SIN-CHN SCIENTIFIC PRESS PTE.LTD.

Sustainable Economies 2025, 3(1), 1363.
https://doi.org/10.62617/se1363

Article

Determinants of enterprise green innovation performance: Examining the role of environmental orientation, green practices, and organizational commitment

Michael Provide Fumey[1], Frank Agyemang Karikari[1], Seth Acquah Boateng[1], John Wiredu[2,*], Josephine Annan[3], Alexander Opoku[1]

[1] School of Public Policy and Administration, Northwestern Polytechnical University, Xi'an 710072, China
[2] School of Management, Northwestern Polytechnical University, Xi'an 710072, China
[3] School of Economics and Management, Beijing University of Posts and Telecommunications, Beijing 100876, China
*** Corresponding author:** John Wiredu, johnwiredu50@gmail.com

CITATION

Fumey MP, Karikari FA, Boateng SA, et al. Determinants of enterprise green innovation performance: Examining the role of environmental orientation, green practices, and organizational commitment. Sustainable Economies. 2025; 3(1): 1363.
https://doi.org/10.62617/se1363

ARTICLE INFO

Received: 13 January 2025
Accepted: 19 February 2025
Available online: 6 March 2025

Abstract: This study examines the links between environmental orientation (EO), green innovation performance (GNP), and green innovation practices (GIP), with technological capabilities (TEC) acting as a moderator. It offers a framework that combines the Resource-Based View (RBV) and the Dynamic Capabilities View (DCV), wherein dynamic capabilities (technological agility) and static resources (organizational commitment, strategic focus) work together to promote sustainable innovation. PLS-SEM, or partial least squares structural equation modeling, was used to analyze data from 535 SMEs in Ghana. The findings indicate that green organizational commitment (GOC) and EO incorporating sustainability into internal operations and culture and external stakeholder collaboration significantly increase GNP. By facilitating the effective deployment of green technologies, TEC strengthens the GOC-GNP relationship. The study emphasizes the difficulties SMEs face in developing nations such as Ghana and suggests solutions according to local limitations (such as a lack of resources or regulatory gaps) and stakeholder requirements. Combining RBV and DCV into a multi-level framework that addresses firm- and industry-level factors (e.g., market demand, regulation) theoretically fills in the gaps in the sustainability literature. It provides managers with practical guidance on how to link TEC, GOC, and EO for eco-competitive results. Validated context-sensitive EO, GOC, and TEC measurement scales provide instruments for cross-regional study and enhance knowledge of green innovation in under-researched areas such as sub-Saharan Africa.

Keywords: organizational commitment; technological capability; environmental orientations; green practices; and green innovation performance
JEL Classification: Q01; Q50; Q55; Q56

1. Introduction

The escalating global environmental concerns mandate businesses, particularly those significantly contributing to environmental degradation, to shoulder responsibility for ameliorating environmental challenges [1–3]. This paper offers a profound consideration of this issue and identifies specific dimensions of decision-making. Various stakeholders, including communities, governments, competitors, and consumers, pressure enterprises to foster innovation and consciousness of the environment [4–7]. To address conservational problems such as pollution prevention and optimal resource utilization, businesses must acknowledge and leverage internal and external knowledge of the natural environment. Moreover, many organizations recognize green innovation as a pivotal approach to reducing negative environmental impacts [8–10]. For example, Chang [11] and Tseng et al. [12] argue that enterprises should pursue sustainable innovation to attain a competitive edge. Furthermore, employing green innovation strategies has proven effective in managing uncertainties. Despite the calls from various stakeholders, recent studies underscore the imperative for companies to enhance their performance in green innovation (GNP) [13,14], thus underscoring the necessity of identifying avenues to promote green innovation practices (GIP).

Moreover, Banerjee [15] defines environmental orientation (EO) as the magnitude to which a corporation’s management acknowledges the significance of its environmental issues. EO is frequently articulated in corporate vision and mission statements and comprises internal and external dimensions [15]. Internal EO encompasses the organization’s internal initiatives for environmental preservation. At the same time, external EO pertains to the company’s stance on environmental conservation and its impact on interactions with external entities such as suppliers, communities, and government agencies. Past literature has recognized the role of EO [16–18]. For instance, Menguc and Ozanne [19] and Luo et al. [20] discovered that EO significantly influences organizational effectiveness in green innovation (GNP). Green innovation performance, or GNP, denotes an organization’s enhancement of its manufacturing processes or product designs with a focus on environmental management and conservation. GNP encloses both product innovation and green process performance within the origination environment. Advancing pollution control, energy efficiency, non-toxic product designs, waste recycling, and other product and process innovation aspects can confer businesses a first-mover advantage and a differentiated competitive advantage [21,22]. However, this perspective prioritizes developing or adopting new technologies to enhance a firm’s social and economic value [23,24]. Technological capabilities (TEC) encompass manufacturing tools, methods, procedures, product designs, and delivery systems aimed at conserving energy and natural capital to mitigate the environmental impact of human happenings [25]. Previous studies have also examined components of GNP, such as enterprise financial performance, ecological sustainability, and social impact. TEC constitutes a vital component of a firm’s GNP and GIPs.

In industries characterized by technological volatility, firms often face significant uncertainty regarding the anticipated benefits of their green innovation performance (GNP) and ecological outlook [26]. Recent lessons in environmental research have underscored the importance of environmental orientation (EO) in analyzing organizations’ ecological performance and GNP. For example, Aboelmaged [27] suggested that green innovation activities mitigate the effect of EO on firm performance through both direct and indirect mechanisms. Embodying a firm’s corporate culture and strategy in response to environmental issues valued by diverse stakeholders, EO is posited as a critical precursor to green innovation [28,29]. However, further investigation is warranted, as the impacts of internal and external environmental perspectives on innovations in environmentally friendly processes and products may vary. Internal environmental orientation emphasizes the company’s internal initiatives toward ecological preservation, while external environmental orientation pertains to managing interactions with external stakeholders [15]. As evidenced by Li et al. [30] and Mukhtar [31] green process innovation may benefit more from internal integration than green product innovation. Conversely, outward amalgamation might enhance green product innovation more successfully than green process innovation [32,33]. Consequently, the effect of environmental orientation (EO) on GNP warrants further exploration. Therefore, assessing how companies' implementation of EO affects GNP and enhances ecological performance is imperative. This study elucidates the relative impacts of the two components of EO on two distinct forms of GIP and organizational commitment through a comparative analysis.

Scholars have redirected their focus more and more to the Dynamic Capabilities View (DCV) because they believe that the Resource-Based View (RBV) is too static and inadequate to explain how a firm gains a competitive advantage in the swift changes in the environment [34–37]. This viewpoint holds that a firm's volume to create, incorporate, and modify its resources via specialized abilities determines its competitive edge. Scholars view DCV and RBV as complementary frameworks that aid in clarifying the intricate relationships between resource configuration, technological capability adoption, and green innovation performance (GNP) due to their shared foundational assumptions [38,39]. Moreover, several research studies have used a resource-based approach (RBV) to investigate the factors contributing to GNP [40,41]. Because businesses may see stakeholder satisfaction as a valuable resource, RBV may help advance stakeholder theory [42,43]. Firms viewing technology as an indispensable resource are more likely to leverage every available avenue to engage with it [44–47]. RBV posits that technological capital would elevate the importance of environmental orientations (EO) as a significant external resource. However, from the perspective of DCV theory, the high costs associated with addressing environmental concerns are expected to diminish the significance of EO once the technological infrastructure is established in a vibrant and changing organization [48,49].

The research motivation and contribution

This paper probes the impacts of environmental orientation (EO), GIP, technological capabilities (TEC), and green GOC on GNP to resolve the disparities seen in earlier studies. Regarding the conceptual outlines of the resource-based view (RBV) and dynamic capabilities view (DCV), it focuses on how TEC influences the link between GIPs and GNP and the mediating roles that GOC and GIPs play in the interaction between EO and GNP. The study develops critical research questions to direct its investigation: (RQ1) What effects do EO, GIPs, GOC, and TEC have on GNP? (RQ2): What role do GIPs play in moderating the EO-GNP relationship? (RQ3): How does GOC influence how EO and GNP are related? (RQ4): Does TEC control the relationship between GNP and GOC? (RQ5): Does TEC lessen the impact of GNP and GIPs on each other? This research aims to underwrite the current corpus of work on GNP by scrutinizing the influence of GIPs on perceptions of organizational performance and EO. Empirically and policy-wise, it offers administrators, stakeholders, and business practitioners' insightful information on successfully using GIPs, GOC, and EO to boost GNP and enhance business performance. The investigation evaluates the theoretical intuition and research model and hypotheses using partial least squares structural equation modeling (PLS-SEM). It also provides theoretical and practical ramifications for further studies in this facet.

The article follows this arrangement: Section 3 describes the technique, including sample selection, data collection, validity, and dependability. Section 2 examines the theoretical underpinnings and research assumptions. The results are accessible in Section 4, and analysis and discussion are given in Section 5. In conclusion, Section 6 discusses the findings and makes submissions for more inquiry.

2. Review of the literature

2.1. Theoretical underpinnings

This study is based on the Resource-Based View (RBV) and Dynamic Capabilities View (DCV) integrated theoretical framework, which makes a clear connection between these theories and the selection of variables (GIP, GOC, and GNP) as well as the objectives of the research. DCV builds on RBV's explanation of how green innovation practices (GIP) and green organizational capabilities (GOC) function as valuable, rare, inimitable, and non-substitutable (VRIN) resources essential for environmental performance by describing how firms dynamically reconfigure these resources through capabilities like knowledge integration and stakeholder responsiveness to achieve green new product performance (GNP) [50,51]. The combination of RBV and DCV clarifies the theoretical link between variables. While DCV explains the adaptive mechanisms (how) that transform GIP and GOC into marketable results (GNP), RBV identifies them as essential resources (what). This dual lens strongly aligns with the study's objective of identifying pathways for increasing GNP, which is in line with current calls to bridge resource stability (RBV) and adaptive agility (DCV) in sustainability research [52,53]. The incorporation of fresh empirical evidence [54]. Bag et al. [55] shows the connections between theories and variables (e.g., framing GIP/GOC as VRIN resources under RBV and GNP as a DCV-driven outcome) are crucial for expanding the framework's relevance to green innovation.

2.2. Hypothesis development

2.2.1. EO and GIP linkage

Environmental orientations (EO), both inner and outward, have a momentous constructive impact on Green Innovation Practices (GIPs) [56]. An internal environmental observation (EO) is focused on the company's efforts to protect the environment Banerjee, [15]. An external management's belief that it is critical to address external stakeholders' concerns about environmental problems [15,57]. Additionally, it has been demonstrated that EO, such as inner and outward environmental orientation and green entrepreneurial orientation, positively influences GIPs [58–60]. According to Zehir and Ozgul [61] these orientations are linked to developing GIPs and adopting green creative abilities. Green product development and process innovation are further enhanced by examining green market data and technical skills via the prisms of DCV and RBV theory [62]. GIP has been seen in the association among EO and GNP [63]. According to research by Fatoki [64] shows green innovation indirectly affects the correlation between an environmental mindset and eco-friendly competitive advantage. There are several advantages to this connection. Similarly, research by Bai and Lyu [65] suggests that green innovation benefits from environmental information disclosure, and Li et al. [66] discovered a significant correlation between EO and GIPs. On the other hand, Wang and Ozturk [67] study revealed that total quality management (TQM) did not affect environmental performance, indicating that there was no favorable relationship between TQM and GIPs. The findings support the RBV and DCV hypotheses [68]. When the whole research is considered, it demonstrates a favorable correlation between environmental attitudes and GIPs, underscoring the role that environmental laws and transparency of information play in fostering green innovation. Thus, the following conclusions are drawn from the paper:

H1: There is a direct and positive link between EO and GIP.

2.2.2. EO and GOC linkage

There is a robust link between GOC and EO. Studies have shown that there are correlations between environmental orientations (EO) and green organizational commitment (GOC) that are both positive and negative. Numerous studies indicate that external environmental orientation affects reactive environmental strategies more than proactive ones [69]. The DCV and RBV theories suggest that companies with a solid green organizational identity and a commitment to green practices include environmental objectives in their purpose and strategy [70]. The link between eco-friendly organizational culture, sustainable innovation, and green technologies determines green behaviors and performance inside the firm [71]. The organization's focus on environmental protection positions it as a market leader and strengthens its standing as a socially responsible business [72]. Corporate houses deliberately try to match their creative policies with their environmental objectives via GIPs. These measures include, for example, encouraging sustainable business practices and using innovative manufacturing techniques that are ecologically beneficial [73]. Additionally, Zhang and Walton [74] claim that eco-innovation is essential to increasing GOC and that greener businesses gain more from eco-innovation in terms of performance when they allocate more organizational resources. According to the DCV and RBV concept, proactive environmental strategies like green marketing and strengthening the company's social and ecological responsibility can also enhance employee satisfaction, pride, and support for green innovation and entrepreneurship [75] Vargas-Hernández et al. [76] discovered a significant correlation between green company branding environmental commitment and green innovation performance. Furthermore, Soewarno et al. [77] research found a favorable correlation between workers' energy- and recycling-saving actions and organizational-level EO's internal and external components. The link between EO and GOC is often complicated, with specific features having an advantage over others. The link between GOC and EO is thus as follows:

H2: EO directly and favorably influences GOC.

2.2.3. GIP and GNP linkage

GIPs are business strategies and initiatives to design and introduce eco-friendly products, services, and technology. Consequently, it is suggested by the DCV and

RBV theories that these approaches seek to improve sustainability and lessen the negative environmental effects of corporate operations. Studies by Khan et al. [78] focus on various aspects of GIPs. Lestari and Sunyoto [79] claim that GIPs boost GNP and enhance companies' financial and environmental performance, supporting ecological preservation and sustainability. Zhang et al. [80] found that using GIPs enhances a firm's innovation performance, especially regarding new-to-market or radical product innovation. However, the impact on business performance varies; firms implementing extensive green innovation initiatives report higher labor productivity but no discernible impact on job growth or staff turnover [81]. Li et al. [82] claim that various elements, such as consumer pressure, management commitment, resources, and competencies, affect how successful green innovation is. Additionally, a company's degree of digitalization may mitigate the adverse consequences of certain environmental practices on GNP under DCV theory [83]. As a result, GIPs may help businesses with their GNP, financial, and environmental performance. Thus, the inquiry offers the following hypothesis:

H3: GIP directly and positively influences GNP.

2.2.4. GOC and GNP linkage

Numerous revisions have established the favorable influence of senior management's GOC and a flexible philosophy on organizational GNP, with green product innovation functioning as a mediator [84]. Research focusing on small and medium-sized firms (SMEs) in China has emphasized the significant contribution of green innovative human resource practices and GOC to boosting GNP [85]. Moreover, elements such as management GOC, resources and competencies, and consumer pressure are crucial in SMEs' adoption of GNP, resulting in a more significant competitive advantage and sustained performance [86]. Resource-based view (RBV) and dynamic capabilities view (DCV) theories support the significant improvements in organizational and environmental performance that have been shown through green innovation, especially when it comes to green process and product metrics [87,88]. Research also reveals that combining green innovation and technology with a green organizational culture allows firms to attain green performance and practices [89]. Additionally, a strong internal commitment to green practices has been related to enhanced ecological innovation capacities inside firms [90]. Both green innovation and GOC are crucial for reaching environmental sustainability and boosting organizational GNP. Thus, the current research suggests the following hypothesis based on these observations.

H4: GOC positively improves GNP.

2.2.5. Mediation role of GIP

GIP plays a pivotal starring role in supporting the performance of green innovation, especially when combined with environmental orientation (EO). They serve as a bridge between environmental initiatives and the efficacy of green innovation. Several research papers have highlighted the favorable effects of green innovation methods on GDP, such as adopting green marketing orientation and implementing green human resource management (GHRM) initiatives [91]. Furthermore, a variety of elements, including organizational resources and capabilities, management commitment, consumer expectations, and theories like the Resource-

Based View (RBV) and Dynamic Capabilities View (DCV), impact the adoption of green innovation methods [91]. Additionally, studies show that green innovation practices and transformational leadership have a different relationship, affecting a company's performance in green innovation. These findings relate to green human resource management strategies and transformational leadership. Furthermore, it has been shown that EO mediates the relationship between GIP and the GNP [92]. Absorptive capacity further supports the mediating role of green innovation methods on the influence of policy direction on green innovation performance. Furthermore, it has been shown that consumer pressure, organizational resources and competencies, and management commitment favorably impact green innovation, improving green innovation performance [93]. Businesses may increase resource productivity and create new income streams by using green innovation strategies to optimize labor, energy, and raw materials. Moreover, putting green innovation ideas into reality produces significant competitive benefits in addition to helping to balance the costs of environmental preservation. Furthermore, an organization's credibility and reputation are greatly enhanced by using green innovation strategies. Allowing the Dynamic Capabilities View (DCV) idea, a business's environmental sustainability reputation may provide a competitive edge in the green market, improve employee happiness, boost customer buy intent, and win over the government. These results highlight how crucial it is for businesses to concentrate on putting green innovation methods into place and developing their capacity while considering the impact of environmental orientation and policy direction. As a result, the present investigation puts forward the following theory.

H5: GIP completely mediates the link between EO and GNP.

2.2.6. Mediation role of GOC

GOC serves as a mediator between environmental approaches and the GNP. GOC significantly influences the link between EO and GNP. According to research, senior management's green organizational citizenship (GOC), flexible culture, and organizational GNP are all mediated by green product innovation [84]. Studies have demonstrated that green innovation has a favorable and considerable impact on organizations' environmental performance and GNP [17]. The link between GOC, EO, and green technology leads to green practices and GNP in businesses [78]. Research in Pakistan's textile sector indicates that organizational GNP and top management's green organizational citizenship (GOC) and adaptive culture are mediated by green environmental conditions [80]. Another industrial research study found that green product innovation and proactive EO strategy mostly drove the connection between green culture and green performance. Additionally, by combining green process and product indicators, green innovation dramatically increases organizational and environmental GNP. Consequently, it may be said that organizations play a variety of functions if the same institutional determinants are present. This makes it necessary to determine the mediator environmental commitment between GNP and green company identity, which this study examines. Furthermore, RBV and DCV stress that companies must have enough resources to deal with abnormalities or problems. Institutional pressures may be seen as anomalous and addressed as an external issue since top-tier management has committed to doing so, whereas environmental commitment can be viewed as an internal element in addressing these difficulties [85]. These results demonstrate that companies need to cultivate a green culture and demonstrate care for environmental concerns to grow their GNP [82]. Therefore, we assume the following:

H6: There is a link between EO and GNP, primarily mediated by GOC.

2.2.7. Moderation role of TEC

Studies have discovered that technical capabilities (TEC) are critical in shaping the link between GOC and GNP. TEC is crucial for a firm's ability to promote GOC and environmental results. According to their argument, organizational TEC positively supports both organizational GNP and green supply chain integration (GSCI), which is consistent with the viewpoints of the resource-based view (RBV) and dynamic capabilities view (DCV). Furthermore, study results indicate that green innovation is greatly influenced by both product and process innovation with businesses concentrating on green technology innovation growing [76]. In the interaction between GSCI and GNP, GOC serves as a helpful mediator [68]. The significance of organizational TEC in performance and stress the need for IT competency as a critical component of organizational competence. Thus, the degree of technical skill significantly shapes the relationship between GNP success and GOC. TEC acts as a moderator in the relationships between CEO ethical leadership and environmental performance, as well as between GNP and GIPs. They emphasize that TEC mediates the relationship between the CEO's environmental performance and ethical leadership, combined with green technology innovation, with corporate technical orientation as a moderator [76]. Additionally, studies suggest that TEC, green supply chain management (GSCM) techniques and GIPs' operational success are positively correlated. Additionally, operational GIPs in businesses are directly impacted by TEC [80]. With assistance from TEC, GIPs act as a go-between for GNP and the implementation of green innovation projects. Environmental, organizational, and technological elements are essential for green initiatives that support long-term success in small and medium-sized enterprises (SMEs). Manufacturing companies' inventive ambidexterity is greatly enhanced by TEC, which allows them to depend more on IT to increase agility [67,68] Generally, the contribution of TEC to strengthening the connection between GNP and GIPs supports the theories of the resource-based and dynamic capacities views. **Figure 1**. depicts the conceptual framework of the study.

H7: TEC moderates the relationship between GOC and GNP.

H8: TEC positively moderates the relationship between GIP and GNP.

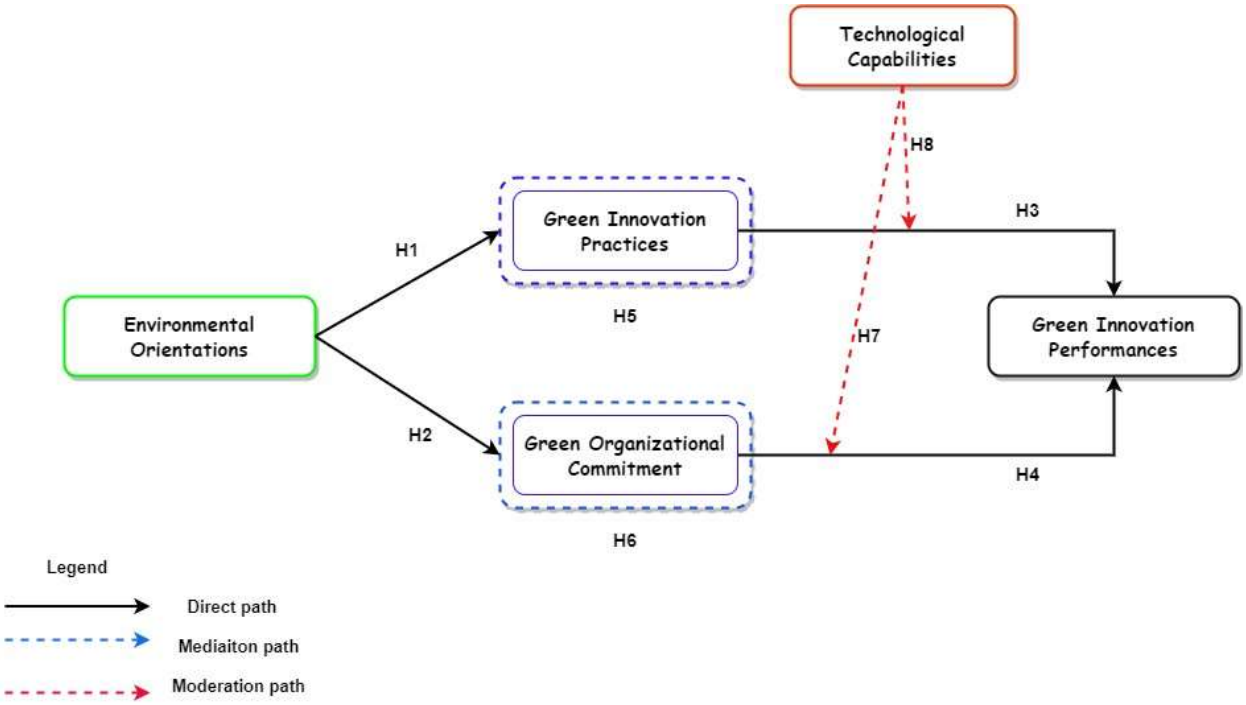

Figure 1. Depicts the conceptual framework of the study.

3. Methodology

3.1. Research method and sampling

Data for this study were collected from SMEs in Ghana. Ghana has shown its commitment to environmentally friendly operations in recent years by substantially changing its environmental protection regulations. The government has taken action to encourage both local and international businesses, especially SMEs, to do thorough ecological impact assessments. Many enterprises in Ghana adhere to the norms and regulations of the Environmental Protection Agency as per the national commitment. Because of this dedication, businesses can actively engage in eco-friendly programs and activities. The data was gathered using a standardized questionnaire to increase Ghana's overall green innovation landscape by creating an environment encouraging businesses to use sustainable methods.

A structured questionnaire is a document having standardized questions with a preset framework outlining the precise phrasing and sequence of questions to obtain data from respondents [94]. This research used self-administered questionnaires to gather data from managers and supervisors directly engaged in implementing environmental sustainability measures in SMEs. Therefore, it was vital for managers competent in EO, GIPs, GNP, GOC, and TEC to participate in the survey. Manufacturing experts were contacted before distributing the questionnaires to gauge the metrics' accuracy and dependability. The survey was constructed. Based on past research, participants were guaranteed anonymity in their replies. This paper did not call for ethical review since it did not include clinical trials or animal experimentation, and participants supplied their comments willingly, retaining anonymity. Thirty-five enterprises directly or indirectly influencing the environment were chosen for the research. Despite this, many corporations intend to comply with environmental standards and develop sustainability initiatives. An online survey was utilized to contact 585 managers well-versed in EO, GIPs, GNP, GOC, and TEC, of which 535 valid replies were obtained, suggesting a high response rate of 91.5%. Among responders, about 70% were males and 30% were women. The majority came from the 25–45 age category (average age = 33.5 years, standard deviation = 0.925). Regarding education, 48% had a bachelor's degree, 40% had a master's degree, and 12% had higher credentials. Regarding job experience, 52% had worked for five to nine years, 34% for one to four years, and 16% for more than ten years. Regarding industry, 21% predominantly worked in the car sector, 25% in pharmaceuticals, 32% in rubber and plastics manufacture, 12% in technology and communication, and 10% in other industries. Additionally, 18% were interns, 12% were full-time employees, and 30% were contract workers.

3.2. Measurements

The form contained two components. The first component took demographic data like age, gender, educational achievement, professional experience, kind of firm, and conditions of employment. The ensuing portion uses altered versions of measuring scales from earlier academic publications. This portion of the questionnaire addressed crucial criteria such as technical capability, organizational commitment to green innovation, environmental orientation, green innovation practices, and performance. Before distributing the questionnaires, manufacturing experts were contacted to guarantee the correctness and reliability of the measures active in this research. Researchers adopted a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (very agree) to measure the different components of the study. **Table 1** shows the measurement details.

Table 1. Measurement details.

Construct	No of items	Source
Environmental Orientation	3	[60–63]
Green Innovation Practices	5	[50–52]
Green Organizational Commitment	5	[40–42]
Technological Capabilities	3	[60,61]
Green Innovation Performance	4	[58–60]

3.3. Data analysis and results

The partial least squares (PLS) structural equation modeling method was employed in this study to investigate the research model using Smart-PLS Version 3.0. This technique was selected due to the inquiry's exploratory character [88]. Following a two-step strategy was used for the statistical evaluation in this paper. Initially, the measuring methodology attracted examination. Subsequently, the structural links included among the latent constructs were explored. This sequential procedure was done to confirm the validity and reliability of the conceptual variables before analyzing the structural links within the model. Moreover, the application of Smart-PLS has substantially boosted its acceptability and appeal [81] delivering complete information about each component. Composite reliability (≥ 0.7) and rho_A (≥ 0.7)

were applied to evaluate the reliability of the data. These indices test the intrinsic consistency of the data by validating that the measurements properly reflect the constructions they imply. Convergent validity was examined using the average variance extracted (AVE) (≥ 0.5), which evaluates the closeness of the measurements to the underlying idea. Discriminant validity was examined using the variance inflation factor (VIF) (< 5.0) and the heterotrait-monotrait ratio (HTMT) (< 1) to find common method bias. Furthermore, the indicator's dependability within the structural model was evaluated using the corresponding effect size ($f2$ above 0.35 [strong], 0.15 [moderate], and 0.02 [weak]) in conjunction with a factor loading (> 0.7; $p \leq 0.05$) demonstrating the indicator's noteworthy input to the latent construct and path coefficient. The coefficient of determination ($r2$) above criteria of 0.67 [substantial], 0.33 [moderate], and 0.19 [weak] was used to measure the instructive rule of the model.

4. Results

Using the reflecting model configuration (repeated indicator), the association between EO, GIP, GOC, TEC, and GNP was examined. Examining the causal linkages between EO, GIP, GOC, TEC, and GNP, among other aspects of business performance, in detail was made easier using this method. Before conducting the significance test for the structural model, the measurement model was assessed using a two-stage approach. **Table 2** shows the construct reliability and validity

4.1. Measurement model

Table 2. Construct reliability and validity.

	Cronbach's alpha	rho_A	Composite reliability	Average variance extracted (AVE)
Environmental Innovation	0.750	0.809	0.856	0.670
Green Innovation Performances	0.826	0.865	0.886	0.666
Green Innovation Practices	0.831	0.831	0.881	0.598
Green Organizational Commitment	0.896	0.909	0.924	0.712
Technological Capabilities	0.785	0.788	0.874	0.699

Cronbach's alpha was employed to gauge constructs' internal consistency, and the results showed that the constructs' data were reasonably dependable (CA > 0.7). Given the caliber of the original data collected using the corresponding scales, the rho_A scores demonstrated that the constructs were reliably quantified (rho_A > 0.7). The constructions' composite reliability was adequate (CR > 0.7). The constructs' convergent validity was sufficient and acceptable (AVE > 0.5). **Table 3** shows the HTMT ratio.

4.2. Discriminant validity

Table 3. HTMT ratio.

	Heterotrait-monotrait ratio (HTMT)
Green Innovation Performances ↔ Environmental Innovation	1.217
Green Innovation Practices ↔ Environmental Innovation	0.490
Green Innovation Practices ↔ Green Innovation Performances	0.501
Green Organizational Commitment ↔ Environmental Innovation	0.481
Green Organizational Commitment ↔ Green Innovation Performances	0.504
Green Organizational Commitment ↔ Green Innovation Practices	0.705
Technological Capabilities ↔ Environmental Innovation	0.454
Technological Capabilities ↔ Green Innovation Performances	0.481
Technological Capabilities ↔ Green Innovation Practices	1.107
Technological Capabilities ↔ Green Organizational Commitment	0.794

The findings of discriminant validity demonstrate that most of the constructs (HTM scores < 1) had no issues with discriminant validity, except the pairings related to GIP, EO, and TEC. However, since dynamic capacities and organizational learning were conceived of as second-order constructs, this issue does not pose a danger to the estimated model.

4.3. Common method bias (inner VIF)

Harman's single-factor test evaluates common technique bias in the dataset. According to Harman's technique, if all variables are put into a factor analysis and the first component accounts for more than half of the total variance, it implies the existence of common method bias. To run this test, all variables were combined into a single factor using a rotation matrix and the dimension reduction technique inside SPSS. The first component accounted for 38.23% of the total variance, which is less than half. As indicated in **Tables 4** and **5**, the correlations were determined to be nonsignificant, as proven by the VIF coefficient values ranging from 1.234 to 3.47. These data imply that common technique bias in this research is not a big problem. **Table 6** shows the indicator loading.

Table 4. Common method bias.

	Inner VIF
Environmental Orientation → RANDOM	1.032
Green Innovation Performances → RANDOM	1.050
Green Innovation Practices → RANDOM	1.404
Green Organizational Commitment → RANDOM	1.310
Technological Capabilities → RANDOM	1.131

4.4. Collinearity statistics

Table 5. Multi-collinearity statistics (outer VIF).

	VIF
EO1	1.234
EO3	2.088
EO4	2.001
GIP1	1.975
GIP2	1.857
GIP3	1.361
GIP4	1.666
GIP5	2.362
GNP1	1.257
GNP3	3.254
GNP4	2.179
GNP5	2.295
GOC1	1.451
GOC2	2.395
GOC3	2.775
GOC4	3.269
GOC5	3.472
TEC2	1.663
TEC3	1.580
TEC4	1.685
Technological Capabilities x Green Organizational Commitment	1.000
Technological Capabilities x Green Innovation Practices	1.000

4.5. Structural model

Table 6. Indicator loading.

	Original sample (*O*)	**Sample mean (*M*)**	**Standard deviation (STDEV)**	***T* statistics**	***P* values**
EO1 ← Environmental Orientation	0.647	0.643	0.057	11.390	0.000
EO3 ← Environmental Orientation	0.904	0.904	0.013	69.639	0.000
EO4 ← Environmental Orientation	0.880	0.880	0.017	50.724	0.000
GIP1 ← Green innovation Practices	0.794	0.793	0.022	36.454	0.000
GIP2 ← Green innovation Practices	0.777	0.776	0.026	29.631	0.000
GIP3 ← Green innovation Practices	0.684	0.685	0.038	18.123	0.000
GIP4 ← Green innovation Practices	0.762	0.761	0.028	26.970	0.000
GIP5 ← Green innovation Practices	0.842	0.840	0.019	45.337	0.000
GNP1 ← Green Innovation Performances	0.598	0.596	0.053	11.365	0.000
GNP3 ← Green Innovation Performances	0.920	0.920	0.009	104.565	0.000

Table 6. (*Continued*).

	Original sample (*O*)	Sample mean (*M*)	Standard deviation (STDEV)	*T* statistics	*P* values
GNP4 ← Green Innovation Performances	0.841	0.841	0.021	40.242	0.000
GNP5 ← Green Innovation Performances	0.867	0.867	0.015	58.793	0.000
GOC1 ← Green Organizational Commitment	0.679	0.679	0.033	20.699	0.000
GOC2 ← Green Organizational Commitment	0.845	0.844	0.020	42.418	0.000
GOC3 ← Green Organizational Commitment	0.874	0.874	0.013	67.729	0.000
GOC4 ← Green Organizational Commitment	0.895	0.895	0.011	79.935	0.000
GOC5 ← Green Organizational Commitment	0.903	0.903	0.011	81.716	0.000
TEC2 ← Technological Capabilities	0.832	0.831	0.022	37.354	0.000
TEC3 ← Technological Capabilities	0.842	0.843	0.020	42.244	0.000
TEC4 ← Technological Capabilities	0.834	0.833	0.022	38.650	0.000

Every indicator was determined to be significant ($p < 0.05$) and to reliably evaluate the components they were designed to measure. This research examined common method bias (CMB) since it cannot be overlooked. To reduce the impact of contextual factors, discrete portions of the questionnaire were designed with clear instructions for each variable, using Harman's single-factor method [79]. The variance inflation factor (VIF) coefficient is calculated to determine whether the study's variables are collinear. VIF coefficient must be lower than a minimum threshold of 5.0. This is the same as the VIF shown in **Table 5**, where values falling between 1.234 and 3.47 indicate that no CMB was found throughout the investigation. **Table 7** shows the path coefficient (contributions).

4.6. Direct analysis

Table 7. Path coefficient (contributions).

	Original sample (O)	*F*-Square	Standard deviation	*T* statistics	*P* values
Environmental Orientation → Green Innovation Practices	0.394	0.399	0.039	10.169	0.000
Environmental Orientation → Green Organizational Commitment	0.409	0.411	0.041	9.887	0.000
Green Innovation Practices → Green Innovation Performances	0.321	0.328	0.087	3.693	0.000
Green Organizational Commitment → Green Innovation Performances	0.256	0.256	0.059	4.355	0.000
Technological Capabilities → Green Innovation Performances	−0.116	−0.118	0.093	1.249	0.106
Technological Capabilities x Green Innovation Practices → Green Innovation Performances	−0.003	−0.001	0.048	0.054	0.478
Technological Capabilities x Green Organizational Commitment → Green Innovation Performances	−0.106	−0.107	0.048	2.215	0.013

With no impact size ($f2 = 0.399$), EO is a substantial positive predictor of GIP (Beta = 0.394; $p = 0.000$: $p < 0.05$) H1 is accepted. EO is substantially predicted by

GOC (Beta = 0.409; $p = 0.000$: $p < 0.05$). H2 is established. With an impact value of ($f2 = 0.328$), GIP significantly improves GNP (Beta = 0.321; $p = 0.000$: $p < 0.05$). H3 is compatible. Positive significance in GNP is caused by GOC (Beta = 0.256; $p = 0.000$: $p < 0.05$; $f2 = 0.256$). H4 is accepted. The results of the moderation studies demonstrate that technological capability (TEC) significantly and adversely moderates the predictive associations between GOC and GNP [H7] (Beta = −0.106; $p = 0.013$: $p < 0.05$; $f2 = 0.107$). However, the predictive connection between green innovation practices (GIP) and green innovation performance (GNP) [H8] (Beta = −0.003; $p = 0.478$; $p > 0.05$) is not moderated by Technological capabilities (TEC). **Table 8** Shows the specific indirect effect.

4.7. Mediation analysis

Table 8. Specific indirect effect.

	Beta	*T* statistics	*P* values
Environmental Orientation → Green Innovation Practices → Green Innovation Performances	0.127	3.115	0.001
Environmental Orientation → Green Organizational Commitment → Green Innovation Performances	0.105	3.296	0.000

The nexus between environmental orientations (EO) and GNP is mediated by green innovation practices (GIP) (Beta = 0.127; $p = 0.001$: $p < 0.05$), and H5 is supported. However, the predictive relationship between GNP and GNP is not moderated by technological capabilities (TEC). GNP and environmental orientations (EO) are mediated by GOC (Beta = 0.105; $p = 0.000$: $p < 0.05$), and H6 is supported. **Table 9** shows the coefficient of determination.

4.8. Coefficient of determination

Table 9. Coefficient of determination.

	R-square	*R*-square adjusted
Green Innovation Performances	0.250	0.242
Green Innovation Practices	0.155	0.154
Green Organizational Commitment	0.167	0.166

The performance of the selected businesses varied by 24.2% (moderate). Variations in EO were linked to changes in green innovation practices and green organizational commitment by 15.4% and 16.6%, respectively.

4.9. Important performance map-model

In this work, we applied the importance-performance map analysis (IPMA) as an upgraded approach inside PLS-Structural Equation Modeling, concentrating on firm performance as the final construct. IPMA increases the understanding of findings from PLS-SEM analysis [56,57,95–98]. IPMA evaluates the mean values of latent constructs and associated indicators (i.e., performance measures) and analyzes path coefficients (i.e., importance measures). In line with IPMA, the average values of EO, GIP, GOC, and TEC reflect the performance of the latent constructs. At the same time, the total effects demonstrate the relevance of these elements in defining the target construct (i.e., competitiveness and firm performance). The IPMA findings are displayed in **Figure 2**. The efficacy and applicability of the four sustainability indicators, EO, GIP, GOC, and TEC, were analyzed. The data reveal that although green innovation strategies display comparable efficacy, green organizational commitment emerges as the most impactful element. Innovation and environmental orientation also rank second in performance metrics and relevance evaluations. Furthermore, green innovation strategies rank third in performance and significance metrics. Technological skills demonstrate the lowest importance level compared to environmental innovation or orientation, although they have the most outstanding performance measure value.

Figure 2. Importance of performance map.

Moderation graph

Drawing from the study findings and theoretical considerations, hypotheses H7 and H8 examined the moderating influence of TEC on the links between GOC and green innovation performance (GNP) and between green innovation practices (GIP) and GNP, respectively. The predictive association between GOC and GNP experiences a significant negative moderation by TEC [H7] (Beta = −0.106; $p = 0.013$: $p < 0.05$; $f2 = 0.107$). However, the correlation between GIP and GNP is not moderated by technological capabilities (TEC), as evidenced by the non-significant result in hypothesis H8 (Beta = −0.003; $p = 0.478$; $p > 0.05$). Thus, TEC neither moderates the relationship between GIP and GNP nor the interaction between GOC and GNP. **Figure 3** shows the TEC interaction diagram between GIP and GNP.

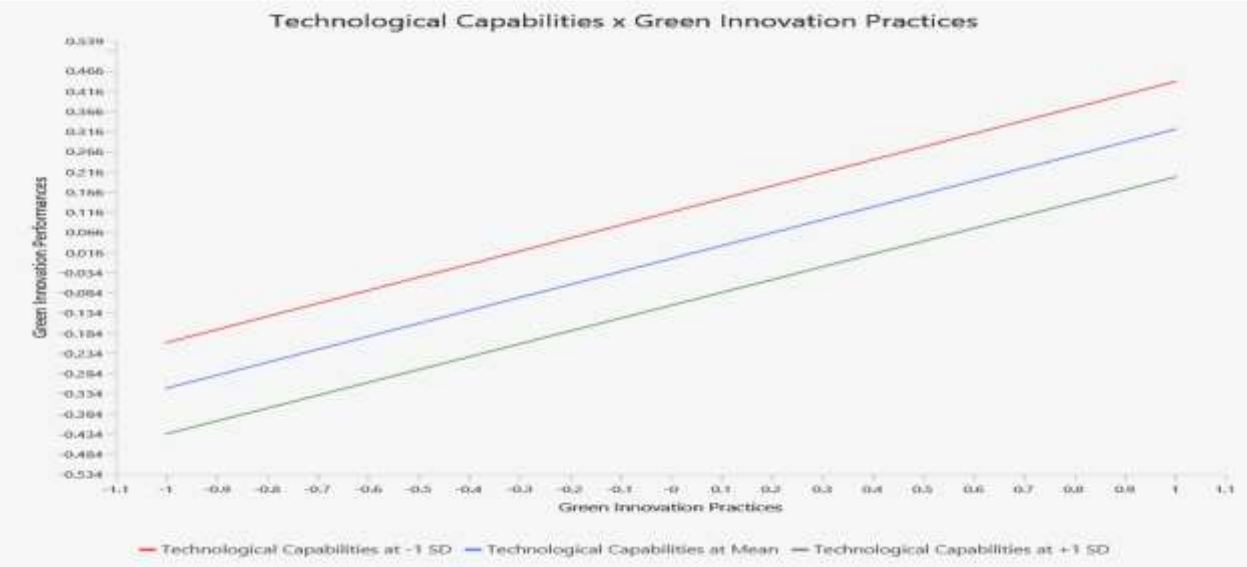

Figure 3. TEC. Demonstrates in further depth the TEC interaction diagram between GIP and GNP.

The graph shows that higher levels of TEC activity do not enhance the interactions between GIP and GNP levels.

Figure 4 shows how TEC can moderate the relationship between GOC and GNP. Demonstrates in further depth the TEC interaction diagram between GOC and GNP. The graph illustrates how increased TEC activity levels may strengthen the interactions between GOC and raise GNP levels, and **Figure 5** shows the structural output.

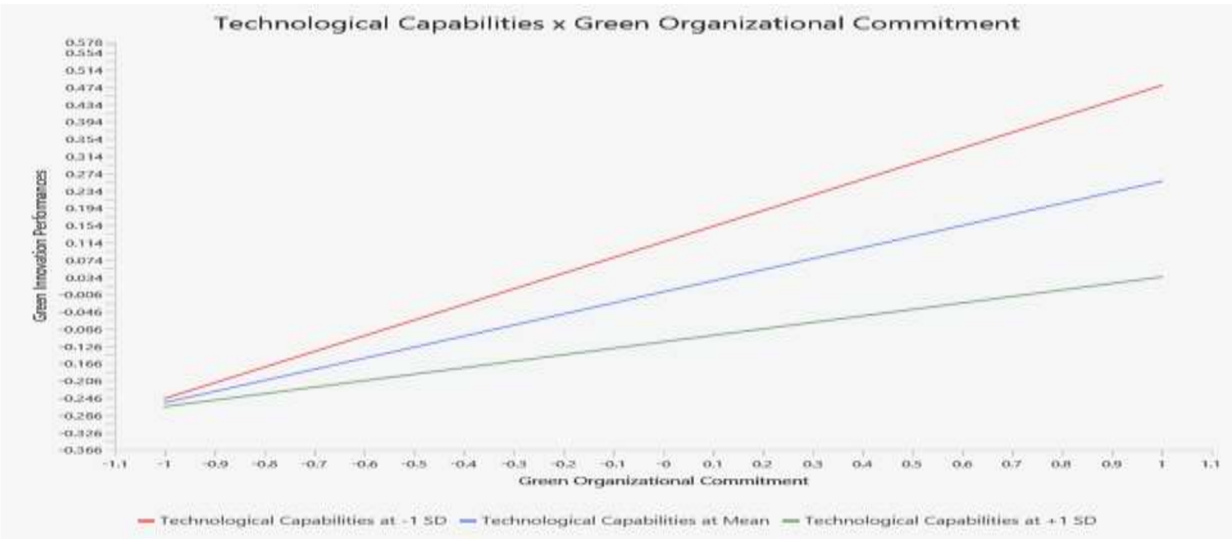

Figure 4. The influence of TEC in moderating the interplay between GOC and GNP.

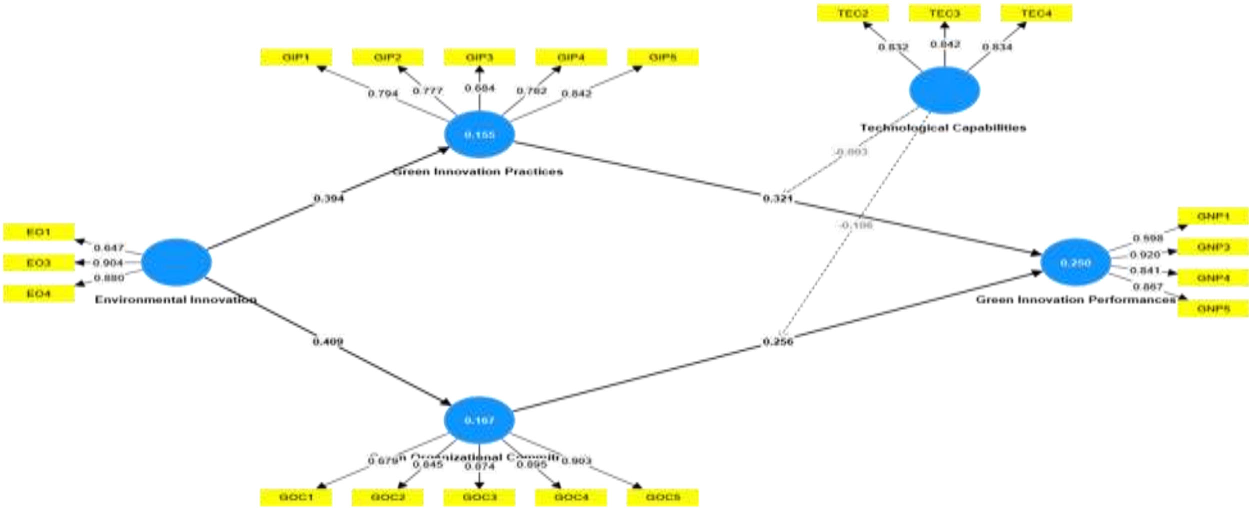

Figure 5. Structural output.

5. Discussion of empirical outcomes

The study examined the noteworthy role played by SMEs, which contribute to more than 70% of the GDP. A rigorous theoretical investigation developed a complete framework explaining the beneficial effect of environmental orientation (EO) on GIP and, ultimately, GNP. Eight hypotheses were developed in the research, two of which had direct impacts, two of which had indirect effects, and two had moderation effects. In line with the results of Wang and Ozturk [56], the first direct hypothesis (H1) evaluated the effect of EO on GIP and found a substantial constructive impact (Beta = 0.394; p = 0.000: p < 0.05). In line with other studies [56–58], hypothesis H2 also found a significant association between environmental orientation and green organizational commitment (GOC) (Beta = 0.409; p = 0.000: p < 0.05). Research by Zhang et al. [94], Khan et al. [66], confirmed the positive link (Beta = 0.321; p = 0.000: p < 0.05) found in Hypothesis H3's investigation of the relationship between GIP and GNP. Furthermore, H4 found that green organizational commitment (GOC) has a positive and substantial bearing on GNP (Beta = 0.256; p = 0.000: p < 0.05; $f2$ = 0.256), which supports other studies [60–63]. Moreover, via environmental orientation (EO), the paper discovered an indirect link between green innovation practices (GIP) and GNP (Beta = 0.127; p = 0.001: p < 0.05), which is backed by Jory's research [70–73]. Similarly, Cheng et al. [23], confirm the substantial mediating impact of green organizational commitment (GOC) between EO and GNP (Beta = 0.105; p = 0.000: p < 0.05). The last set of hypotheses, H7 and H8, examined the moderating effects and found that, although TEC did not significantly moderate the link between GIP and GNP (Beta = −0.003; p = 0.478; p > 0.05), it had a substantial adverse effect on the relationship between GOC and GNP (Beta = −0.106; p = 0.013: p < 0.05; $F2$ = 0.107). Overall, every direct hypothesis showed arithmetic implication (p-value < 0.05 and t-value > 2) and a positive route coefficient. The moderation interaction graph shown in **Figures 3** and **4** highlighted the significant moderating influence of TEC between GOC and GNP, highlighting the combined impact of all variables on the green innovation culture and overall performance.

5.1. Theoretical implications

This paper significantly increases the understanding of green innovation performance (GIP) by merging the Dynamic Capabilities View (DCV) with the Resource-Based View (RBV) [40–44]. This integration offers a framework that defines the complicated relationships among a company's resources, competencies, and environmental strategies, providing a stronger theoretical foundation for learning how organizations may generate remarkable achievements in green innovation. The RBV claims that having rare, valuable, distinctive, non-substitutable resources gives businesses a competitive advantage. This article enhances the RBV by stressing fundamental intangible resources driving green innovation, environmental orientation (EO), and green organizational commitment (GOC). EO captures an enterprise's strategic focus on environmental sustainability from both within and outside viewpoints. Strong EO guarantees internal integration of sustainability into operational systems, corporate culture, and strategic goals. Externally, it is proactive involvement to encourage cooperative solutions to environmental challenges, including stakeholders like suppliers, customers, authorities, and community groups. On the other hand, GOC, for the corporate commitment to environmental goals, motivates the acceptance and utilization of green technology in all business sectors. This twofold focus on EO and GOC highlights the need for organizational commitment and strategic direction in promoting green innovation. Highlighting a company's resources, competencies, and performance in helping businesses to adjust, combine, and restructure internal and external capabilities in response to rapidly altering surroundings, the DCV balances the RBV. Technical capabilities (TEC) are underlined in this study as a dynamic ability enhancing a corporation's potential to use green technologies effectively. It is shown that TEC is a moderating factor improving the effect of EO and GOC on green innovation performance (GNP). Strong TEC companies can more quickly adapt and use sustainable technologies and practices, producing superior outcomes of green innovation. From their perspective, this outcome underlines the importance of dynamic talents in transforming passive resources into active tactics that foster competitiveness and creativity. Moreover, the studies provide real statistics demonstrating that businesses with high TEC and strong EO and GOC are better suited for green innovation growth. This highlights the harmonic interplay among these elements and suggests that the mix of EO, GOC, and TEC creates a comprehensive framework, increasing the potential of a firm to attain sustainable innovation. This theoretical integration offers a framework that considers the stationary resources and the dynamic skills required for green innovation, enhancing the debate on sustainable business practices. Stressing the organizational culture role and stakeholder participation play in promoting green innovation, the research adds to the more general knowledge pool on strategic management and creativity. It underlines that EO and GOC are active, strategic resources rather than just passive features that, with appropriate utilization of dynamic technology capabilities, may cause a major rise in GNP. This outcome suggests that businesses should address sustainability holistically, combining strategic viewpoints, organizational dedication, and technological capability to generate exceptional outcomes of green innovation. Furthermore, the context-specific findings of the studies provide a perceptive assessment of the distinctive challenges and opportunities businesses in underdeveloped countries such as Ghana face. It underlines the requirement of tailoring green innovation approaches to the local environment, given components like stakeholder expectations, resource constraints, and regulatory settings. This study offers an detailed understanding of the associations between resources, abilities, and environmental projects, helping develop more effective and context-sensitive green innovation frameworks. Besides the method in which RBV and DCV are merged, the study offers a multi-level analysis of green innovation performance, including industry-level and firm-level elements. This approach recognizes that in addition to internal resources and competencies, institutional restrictions and outside industry dynamics influence the success of green innovation. The research suggests that industry-level factors like legislative frameworks, market demand for green products, and competition intensity greatly influence the effectiveness of a firm's green innovation activities. This multi-level perspective emphasizes the need for a comprehensive strategy incorporating macro- and micro-level impacts, challenging the theoretical understanding of green innovation. Within the perspective of green innovation, the study also provides a theoretical basis for the design of new measurement scales for EO, GOC, and TEC. These scales might be used in further research to assess how these elements affect the success of green innovation in many different industries and geographical locations. Using the construction and validation of these measuring scales, the study serves to enhance empirical research in the field of green innovation by thus optimizing theoretical concepts. Likewise, the studies help to grasp the temporal dynamics of green innovation and suggest that the interplay among EO, GOC, TEC, and GNP might evolve with time. This temporal perspective highlights the significance of longitudinal research in catching the dynamic nature of green innovation processes. Future research might extend this temporal component by examining how changes in EO, GOC, and TEC influence green innovation performance throughout many periods of a company’s life. Finally, this study’s theoretical contributions include integrating the RBV and DCV to provide a framework for controlling green innovation performance. Using the identification of EO, GOC, and TEC as basic elements of this framework, the study may provide a sophisticated picture of the dynamic interplay among resources, capabilities, and environmental strategies. This integration provides insightful analysis for academics and professionals striving to enhance sustainable business practices and helps strengthen the theoretical dialogue on green innovation. The research’s multi-level, context-specific, temporal elements give a good platform for further research in this emerging area and raise the theoretical understanding of green innovation.

5.2. Managerial implications

This paper’s findings have real-world implications for managers, particularly those working for SMEs in underdeveloped nations like Ghana. These effects could guide managers in creating strategies that enhance the output of green innovation and support environmentally friendly growth. Above all, the firm should be very environmentally oriented (EO). Managers within the company culture should focus intensely on the surroundings. One may use extensive training courses that teach staff members the significance of sustainability and their role in obtaining it. Internal policies should support environmentally friendly behavior like waste reduction, energy conservation, and substituting greener products for others. Creating cross-functional teams focused on sustainability initiatives helps managers ensure that environmental goals penetrate every aspect of the business. Externally, to collectively address environmental issues, one should engage with stakeholders, including suppliers, customers, local businesses, and legal authorities. This might include working with suppliers to produce greener products or local populations on environmental preservation projects. Potent outside EO enables businesses to get approval from many stakeholders and enhance their reputation.

Second, the corporation should have a green organizational commitment (GOC) strategic structure. Managers have to ensure that the business strategy framework integrates environmental sustainability. This means carefully stating measurable environmental goals and regularly assessing development toward them. Managers could set an example by supporting environmentally friendly initiatives and demonstrating their commitment to sustainability. Staff participation in environmental initiatives has to be encouraged relatively highly. Managers might implement initiatives rewarding staff members for assisting in reaching sustainability objectives such as green idea submission systems or energy-saving competitions. Encouragement of a culture aimed at environmental goals helps managers urge staff members to adopt and actively disseminate green techniques.

Thirdly, supporting technical capacities (TEC) will help improve the effectiveness of green innovation strategies. It is essential to invest in modern technologies promoting green innovation. This includes changing to energy-efficient appliances, renewable energy sources, and digital technology, promoting environmentally responsible living. Managers should assess their current technological capability and identify areas where changes might significantly impact the surroundings. Managers should also participate in industry consortia and investigate collaborative initiatives with technical partners to remain current on the most recent advancements in green technologies. Using access to new technologies and best practices, these partnerships may enable businesses to raise their capacity for green innovation. Finally, for Ghanaian SMEs, local adaptation of these strategies is essential. Ghanaian managers of SMEs must adapt their strategies to match the specific circumstances. This might involve working with local government agencies on environmental initiatives or building green supply chains with local vendors. Given SMEs' budgetary constraints, managers should seek innovative, reasonably priced approaches to increase their environmental performance. Executives should also engage politicians to advocate ecologically friendly laws and incentives supporting green creativity. Working closely with government agencies lets managers work to modify the surroundings of these operations, therefore supporting sustainable business practices. Using these tailored strategies, managers of SMEs may significantly improve the performance of green innovation, therefore fostering environmental sustainability and economic growth. These management implications provide a road map for employing EO, GOC, and TEC to attain long-term sustainability and competitive advantage in the quickly changing international market.

6. Conclusion

Green organizational performance has forced globally active enterprises to continuously improve their green product, process, and commitment skills, use GIP to prevent environmental degradation, and advance firm innovation performance. Therefore, using the perspectives of stakeholders and the lenses of EO, GIP, GOC, and TEC, this study categorizes the critical elements that contribute to green innovation or organizational performance. The information suggests that environmental orientations, both internal and external, have a substantial and beneficial effect on green innovation practices, which then augment and raise the performance of the firm in green innovation. Achieving improved greener performance largely depends on other governmental actions and institutional strategies for becoming green. Additionally, our research shows that companies that combine technological prowess with environmentally conscious organizational commitments do better. Furthermore, our data demonstrate that GOC and GIP practices positively and significantly indirectly impact GNP. The paper suggests a strong link between green innovation performance and EO, GIP, and GOC. Additionally, the findings demonstrate that while having a negative coefficient value, the moderating impact of TEC was statistically significant. The paper also offers important takeaways and suggestions for managers and legislators.

Limitations and recommendations

Boosting innovation is vital for enterprises in emerging countries' survival. While our research gives insights, it has limits. Conducted in Ghana, it ignores small cities. Industry conventions may constrain CEOs' opinions on Green Innovation Practices (GIP). We urge replication in varied situations for broader relevance. Future studies should incorporate stakeholder viewpoints, market dynamics, and effects of HR policies. Further investigation of moderating impacts is also required.

Author contributions: Conceptualization, MPF; methodology, MPF and FAK; software, FAK; validation, JW, SAB and JA; formal analysis, MPF and FAK; investigation, FAK; resources, MPF; data curation, SAB, AO and JW; writing—original draft preparation, MPF; writing—review and editing, MPF and JW; visualization, FAK; supervision, JW, JA and AO. All authors have read and agreed to the published version of the manuscript.

Conflict of interest: The authors declare no conflict of interest.

References

1. Aboelmaged M. Direct and indirect effects of eco-innovation, environmental orientation and supplier collaboration on hotel performance: An empirical study. Journal of Cleaner Production. 2018; 184: 537-549. doi: 10.1016/j.jclepro.2018.02.192
2. Aboelmaged M, Hashem G. Absorptive capacity and green innovation adoption in SMEs: The mediating effects of sustainable organisational capabilities. Journal of Cleaner Production. 2019; 220: 853-863. doi: 10.1016/j.jclepro.2019.02.150
3. Afzal CM, Khan SN, Baig FJ, et al. Impact of Green Human Resource Management on Environmental Performance: the Mediating Role of Green Innovation and Environmental Strategy in Pakistan. Review of Applied Management and Social Sciences. 2023; 6(2): 227-242. doi: 10.47067/ramss.v6i2.311

4. Ahmad Zaidi MF, Othman SN. Understanding the concept of dynamic capabilities by dismantling Teece, Pisano, and Shuen's (1997) definition. International Journal of Academic Research in Business and Social Sciences. 2012; 2(8): 367-378.
5. Ahmed RR, Akbar W, Aijaz M, et al. The role of green innovation on environmental and organizational performance: Moderation of human resource practices and management commitment. Heliyon. 2023; 9(1): e12679. doi: 10.1016/j.heliyon.2022.e12679
6. Albort-Morant G, Leal-Millán A, Cepeda-Carrión G. The antecedents of green innovation performance: A model of learning and capabilities. Journal of Business Research. 2016; 69(11): 4912-4917. doi: 10.1016/j.jbusres.2016.04.052
7. Alraja MN, Imran R, Khashab BM, et al. Technological Innovation, Sustainable Green Practices and SMEs Sustainable Performance in Times of Crisis (COVID-19 pandemic). Information Systems Frontiers. 2022; 24(4): 1081-1105. doi: 10.1007/s10796-022-10250-z
8. Momayez A, Rasouli N, Alimohammadirokni M, et al. Green entrepreneurship orientation, green innovation and hotel performance: the moderating role of managerial environmental concern. Journal of Hospitality Marketing & Management. 2023; 32(8): 981-1004. doi: 10.1080/19368623.2023.2225495
9. Bai X, Lyu C. Environmental Information Disclosure and Corporate Green Innovation: The Moderating Effect of Formal and Informal Institutions. Sustainability. 2023; 15(7): 6169. doi: 10.3390/su15076169
10. Banerjee SB. Corporate environmentalism: the construct and its measurement. Journal of Business Research. 2002; 55(3): 177-191. doi: 10.1016/S0148-2963(00)00135-1
11. Barney J. Firm Resources and Sustained Competitive Advantage. Journal of Management. 1991; 17(1): 99-120. doi: 10.1177/014920639101700108
12. Barreto I. Dynamic Capabilities: A Review of Past Research and an Agenda for the Future. Journal of Management. 2009; 36(1): 256-280. doi: 10.1177/0149206309350776
13. Becker B. Green Innovation Strategies, Innovation Success, and Firm Performance—Evidence from a Panel of Spanish Firms. Sustainability. 2023; 15(2): 1656. doi: 10.3390/su15021656
14. Cepeda G, Vera D. Dynamic capabilities and operational capabilities: A knowledge management perspective. Journal of Business Research. 2007; 60(5): 426-437. doi: 10.1016/j.jbusres.2007.01.013
15. Chan RYK. Corporate environmentalism pursuit by foreign firms competing in China. Journal of World Business. 2010; 45(1): 80-92. doi: 10.1016/j.jwb.2009.04.010
16. Chang CH. The Influence of Corporate Environmental Ethics on Competitive Advantage: The Mediation Role of Green Innovation. Journal of Business Ethics. 2011; 104(3): 361-370. doi: 10.1007/s10551-011-0914-x
17. Chen L, Yuan M, Lin H, et al. Organizational improvisation and corporate green innovation: A dynamic capability perspective. Business Strategy and the Environment. 2023; 32(8): 5686-5701. doi: 10.1002/bse.3443
18. Chen M, Liu H, Wei S, et al. Top managers' managerial ties, supply chain integration, and firm performance in China: A social capital perspective. Industrial Marketing Management. 2018; 74: 205-214. doi: 10.1016/j.indmarman.2018.04.013
19. Chen S, Wang J, Zhang Z. Enterprise Green Innovation Mechanism under the "Target-Resource-Network" System—An Empirical Study Based on Data of Listed Companies in China's Construction Industry. Sustainability. 2023; 15(4): 3687. doi: 10.3390/su15043687
20. Chen Y, Lin S, Lin C, et al. Improving green product development performance from green vision and organizational culture perspectives. Corporate Social Responsibility and Environmental Management. 2019; 27(1): 222-231. doi: 10.1002/csr.1794
21. Cheng Z, Wu B, Deng X, et al. Corrigendum: The impact of employees' pro-environmental behaviors on corporate green innovation performance: The mediating effect of green organizational identity. Frontiers in Psychology. 2023; 14. doi: 10.3389/fpsyg.2023.1130314
22. Dragomir VD. Corporate Environmental Strategy. Springer International Publishing; 2020.
23. Fahad S, Alnori F, Su F, et al. Adoption of green innovation practices in SMEs sector: evidence from an emerging economy. Economic Research-Ekonomska Istraživanja. 2022; 35(1): 5486-5501. doi: 10.1080/1331677x.2022.2029713
24. Fatoki O. Environmental Orientation and Green Competitive Advantage of Hospitality Firms in South Africa: Mediating Effect of Green Innovation. Journal of Open Innovation: Technology, Market, and Complexity. 2021; 7(4): 223. doi: 10.3390/joitmc7040223
25. Fraj-Andrés E, Martinez-Salinas E, Matute-Vallejo J. A Multidimensional Approach to the Influence of Environmental Marketing and Orientation on the Firm's Organizational Performance. Journal of Business Ethics. 2008; 88(2): 263-286. doi: 10.1007/s10551-008-9962-2

26. Fumey MP, Wiredu J, Essuman AN. Evaluating taxation’s dual impact on business and social development: A case study of the Cape Coast metropolis in Ghana. Financial Statistical Journal. 2024; 7(1). doi: 10.24294/fsj.v6i2.3833
27. Grindley PC, Teece DJ. Managing Intellectual Capital: Licensing and Cross-Licensing in Semiconductors and Electronics. California Management Review. 1997; 39(2): 8-41. doi: 10.2307/41165885
28. Gull M, Rashid M, Hassan S, et al. Role of top management green commitment, adaptability culture and green product innovation in boosting organizational green performance in Pakistan. Research Journal of Textile and Apparel. 2023; 28(4): 1066-1090. doi: 10.1108/rjta-12-2022-0159
29. Guo Y, Wang L, Yang Q. Do corporate environmental ethics influence firms’ green practice? The mediating role of green innovation and the moderating role of personal ties. Journal of Cleaner Production. 2020; 266: 122054. doi: 10.1016/j.jclepro.2020.122054
30. Hair JF, Ringle CM, Sarstedt M. PLS-SEM: Indeed a Silver Bullet. Journal of Marketing Theory and Practice. 2011; 19(2): 139-152. doi: 10.2753/mtp1069-6679190202
31. Hair JF, Ringle CM, Sarstedt M. Editorial - Partial Least Squares: The Better Approach to Structural Equation Modeling?. Long Range Planning. 2012; 45(5-6): 312-319.
32. Hair JF, Ringle CM, Sarstedt M. Editorial - Partial Least Squares Structural Equation Modeling: Rigorous Applications, Better Results and Higher Acceptance. Long Range Planning. 2013; 46(1-2): 1-12.
33. Hair JF, Sarstedt M, Pieper TM, et al. The Use of Partial Least Squares Structural Equation Modeling in Strategic Management Research: A Review of Past Practices and Recommendations for Future Applications. Long Range Planning. 2012; 45(5-6): 320-340. doi: 10.1016/j.lrp.2012.09.008
34. Hamann R, Smith J, Tashman P, et al. Why Do SMEs Go Green? An Analysis of Wine Firms in South Africa. Business & Society. 2016; 56(1): 23-56. doi: 10.1177/0007650315575106
35. Hameed Z, Naeem RM, Misra P, et al. Ethical leadership and environmental performance: The role of green IT capital, green technology innovation, and technological orientation. Technological Forecasting and Social Change. 2023; 194: 122739. doi: 10.1016/j.techfore.2023.122739
36. Hitt MA, Ireland RD, Camp SM, et al. Strategic entrepreneurship: entrepreneurial strategies for wealth creation. Strategic Management Journal. 2001; 22(6-7): 479-491. doi: 10.1002/smj.196
37. Iqbal S, Akhtar S, Anwar F, et al. Linking green innovation performance and green innovative human resource practices in SMEs; a moderation and mediation analysis using PLS-SEM. Current Psychology. 2021; 42(13): 11250-11267. doi: 10.1007/s12144-021-02403-1
38. Khan MAS, Du J, Malik HA, et al. Green innovation practices and consumer resistance to green innovation products: Moderating role of environmental knowledge and pro-environmental behavior. Journal of Innovation & Knowledge. 2022; 7(4): 100280. doi: 10.1016/j.jik.2022.100280
39. Khan MT, Idrees MD, Rauf M, et al. Green Supply Chain Management Practices’ Impact on Operational Performance with the Mediation of Technological Innovation. Sustainability. 2022; 14(6): 3362. doi: 10.3390/su14063362
40. Lee H, Peirsman Y, Chang A, et al. Stanford’s Multi-Pass Sieve Coreference Resolution System at the CoNLL-2011 Shared Task. In: Proceedings of the 15th Conference on Computational Natural Language Learning: Shared Task; 23-24 June 2011; Portland, Oregon.
41. Lestari ER, Sunyoto NMS. Fostering green innovation in achieving sustainable performance. Natural Resources Forum. 2023; 47(3): 413-434. doi: 10.1111/1477-8947.12293
42. Li B, Lei Y, Hu M, et al. The Impact of Policy Orientation on Green Innovative Performance: The Role of Green Innovative Capacity and Absorptive Capacity. Frontiers in Environmental Science. 2022; 10. doi: 10.3389/fenvs.2022.842133
43. Li C, Zhang Z, De Sisto M, et al. Environmental Practices, Digitalization, and Green Innovation in Multinational Firms. Journal of Global Information Management. 2023; 31(1): 1-16. doi: 10.4018/jgim.323183
44. Li D, Zheng M, Cao C, et al. The impact of legitimacy pressure and corporate profitability on green innovation: Evidence from China top 100. Journal of Cleaner Production. 2017; 141: 41-49. doi: 10.1016/j.jclepro.2016.08.123
45. Li H. Green Innovation, Green Dynamic Capability, and Enterprise Performance: Evidence from Heavy Polluting Manufacturing Enterprises in China. Zhang W, ed. Complexity. 2022; 2022(1). doi: 10.1155/2022/7755964
46. Li X, Yang J, Liu H, et al. Entrepreneurial orientation and green management in an emerging economy: The moderating effects of social legitimacy and ownership type. Journal of Cleaner Production. 2021; 316: 128293. doi: 10.1016/j.jclepro.2021.128293

47. Li X, Zeng W, Xu M. The Moderating Role of IT Capability on Green Innovation and Ambidexterity: Towards a Corporate Sustainable Development. Sustainability. 2022; 14(24): 16767. doi: 10.3390/su142416767
48. Liao Y, Deschamps F, Loures E de FR, et al. Past, present and future of Industry 4.0 - a systematic literature review and research agenda proposal. International Journal of Production Research. 2017; 55(12): 3609-3629. doi: 10.1080/00207543.2017.1308576
49. Lin H, Zeng SX, Ma HY, et al. Can political capital drive corporate green innovation? Lessons from China. Journal of Cleaner Production. 2014; 64: 63-72. doi: 10.1016/j.jclepro.2013.07.046
50. Luo X, Abbas A, Wattoo MU, et al. Organizational Behavior in Green Supply Chain Integration: Nexus Between Information Technology Capability, Green Innovation, and Organizational Performance. Frontiers in Psychology. 2022; 13. doi: 10.3389/fpsyg.2022.874639
51. Mady K, Abdul Halim MAS, Omar K, et al. Institutional pressure and eco-innovation: The mediating role of green absorptive capacity and strategically environmental orientation among manufacturing SMEs in Egypt. Cogent Business & Management. 2022; 9(1). doi: 10.1080/23311975.2022.2064259
52. Menguc B, Ozanne LK. Challenges of the "green imperative": a natural resource-based approach to the environmental orientation–business performance relationship. Journal of Business Research. 2005; 58(4): 430-438. doi: 10.1016/j.jbusres.2003.09.002
53. Mitchell S, Dimache A, O'Dowd P. Environmental challenges for European manufacturing SMEs. In: Proceedings of the International Manufacturing Conference IMC27; 2010.
54. Mondéjar-Jiménez J, Segarra-Oña M, Peiró-Signes Á, et al. Segmentation of the Spanish automotive industry with respect to the environmental orientation of firms: towards an ad-hoc vertical policy to promote eco-innovation. Journal of Cleaner Production. 2015; 86: 238-244. doi: 10.1016/j.jclepro.2014.08.034
55. Mose N, Fumey M, Kipchirchir E. Drivers of Carbon Emissions in Kenya: The Perspective of Technology. Asian Journal of Geographical Research. 2024; 7(2): 1-10. doi: 10.9734/ajgr/2024/v7i2226
56. Mukhtar B, Shad MK, Woon LF. Predicting the Effect of Environment, Social and Governance Practices on Green Innovation: An Artificial Neural Network Approach. In: Proceedings of the International Conference on Information Systems and Intelligent Applications; 2022.
57. Ogiemwonyi O, Alam MN, Hago IE, et al. Green innovation behaviour: Impact of industry 4.0 and open innovation. Heliyon. 2023; 9(6): e16524. doi: 10.1016/j.heliyon.2023.e16524
58. Pacheco DA de J, ten Caten CS, Jung CF, et al. Eco-innovation determinants in manufacturing SMEs: Systematic review and research directions. Journal of Cleaner Production. 2017; 142: 2277-2287. doi: 10.1016/j.jclepro.2016.11.049
59. Pandithasekara D. Green Innovation Practices and Its Impact on Organizational Performance: Evidence from Apparel Industry of Sri Lanka. International Journal of Research Publication and Reviews; 2022.
60. Peng YS, Lin SS. Local Responsiveness Pressure, Subsidiary Resources, Green Management Adoption and Subsidiary's Performance: Evidence from Taiwanese Manufactures. Journal of Business Ethics. 2007; 79(1-2): 199-212. doi: 10.1007/s10551-007-9382-8
61. Rehan M, Hussain Y, Khan J, et al. Top management green commitment, green process innovation and green intellectual capital as enablers of hotel environmental performance: The mediating role of green human resource management. Research square; 2023.
62. Rehman SU, Elrehail H, Poulin M, et al. Green managerial practices and green performance: A serial mediation model. International Journal of Innovation Studies. 2023; 7(3): 196-207. doi: 10.1016/j.ijis.2022.12.004
63. Xiao R, Ding J, Qian L. Review on the Green Innovation Performance Evaluation. Journal of Guizhou University of Finance and Economics. 2017; 35(02): 100.
64. Riani AL, Subanti S, Islamiyah. Improving green innovation performance by smes in indonesia. Journal of Southwest Jiaotong University. 2022; 57(6): 167-181. doi: 10.35741/issn.0258-2724.57.6.15
65. Richter NF, Hauff S, Ringle CM, et al. The Use of Partial Least Squares Structural Equation Modeling and Complementary Methods in International Management Research. Management International Review. 2022; 62(4): 449-470. doi: 10.1007/s11575-022-00475-0
66. Ruan R, Chen W, Zhu Z. Linking Environmental Corporate Social Responsibility with Green Innovation Performance: The Mediating Role of Shared Vision Capability and the Moderating Role of Resource Slack. Sustainability. 2022; 14(24): 16943. doi: 10.3390/su142416943

67. Boateng SA, Karikari FA, Fumey MP, et al. Understanding Global Commodity Price Shocks on Exchange Rates and Inflation in Emerging Economies: ARDL Perspective. Journal of Economics, Management and Trade. 2024; 30(5): 33-47. doi: 10.9734/jemt/2024/v30i51208
68. Shahriari M, Tajmir Riahi M, Azizan O, et al. The effect of green organizational culture on organizational commitment: The mediating role of job satisfaction. Journal of Human Behavior in the Social Environment. 2022; 33(2): 180-197. doi: 10.1080/10911359.2022.2029789
69. Shuwaikh F, Benkraiem R, Dubocage E. Investment in Green Innovation: How does It Contribute to Environmental and Financial Performance? Journal of Innovation Economics & Management. 2023; N° 41(2): 107-149. doi: 10.3917/jie.pr1.0137
70. Singh D, Pandey A. Green HRM: An organizational commitment. JIMS8M: The Journal of Indian Management & Strategy. 2020; 25(1): 14. doi: 10.5958/0973-9343.2020.00002.2
71. Soewarno N, Tjahjadi B, Fithrianti F. Green innovation strategy and green innovation. Management Decision. 2019; 57(11): 3061-3078. doi: 10.1108/md-05-2018-0563
72. Song W, Yu H. Green Innovation Strategy and Green Innovation: The Roles of Green Creativity and Green Organizational Identity. Corporate Social Responsibility and Environmental Management. 2017; 25(2): 135-150. doi: 10.1002/csr.1445
73. Su J, He J. Does Giving Lead to Getting? Evidence from Chinese Private Enterprises. Journal of Business Ethics. 2009; 93(1): 73-90. doi: 10.1007/s10551-009-0183-0
74. Tahir R, Athar MR, Faisal F, et al. Green Organizational Culture: A Review of Literature and Future Research Agenda. Annals of Contemporary Developments in Management & HR. 2019; 1(1): 23-38. doi: 10.33166/acdmhr.2019.01.004
75. Tseng ML, Wang R, Chiu ASF, et al. Improving performance of green innovation practices under uncertainty. Journal of Cleaner Production. 2013; 40: 71-82. doi: 10.1016/j.jclepro.2011.10.009
76. Vargas-Hernández JG, Maillard CAR, Vargas-González OC. Green Organizational Culture, Green Innovation, and Green Performance for Achieving Environmental Sustainability. In: Handbook of Research on Promoting an Inclusive Organizational Culture for Entrepreneurial Sustainability. IGI Global; 2022.
77. Vargas-Hernández JG, Vargas-González OC. Organizational Innovation Approach to Green Technological Innovation. In: Intellectual Capital as a Precursor to Sustainable Corporate Social Responsibility. IGI Global; 2023.
78. Vargas-Hernandez JG, Higuera-Cota MF, Vargas-González OC. Organizational Socio-Ecology and Green Technological Innovation. In: Intersecting Health, Livability, and Human Behavior in Urban Environments. IGI Global; 2023.
79. Wang H, Khan MAS, Anwar F, et al. Green Innovation Practices and Its Impacts on Environmental and Organizational Performance. Frontiers in Psychology. 2021; 11. doi: 10.3389/fpsyg.2020.553625
80. Wang H, Qian C. Corporate Philanthropy and Corporate Financial Performance: The Roles of Stakeholder Response and Political Access. Academy of Management Journal. 2011; 54(6): 1159-1181. doi: 10.5465/amj.2009.0548
81. Wang N, Zhang J, Zhang X, et al. How to Improve Green Innovation Performance: A Conditional Process Analysis. Sustainability. 2022; 14(5): 2938. doi: 10.3390/su14052938
82. Wang S, Abbas J, Sial MS, et al. Achieving green innovation and sustainable development goals through green knowledge management: Moderating role of organizational green culture. Journal of Innovation & Knowledge. 2022; 7(4): 100272. doi: 10.1016/j.jik.2022.100272
83. Wang Y, Ozturk I. Role of green innovation, green internal, and external supply chain management practices: a gateway to environmental sustainability. Economic Research-Ekonomska Istraživanja. 2023; 36(3). doi: 10.1080/1331677x.2023.2192769
84. Weaver DC, Workman C, Stormo GD. Modeling regulatory networks with weight matrices. World Scientific; 1998.
85. Wei F, Abbas J, Alarifi G, et al. Role of green intellectual capital and top management commitment in organizational environmental performance and reputation: Moderating role of pro-environmental behavior. Journal of Cleaner Production. 2023; 405: 136847. doi: 10.1016/j.jclepro.2023.136847
86. Wiredu J, Yang Q, Sampene AK, et al. Key Barriers for Bioenergy Projects Implementation: A fresh insight from Ghana. International Journal of Scientific and Management Research. 2022; 05(04): 237-256. doi: 10.37502/ijsmr.2022.5418
87. Wiredu J, Yang Q, Saljoughipour S, et al. Stimulating environmental performance through green human resource practice: Does green transformational leadership matter? Journal of Infrastructure, Policy and Development. 2023; 7(1): 2127. doi: 10.24294/jipd.v7i1.2127
88. Wiredu J, Yang Q, Lu T, et al. Delving into environmental pollution mitigation: does green finance, economic development,

renewable energy resource, life expectancy, and urbanization matter? In: Environment, Development and Sustainability. Open University Press; 2025.

89. Wiredu J, Yang Q, Sampene AK, et al. Economic Advancement and Renewable Energy Transition: Exploring the Integral Role of Trade Openness, Digital Transition, and Urbanization Among the NAFTA Economies. Springer Nature; 2024.
90. Xing X, Wang J, Tou L. The Relationship between Green Organization Identity and Corporate Environmental Performance: The Mediating Role of Sustainability Exploration and Exploitation Innovation. International Journal of Environmental Research and Public Health. 2019; 16(6): 921. doi: 10.3390/ijerph16060921
91. Xu N, Fan X, Hu R. Adoption of Green Industrial Internet of Things to Improve Organizational Performance: The Role of Institutional Isomorphism and Green Innovation Practices. Frontiers in Psychology. 2022; 13. doi: 10.3389/fpsyg.2022.917533
92. Xu X, Cheng M, Zhang K. Driving mechanism of low-carbon innovation: based on the perspective of green entrepreneurship orientation and innovation flexibility. Advances in Economics and Management Research. 2023; 3(1): 106. doi: 10.56028/aemr.3.1.106
93. Yang H, Zhu X. Research on Green Innovation Performance of Manufacturing Industry and Its Improvement Path in China. Sustainability. 2022; 14(13): 8000. doi: 10.3390/su14138000
94. Yin J, Li C. Data governance and green technological innovation performance: A curvilinear relationship. Journal of Cleaner Production. 2022; 379: 134441. doi: 10.1016/j.jclepro.2022.134441
95. Zahra SA, Sapienza HJ, Davidsson P. Entrepreneurship and Dynamic Capabilities: A Review, Model and Research Agenda*. Journal of Management Studies. 2006; 43(4): 917-955. doi: 10.1111/j.1467-6486.2006.00616.x
96. Zehir C, Ozgul B. Environmental orientation and firm performance. International Journal of Research in Business and Social Science (2147- 4478). 2020; 9(5): 13-25. doi: 10.20525/ijrbs.v9i5.883
97. Zhang JA, Walton S. Eco-innovation and business performance: the moderating effects of environmental orientation and resource commitment in green-oriented SMEs. R&D Management. 2016; 47(5). doi: 10.1111/radm.12241
98. Zhang X, Song Y, Zhang M. Exploring the relationship of green investment and green innovation: Evidence from Chinese corporate performance. Journal of Cleaner Production. 2023; 412: 137444. doi: 10.1016/j.jclepro.2023.137444