daramola et al., 2024; Henderson & Loreau, 2023; Yin et al., 2024); this paper, however, combines these aspects into a single framework that connects external pressures and internal resources and capabilities. Therefore, this paper provides a unified theoretical perspective by integrating the external legitimacy framework of INT with the resource and capability perspective of RBV. This integration improves the

clarity on the unfolding of sustainability transformation in emerging economies. Accordingly, this accentuates that environmental performance is a linear consequence of compliance, or innovation, and a dynamic, capability-driven process of strategic integration with supportive institutional evolution.

5.2. Practical implications

Our findings lead to actionable recommendations for policymakers, managers, and sustainability practitioners interested in improving the environment in Saudi organizations. First, the results highlight the value of shifting the perspective of environment-related laws and regulations from merely compliance mechanisms to being the key drivers of the integration of sustainability. Thus, this means that policymakers should be more focused on strengthening the regulatory mechanisms of compliance incentives, like tax reliefs, green financing, and even some forms of public acknowledgement for organizations that adopt sustainability. Environmental regulators can also create sustainability objectives and practices that align with compliance regulations to go beyond the bare minimum. Since the institutional forces at play differ by industry, firm size, and sector, a more tailored policy for small and medium enterprises and equitable distribution of capacity development resources will also be necessary.

The government, in conjunction with sustainability agencies, should continue supporting firms' transition to sustainable practices aligned with Vision 2030 through capacity-building workshops, training in environmental management, and technology transfer to achieve a balance between sustainable practices and Vision 2030. Therefore, this should also include sustainability integration performance indicators into national evaluation systems, to strengthen accountability and promote compliance innovation. In organizations, managers should internalize the value of sustainability integration in strategy and not consider it peripheral or a mere symbol.

Businesses are encouraged to incorporate sustainability into foundational strategic plans, governance structures, and frameworks for assessing organizational performance. Executives can further advance integration within the organization by forming cross-disciplinary sustainability committees, pairing environmental initiatives with performance goals, utilizing digital green innovations for the governance and reporting of resource surveillance, and optimizing resource use. Investing in digital systems such as IoT-enabled energy systems and AI-driven waste management solutions could enhance transparency, operational efficiency, and sustainability. Moreover, businesses should adopt an orientation. Within the circular economy paradigm, it is a fundamental long-term business strategy focused on enhancing resource efficiency and recovery, redesigning and re-engineering products to incorporate safe and sustainable materials, and valorizing waste. Managers can collaborate with suppliers, universities, and innovation hubs to co-create circular solutions.

HR managers should integrate sustainability competencies into systems for training and performance appraisal to reinforce a culture of environmental stewardship at all organizational levels. Finally, sustainability integration within the organizational structure should galvanize innovation and mitigate intersecting initiatives such as regulatory compliance, innovation, and circulation to deliver on targets and reduce the ecological footprint. Implementing these organizational strategies will enable Saudi firms to advance their levels of environmental stewardship to a more strategic, innovation-led approach and eliminate reliance on compliance to meet national and international sustainability targets.

5.3. Limitations and future research

Despite its contributions, this study has limitations, which create research opportunities for ceramics. The first limitation is that the study was limited to the data collected from Saudi organizations spanning several industries. Thus, this may restrict the applicability of the findings to different cultural or regulatory scenarios. Future research may include country comparative studies to understand the impact of different institutional frameworks and country environment policies on the embedding and enacting of sustainability within organizations. The second limitation of this study is that it was designed and conducted as a cross-sectional study, which does not allow for the inference of causality between the different constructs. As such, this would provide a strong basis for conducting longitudinal studies on the dynamism of sustainability over time. Further development of the current model would focus on the potential impact of contextual variables, including leadership, organizational culture, or stakeholder engagement, on performance and the embedding of sustainability. Studying sustainability-driven decision-making would benefit theoretically from adding qualitative or mixed-method approaches. Therefore, this would balance the study with sustainability's behavioral and managerial aspects.

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