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Green leadership for a sustainable future: The path from innovation to enhanced project performance

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Abstract

The effectiveness of green initiatives has emerged as a crucial goal for entities seeking to balance economic growth with environmental responsibility. This study examines how green horizontal leadership impacts the performance of green projects, emphasizing the mediating roles of green proactive innovation and green reactive innovation. This study investigates the role of leadership in fostering innovation and enhancing sustainability outcomes through the application of stewardship theory, organizational learning theory, and the resource-based view (RBV). A quantitative survey was conducted among enterprises in Jiangsu Province, China, a region noted for its industrial and economic development alongside its increasing environmental initiatives. Leadership, innovation, and project performance were examined using structural equation modeling. Green horizontal leadership promotes green project performance by mediating proactive and reactive innovation. Participatory and decentralized leadership styles improve environmental outcomes through strategic and compliance-focused sustainability programs. Merging multiple views, the study provides theoretical insights into leadership and environmental sustainability success. Organizations seeking sustainability through leadership development, investment in green innovations, and flexible laws have demonstrable results. Future research will expand the study's geographic coverage and examine other mediating factors that affect leadership, innovation, and performance.

Keywords:
Green horizontal leadership
Green innovation
Green project performance
Stewardship theory
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1. Introduction

Rising environmental challenges, government regulations, and public expectations have made sustainability a priority for worldwide corporations (Camilleri, 2017). Senior leadership should support environmentally sustainable practices since organizations are under great pressure to follow them (Çop, Olorunsola, & Alola, 2021). Evaluating corporate sustainability initiatives now mostly relies on green project performance, which combines ecological efficiency, sustainability-driven innovation, and corporate environmental responsibility (Al-Nimer, 2024). A recent study emphasizes the significant impact of leadership styles on the effectiveness of green initiatives, noting that green horizontal leadership is increasingly recognized for its participatory and collaborative characteristics (Rafiq, Cham, Tapsir, Mansoor, & Farrukh, 2024). This leadership approach enhances staff empowerment, promotes collaborative decision-making, and develops a collective commitment to sustainability, thus improving the outcomes of environmental initiatives (Aravidou, Triantari, & Zervas, 2025).

Despite the increasing significance of sustainable leadership, the mechanisms by which green horizontal leadership influences the success of green initiatives remain inadequately explored (Çop et al., 2021). While existing research indicates that leadership affects environmental innovation (Li, Bhutto, Nasiri, Shaikh, & Samo, 2018), further investigation is necessary to elucidate the specific mechanisms connecting leadership practices to project performance (Para-González, Jiménez-Jiménez, & Martínez-Lorente, 2018). This paper develops organizational learning theory and stewardship theory to investigate how green horizontal leadership, via the mediating roles of green proactive and reactive innovation, helps to improve green project performance. While green reactive innovation is mostly compliance-driven and responds to external constraints such as regulations and market demands, green proactive innovation consists of voluntary, forward-looking projects aiming at environmental benefits (Al-Nimer, 2024).

Organizations striving to balance environmental responsibility with economic success must first grasp how, under a sustainability framework, innovation and project performance interact. By providing empirical insights on the purpose of green horizontal leadership in fostering innovation and achieving exceptional green project performance (Para-González et al., 2018), this study offers beneficial effects for both academics and practitioners by filling the void in the current literature.

Roome (2017) claims that companies all around the world are dealing with major environmental, ethical, and sustainability issues. Companies have to use green management techniques to lessen the effects of climate change and the loss of natural resources. Gürlek and Kılıç (2024) indicate that firms increasingly prioritize green project performance, encompassing ecological efficiency, sustainability-driven innovation, and corporate environmental accountability. The effectiveness of green initiatives depends on robust leadership. To enhance collaborative decision-making, teamwork, and individual accountability in achieving environmental objectives, green horizontal leadership is becoming increasingly significant (Li et al., 2018). Little is known about the mechanisms through which green horizontal leadership influences the success of green projects.

This study employs organizational learning theory and stewardship theory as its basis to explore the impact of green horizontal leadership on the performance of green projects. The specific area under examination is how green proactive and green reactive innovation may mediate.

As it relates to environmental issues, green reactive innovation is defined as actions driven by compliance or outside forces, whereas green proactive innovation is defined as proactive, forward-thinking endeavors (Al-Mamary, 2025). If you want your environmentally conscious organization to succeed, you must learn how sustainability, innovation, and leadership are all interrelated. This disparity sparked this investigation, which aims to resolve it by analyzing scientific data on these interactions.

2. Literature Review and Hypotheses

This section explores the conceptual foundations of green horizontal leadership, green innovation, and green project performance. It also presents the hypotheses that guide this study.

2.1. Green Horizontal Leadership and Green Project Performance

Green horizontal leadership helps a company's long-term performance improve. Through this management approach, employees are encouraged to express their ideas on how their choices affect the environmental impact of the business (Arfi, Hikkerova, & Sahut, 2018). Advocates of eco-friendly horizontal leadership argue that adopting principles like transparency, collective responsibility, and collaboration will strengthen a company's commitment to sustainability. A recent study indicates that the capacity of leadership to influence stakeholder engagement, resource allocation, and the execution of sustainable practices plays a crucial role in enhancing the effectiveness of green initiatives (Çop et al., 2021).

Moreover, a crucial element in cultivating a sustainability-oriented organizational culture is green horizontal leadership. Leaders promote green projects to flourish by supporting cooperation and knowledge exchange (Jayashree, El Barachi, & Hamza, 2022). Under horizontal leadership systems, employee empowerment also helps to create and implement green initiatives, improving environmental performance (Singh, Del Giudice, Chierici, & Graziano, 2020). The clear link between project performance and leadership emphasizes the need for leadership dedication to reaching sustainability goals.

H_1: Green horizontal leadership has a positive effect on green project performance.

2.2. Green Horizontal Leadership and Green Proactive Innovation

Green proactive innovation refers to the intentional and voluntary measures taken to create sustainable products, services, and processes (Chang, 2015). By encouraging proactive involvement from their team, leaders employing a green horizontal strategy cultivate a creative and environmentally aware culture. Green horizontal leadership fosters an environment that promotes proactive sustainability initiatives by facilitating experimentation and the exchange of knowledge (Farao, Bernuzzi, & Ronchetti, 2023).

Farao et al. (2023) assert that organizations emphasizing green proactive innovation seek to integrate sustainability into their long-term economic strategies. When leadership provides support and sustainability is woven into the core values of a company, employees are more inclined to suggest innovative and eco-friendly ideas (Fernando, Jabbour, & Wah, 2019). By optimizing organizational frameworks and fostering transparent dialogue about environmentally sustainable policies and practices, this approach enhances the strategy.

H_2: Green horizontal leadership positively influences green proactive innovation.

2.3. Green Horizontal Leadership and Green Reactive Innovation

In contrast to proactive innovation, green reactive innovation is influenced by external factors like regulatory mandates and market needs (Çop et al., 2021). Green horizontal leadership is crucial for enabling organizations to adapt effectively to external influences by cultivating a culture of responsiveness and compliance. Leaders who enable employees to assume responsibility for sustainability challenges can promote a more seamless shift to environmentally compliant business practices (Fernando et al., 2019).

Green reactive innovation enables businesses to adhere to environmental regulations and uphold sustainability standards (Genç & Benedetto, 2019). Organizations guided by green horizontal leaders demonstrate greater agility in adapting to environmental legislation and industry expectations, ensuring that essential adjustments are implemented effectively (Singh et al., 2020). Although reactive innovation might not yield instant competitive benefits, it enhances an organization's sustainability credentials and bolsters its corporate social responsibility profile.

H_3: Green horizontal leadership positively influences green reactive innovation.

2.4. Green Proactive Innovation and Green Project Performance

Integrating sustainability principles into the organization's core strategy is crucial for fostering proactive innovation aimed at enhancing the performance of green projects. Organizations that consistently seek innovative methods to enhance their operations and engage stakeholders are more inclined to discover sustainable solutions beneficial to both the environment and their financial performance (Cheng, 2020). A commitment to environmental stewardship and enduring project success can be realized through the proactive innovation derived from integrating sustainability into business practices (Cheng, 2020).

Organizations can create sustainable value chains through innovations cantered on sustainability, including energy-efficient technologies and circular economy models (Koval et al., 2023). Companies can enhance their profitability and progress towards sustainability through eco-friendly proactive innovation (Leyva-de la Hiz, Ferron-Vilchez, & Aragon-Correa, 2019). Moreover, enterprises dedicated to green innovation are more inclined to lead in sustainability within their sector.

H_4: Green proactive innovation has a positive effect on green project performance.

2.5. Green Reactive Innovation and Green Project Performance

Although reactive innovation is usually a reaction to regulatory compliance, it is also very important to ensure that green initiatives satisfy industry standards and societal expectations (Le, 2022). Companies that successfully apply green reactive innovation can maintain credibility, reduce environmental hazards, and improve their market share. Reactive innovation helps green initiatives to be overall effective by overcoming external environmental demands through organized innovation activities (Voegtlin, Scherer, Stahl, & Hawn, 2022).

Green reactive innovation helps organizations to remain consistent with fast changing environmental legislation and stakeholder expectations. Reactive approach execution can help to achieve a range of goals, including reducing the possibility of legal consequences, improving environmental responsibility, and preserving industry standards' compliance (Jayaraman, Jayashree, & Dorasamy, 2023). Companies can employ proactive sustainability measures as the basis for reactive innovation, often seen as a response to outside forces which will help them to succeed over the long run.

H_5: Green reactive innovation has a positive effect on green project performance.

2.6. The Mediating Role of Green Innovation

Turning green leadership goals into tangible sustainability outcomes requires proactive green innovation (Cheng, 2020). Green horizontal leaders help organizations to create an open and cooperative environment that motivates staff members to investigate sustainable methods and technologies (Singh et al., 2020). This proactive approach not only increases resource efficiency but also promotes continuous development in the execution of green projects (Koval et al., 2023). Companies that pursue green proactive innovation usually become more competitive in the market by differentiating their goods and services using ecologically friendly strategies (Farao et al., 2023). Furthermore, proactive innovation improves long-term organizational resilience by helping companies to predict legislative changes and adjust to growing sustainability criteria (Fernando et al., 2019).

Including innovation into leadership strategies, green proactive innovation is essential as a link between leadership projects with improved green performance.

A key means by which green horizontal leadership enhances green project performance is green proactive innovation (Chowdhury et al., 2022). Those who prioritize horizontal leadership create an open, creative culture that allows employees to engage in initiatives aimed at sustainability. This leadership style promotes information flow and helps develop creative sustainable solutions (Pichlak & Szromek, 2021). Companies that successfully incorporate proactive green innovation into their leadership strategies are more likely to improve their sustainability performance by reducing waste, optimizing resource efficiency, and utilizing environmentally sustainable technologies (Awwad, Anouze, & Elbanna, 2025). Green proactive innovation thus serves as a means of connecting leadership actions with the quantifiable success of green projects.

H_6: Green proactive innovation mediates the relationship between green horizontal leadership and green project performance.

Green reactive innovation enables organizations to maintain adaptability and comply with environmental requirements while effectively addressing external sustainability demands (Jayaraman et al., 2023). Reactive innovation, unlike proactive innovation, is often motivated by compliance standards and external stakeholder expectations (Chang, 2015), making it an essential element of sustainability planning. Green horizontal leadership fosters a dynamic and adaptable company culture that engages employees in efforts aimed at environmental compliance (Genç & Benedetto, 2019). Organizations can effectively execute reactive innovation through transparent communication and collaborative decision-making, thereby maintaining regulatory compliance without jeopardizing operational stability (Yang, Jiang, & Zhao, 2019). Green reactive innovation also helps companies reduce environmental hazards by means of process preemption to fit new policies and industry standards (Singh et al., 2020). Green reactive innovation promotes sustainability adherence while preserving corporate resilience in a dynamically changing corporate environment, hence strengthening the link between leadership and green project performance.

Green reactive innovation guarantees that companies follow environmental rules and react appropriately to demands from outside sustainability (Alnaim, Abdelwahed, & Soomro, 2022). Green horizontal leadership is largely responsible for encouraging a responsive corporate culture in which staff members are driven to quickly address legislative changes and stakeholder needs (Voegtlin et al., 2022). By giving group decision-making and shared responsibility top priority, this leadership style improves the capacity of the company to apply environmentally reactive innovations such as sustainable compliance techniques and pollution-reducing projects (Burki, 2018). Green reactive innovation finally helps to establish the link between leadership and project performance by ensuring that companies satisfy external sustainability criteria and hence reduce their long-term environmental impact (de Medeiros, Garlet, Ribeiro, & Cortimiglia, 2022).

H_7: Green reactive innovation mediates the relationship between green horizontal leadership and green project performance.

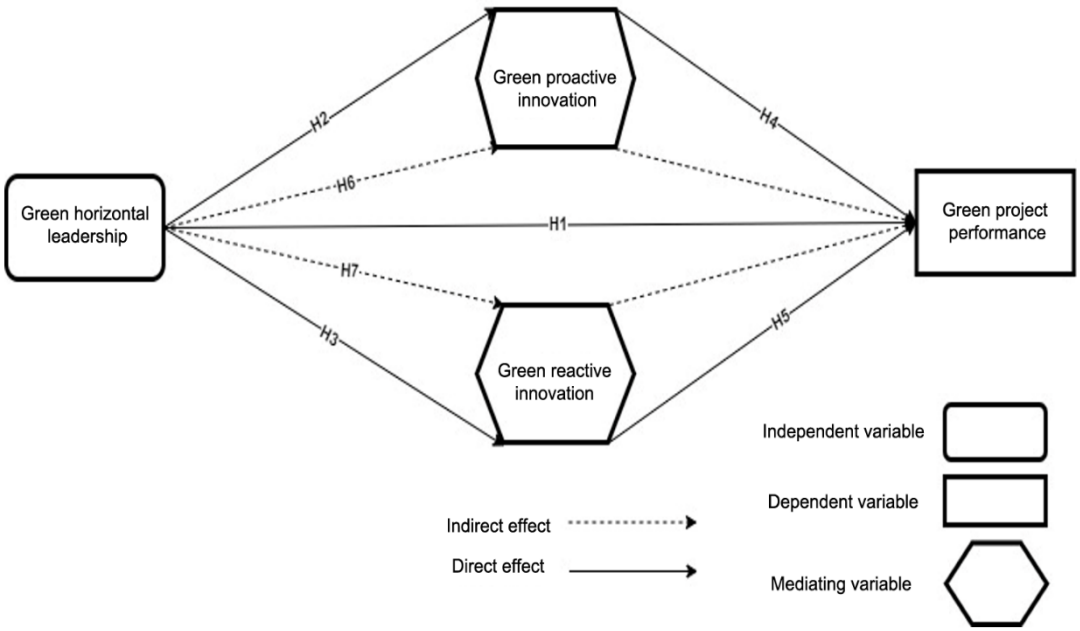

Figure 1. Theoretical framework.

Figure 1 explains the theoretical framework that explores how Green Horizontal Leadership (GHL) influences Green Project Performance (GPP), both directly and indirectly through Green Proactive Innovation (GPI) and Green Reactive Innovation (GRI). It suggests that empowering leadership fosters innovative behaviors, which in turn enhance green project outcomes in green construction projects.

3. Research Methodology

3.1. Data Collection

This study concentrated on a collection of businesses working on projects with an eye toward sustainability. The sample frame included companies in construction showing a strong dedication to environmental projects. Emphasizing organizations that have embraced environmental management systems and sustainability strategies, a stratified random sampling technique was used to guarantee a representative dataset (Altaf, Faraz, & Ahmed, 2016).

A multiple-respondent strategy was used to help reduce common technique bias (Podsakoff, Podsakoff, Williams, Huang, & Yang, 2024). While project managers assessed green innovation techniques and project performance results, senior managers in charge of sustainability projects responded regarding green horizontal leadership. This method made it possible to evaluate the relationships among the investigated variables more objectively.

An online survey tool was used for data collection; where needed, phone interviews augmented the process (Butt, Altaf, Chohan, & Ashraf, 2019). To guarantee familiarity with the sustainability projects of the company, respondents had to have at least two years of experience in their positions. With a response rate of 40%, the 58 companies that participated in the final sample fell within reasonable bounds for studies based on surveys (Holtom, Baruch, Aguinis, & A Ballinger, 2022).

3.2. Sampling Size and Technique

The nature of the present study was cross-sectional and investigated the construction projects of Jiangsu province, China. We selected 58 large construction industries as a population and 540 employees as a sample. A simple random sampling technique was used to gather data. We collected data with the help of a questionnaire through an online survey (Altaf, Li, Altaf, & Siddiqui, 2025; Fricker, 2008). We translated the questionnaires into two languages, English and Chinese, from professional translators to minimize bias (He & van de Vijver, 2012). Finally, we received 432 questionnaires from employees that were properly marked, and some of the questionnaires were discarded due to improper and incomplete filing of data.

Table 1. Demographics.

Respondents	Frequency	Percentage
Gender		
Male	304	70.37%
Female	128	29.62%
Age		
20–30 years	99	22.91%
31–40 years	230	53.24%
41–50 years	70	16.20%
> 50 years	33	7.63%
Years of professional experience		
Less than 3 years	21	4.86%
4-6 years	144	33.33%
7-10 years	181	41.89%
More than 10 years	86	29.60%
Position in firm		
CEO	15	3.47%
Senior manager	37	8.56%
Manager	91	21.06%
Assistant manager	185	42.82%
Other supervisory position	104	24.07%

The Table 1 summarizes the demographic and professional characteristics of the respondents. Out of the total, 70.37% were male and 29.62% female. The majority (53.24%) were aged between 31 and 40 years, followed by 22.91% aged 20–30, 16.20% aged 41–50, and 7.63% above 50 years. Regarding professional experience, most respondents (41.89%) had 7–10 years of experience, while 33.33% had 4–6 years, 29.60% had more than 10 years, and only 4.86% had less than 3 years. In terms of organizational position, assistant managers formed the largest group (42.82%), followed by those in other supervisory roles (24.07%), managers (21.06%), senior managers (8.56%), and CEOs (3.47%). This indicates that most respondents were mid-level professionals with substantial work experience.

3.3. Measures

The study designed a questionnaire with the help of guidelines mentioned in previous literature published by several researchers. In this study, we investigated two independent variables (Green Performance and Mastery Climates), one mediator variable (Green Innovation), and one dependent variable (Green Project Performance). The responses were collected using a Likert scale of 1 to 5 (strongly disagree to strongly agree) (Altaf et al., 2016).

3.4. Measurement Instruments

The Table 2 presents the study's key variables, measurement methods, and sources. Green Horizontal Leadership (GHL) is measured across three dimensions—social structures, individual dynamics, and context—based on a 12-item scale adapted from Zhu, Wang, Sun, Sun, and Müller (2019). These items assess delegation, leadership encouragement, and the role of experience in team coordination. Green Innovation (GI) includes Green Proactive Innovation (GPI) and Green Reactive Innovation (GRI), using scales from Chen, Chang, Lin, Lai, and Wang (2016). GPI reflects voluntary and strategic environmental innovation, while GRI captures innovation driven by compliance or external pressures. Green Project Performance (GPP) is assessed through three dimensions: Financial Performance (FP) and Environmental Performance (EP), adapted from Jiang, Chai, Shao, and Feng (2018) and Stakeholder Satisfaction (SS) from Mazur and Pisarski (2015). These evaluate outcomes such as profitability, pollution reduction, and stakeholder relationship quality. Overall, the measures ensure a multidimensional understanding of green leadership, innovation, and performance in project settings.

Table 2. Measurement instruments.

Variables	Methods of measurement	Source
Green horizontal leadership (GHL)	***(i)Social structures***	Zhu et al. (2019)
	1.Team members are expecting someone who knows how to fix the problem to take the lead.	
	2. I (As project manager)/ My project manager (Vertical leader) delegated mine/ His power to a senior/ Qualified member for a "special mission" [Being a horizontal leader].	
	3. I (As project manager)/ My project manager sat down with me/Team leader (Horizontal leader) and taught him how to deal with the functional departments.	
	4. I (As project manager)/ My project manager always encouraged me/Team leader (Horizontal leader) to take on extra responsibilities and take the lead in areas that we are good at.	
	5. I (As project manager)/ My project manager said he would back me/Team leader (Horizontal leader) up and that he could always turn to him for help.	
	6. I (As project manager) /My project manager sometimes give extra incentives to me/Team leader (Horizontal leader).	
	(ii) Individual dynamics	
	1. Being the lead for the team certainly gave me/Team leader (Horizontal leader) a sense of achievement. Carrying the entire team forward just feels great!	
	2. The role of horizontal leader/Team leader gave me more exposure in the company. I/ he knew this could be an opportunity.	
	3. Leading teams is my/ Team leader (Horizontal leader) strength. I/ S/he have strong communication and coordination skills. I/ He wasn't surprised that I/ He did a good job.	
	(iii) Context	
	1. In the project, different functional departments needed to be coordinated. This was extremely demanding for having a team Leader (Horizontal leader) especially when we kept running into different problems.	
	2. I/ He has been working in this business for a long time, I/ He has seen different strange things. Experience in fact helps me/ him to lead the team.	
Green innovation (GI) Green proactive innovation (GPI)	1. My company often actively has innovations about environmental protection then it can take new measures or have new products to have a lead over its rivals.	Chen et al. (2016)
	2. My company actively engages in constantly betting on environmental innovation resources, successfully takes the opportunity to become a pioneer in the market.	
	3. My company actively improves its production processes, reuses, recycles, and reduces the use of raw materials in order to cut costs.	
	4. My company voluntarily implements innovations regarding environmental protection in order to obtain a competitive advantage.	

Variables	Methods of measurement	Source
Green reactive innovation (GRI)	1. My company passively adopts environment-related innovations in order to comply with environmental regulations;	
	2. My company was asked to create new solutions to meet the needs of interested parties	
	3. My company was forced to respond to changing circumstances;	
	My company will focus on passive and environmentally-related innovation, which is a challenge to cope with competitors.	
Green project performance (GPP)	***(i) Financial performance (FP)***	Jiang et al. (2018)
	1. Green construction increases sales growth of project	
	2. Green construction increases the profit growth of project	
	3. Green construction increases return on assets of the project	
	4. Green construction increases the return on investment of the project	
	5. Green construction increases market share growth of project	
	6. Green construction improves the overall efficiency of operations of the project	
	(ii) Environmental performance (EP)	
	1. In green construction return on sales is high	
	2. Green construction reduces pollution	
	3. Green construction reduces energy and materials consumption	
	4. Green construction reduces the consumption of hazardous/harmful/toxic materials	
	5. Green construction reduced the frequency for environmental accidents	
	(iii) Stakeholders satisfaction (SS)	Mazur and Pisarski (2015)
	1. I am satisfied with the benefits I receive from my relationships with those I work with.	
	2. My feelings toward those I work with are positive.	
	3. I feel enthusiastic about my relationships with the people I work with.	
	4. All in all, I am satisfied with my relationships with the people I work with.	
	5. I am satisfied with the benefits I receive from my stakeholder relationships.	
	6. I am committed to my stakeholders.	
	7. My feelings toward my stakeholders are positive.	
	8. I feel enthusiastic about my stakeholder relationships.	
	9. All in all, I am satisfied with my stakeholder relationships	

3.5. Reliability and Validity Test

The Table 3 presents the reliability and validity statistics for the constructs used in the study. Green Horizontal Leadership (GHL) is measured with 11 items, showing strong factor loadings (0.775–0.899), high internal consistency (Cronbach's Alpha = 0.884), Composite Reliability (CR = 0.955), and good convergent validity (AVE = 0.627).

Green Proactive Innovation (GPI) has four items with factor loadings between 0.722 and 0.912, and acceptable reliability (α = 0.867, CR = 0.879, AVE = 0.534). Green Reactive Innovation (GRI) includes four items with strong loadings (0.775–0.900), high reliability (α = 0.889), and acceptable convergent validity (AVE = 0.531).

Green Project Performance (GPP) combines three dimensions—environmental, financial, and stakeholder satisfaction—with good overall reliability (α = 0.807, CR = 0.883, AVE = 0.574). Variance Inflation Factor (VIF) values for all constructs range from 1.88 to 2.50, indicating no multicollinearity issues. Overall, the measurement model demonstrates solid reliability and validity across constructs.

Table 3. EFA factor loading.

Constructs	Measurement	Factor loading	Cronbach's Alpha	CR	AVE	VIF
Green horizontal leadership (GHL)	GHL 1	0.831	0.884	0.955	0.627	2.50
	GHL 2	0.778				
	GHL 3	0.801				
	GHL 4	0.893				
	GHL 5	0.899				
	GHL 6	0.874				
	GHL 7	0.832				
	GHL 8	0.799				
	GHL 9	0.775				
	GHL 10	0.863				
	GHL 11	0.853				
Green proactive innovation (GPI)	GPC 1	0.912	0.867	0.879	0.534	1.88
	GPC 2	0.722				
	GPC 3	0.863				
	GPC 4	0.736				
Green reactive innovation (GRI)	GI 5	0.863	0.889	0.858	0.531	2.19
	GI 6	0.872				
	GI 7	0.775				
	GI 8	0.900				
Green project performance (GPP)			0.807	0.883	0.574	1.89
(i)Environmental performance	EP 1	0.821				
	EP 2	0.800				
	EP 3	0.721				
	EP 4	0.889				
(ii)Financial performance	FP 1	0.799				
	FP 2	0.805				
	FP 3	0.901				
	FP 3	0.899				
	FP 4	0.863				
	FP 6	0.898				
	FP 7	0.821				
(iii) Stakeholders satisfaction	SS 1	0.863				
	SS 2	0.842				
	SS 3	0.854				
	SS 4	0.783				
	SS 5	0.732				
	SS 6	0.731				
	SS 7	0.843				
	SS 8	0.789				
	SS 9	0.900				

The Table 4 demonstrates discriminant validity using the Fornell-Larcker criterion, where the square root of the Average Variance Extracted (AVE) for each construct (shown on the diagonal) is compared to the inter-construct correlations (off-diagonal). Each construct's AVE square root exceeds its correlations with other constructs, indicating satisfactory discriminant validity. For instance, Green Horizontal Leadership (GHL) has a square root of AVE of 0.811, which is higher than its correlations with Green Proactive Innovation (GPI) at 0.799, Green Reactive Innovation (GRI) at 0.314, and Green Project Performance (GPP) at 0.768. Similarly, GPI shows a square root of AVE of 0.755, greater than its correlations with GRI (0.281) and GPP (0.720). GRI and GPP also meet the criteria with AVE square roots of 0.836 and 0.843 respectively, both exceeding their inter-construct correlations. These results confirm that the constructs are distinct from one another, supporting the model's discriminant validity.

Table 4. Discriminant validity.

Constructs	GHL	GPI	GRI	GPP
GHL	0.811			
GPI	0.799	0.755		
GRI	0.314	0.281	0.836	
GPP	0.768	0.720	0.259	0.843

4. Results and Data Analysis

The Figure 2 structural equation modeling SEM method was used to test the hypotheses. This method was used to check the causal effect between indicators. This technique was widely used in management science research to measure relationships.

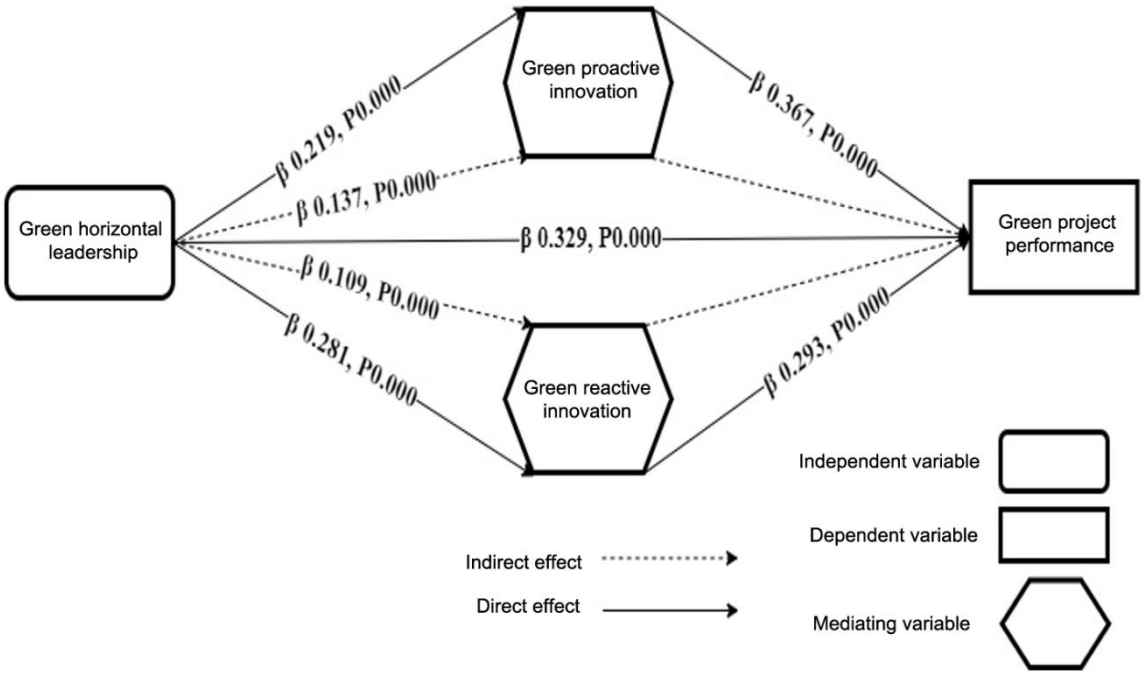

Figure 2. Direct and indirect effect between variables.

4.1. Test of Hypotheses

4.1.1. Direct Effects

The direct effect Table 5 shows that all proposed hypotheses are supported, with significant relationships among the constructs. Green Horizontal Leadership (GHL) positively impacts Green Project Performance (GPP) ($\beta = 0.329$), Green Proactive Innovation (GPI) ($\beta = 0.367$), and Green Reactive Innovation (GRI) ($\beta = 0.293$). Both GPI ($\beta = 0.219$) and GRI ($\beta = 0.281$) also significantly enhance GPP. All effects are statistically significant ($p < 0.001$), confirming the model's direct pathways.

Table 5. Direct effects.

Hypotheses	Relationship	β	T	p	Supported/Not supported
H1	GHL and GPP	0.329	3.842	0.000	Supported
H2	GPI and GPP	0.219	2.622	0.000	Supported
H3	GRI and GPP	0.281	2.231	0.000	Supported
H4	GHL and GPI	0.367	2.746	0.000	Supported
H5	GHL and GRI	0.293	3.715	0.000	Supported

4.1.2. Indirect Effects

Table 6 shows that Green Proactive Innovation (GPI) and Green Reactive Innovation (GRI) significantly mediate the relationship between Green Horizontal Leadership (GHL) and Green Project Performance (GPP). Both effects are positive and statistically significant ($\beta = 0.137$ and 0.109; $p < 0.001$), confirming the mediation.

Table 6. Indirect effects.

Hypotheses	Relationship	β	T	p	Supported/Not supported
H6	GHL, GPI and GPP	0.137	2.823	0.000	Supported
H7	GHL, GRI and GPP	0.109	2.575	0.000	Supported

4.1.3. Mediation through Bootstrapping

The bootstrapping mediation Table 7 shows the effects of Green Horizontal Leadership (GHL) and Green Vertical Leadership (GVL) on Green Project Performance (GPP) through Green Innovation (GI). For GHL-GI-GPP, the standardized indirect effect is 0.175 with a confidence interval (0.137, 0.705), and the direct effect is 0.512, indicating partial mediation. Similarly, for GVL-GI-GPP, the indirect effect is 0.089 (CI: 0.041, 0.725) with a direct effect of 0.372, also confirming partial mediation. Since both confidence intervals do not include zero, the mediating effects are statistically significant.

Table 7. Mediation through bootstrapping.

IVs	Standardized indirect effect	Lower	Upper	Standardized direct effect	Total effect	Results
GHL-GI- GPP	0.175	0.137	0.705	0.512	0.621	Partial mediation
GVL-GI-GPP	0.089	0.041	0.725	0.372	0.461	Partial mediation

5. Discussion

This paper presents empirical data regarding the effect of green horizontal leadership on improving the performance of green projects in Jiangsu Province, China. Recognized for its industrial and financial development, Jiangsu has increasingly prioritized environmental sustainability. The findings show that companies implementing participative and cooperative leadership approaches produce better results related to sustainability. These results confirm current research showing the need for effective leadership in promoting corporate environmental responsibility.

Empirical data verified the hypotheses of the study, therefore proving the relationships among green innovation, green horizontal leadership, and successful green projects. The results support the theory that approaches to leadership stressing employee agency, shared responsibility for the environment, and distributed decision-making can enhance company environmental performance and inspire sustainable innovation.

5.1. Hypothesis Testing and Theoretical Contributions

The results of this study robustly support H1, i.e., ($\beta = 0.329, T = 3.842, p = 0.000$), which posits that the efficacy of green projects is derived from green horizontal leadership. Organizations employing participative and distributed leadership models demonstrate superior outcomes in sustainability (Çop et al., 2021). This outcome underscores the essential role of leadership in cultivating a sustainability-focused society that enhances environmental stewardship, resource efficiency, and stakeholder engagement (Arfi et al., 2018; Singh et al., 2020). Strong leadership is necessary for launching successful green projects; green horizontal leadership helps companies implement sustainable practices at every level.

The findings validate H2 i.e. ($\beta = 0.219, T = 2.622, p = 0.000$), which holds that green proactive innovation benefits from green horizontal leadership. Proactive innovation is characterized by voluntary, intentional projects focused on environmental sustainability. The findings indicate that green horizontal CEOs cultivate an open and innovative atmosphere that encourages employees to explore environmentally beneficial concepts and integrate sustainability into core business strategies (Chang, 2015; Fernando et al., 2019). These findings align with stewardship theory, which emphasizes leaders' responsibility to nurture environmental and organizational health.

H3 i.e. ($\beta = 0.281, T = 2.231, p = 0.000$), research indicates that green reactive innovation is positively impacted by green horizontal leadership. Reactive innovation refers to sustainability activities driven by external factors such as regulations and stakeholder requirements (Fernando et al., 2019; Genç & Benedetto, 2019). Green horizontal executives manage firms that exhibit greater adaptability to environmental regulations, ensuring compliance and maintaining operational stability (Çop et al., 2021). This reinforces the argument that a corporation's ability to effectively tackle sustainability challenges is enhanced by leadership styles that emphasize collaboration and collective accountability.

The results for H4, i.e., ($\beta = 0.367, T = 2.746, p = 0.000$), show that green project performance benefits from green proactive innovation. Businesses that practice proactive innovation, namely those that invest in renewable energy, create green products, and apply waste-reducing techniques, achieve better operational and environmental results (Cheng, 2020; Leyva-de la Hiz et al., 2019). These results support the case that long-term business resilience is fostered by sustainability-driven innovation, thereby acting as a competitive advantage.

Likewise, H5 i.e. ($\beta = 0.293, T = 3.715, p = 0.000$) is supported, meaning that green project performance benefits from green reactive innovation. Although compliance needs drive reactive innovation most of the time, it is absolutely essential for regulatory conformity and maintaining business legitimacy (Le, 2022). According to the research, companies that successfully control regulatory limits through reactive innovation can enhance their sustainability credentials and thereby reduce environmental hazards (Jayaraman et al., 2023; Voegtlin et al., 2022).

Furthermore, validated were the mediation functions of green proactive and reactive innovation in the link between green horizontal leadership and green project performance. The results confirm H6 i.e. ($\beta = 0.137, T = 2.823, p = 0.000$), green proactive innovation moderates the link between green horizontal leadership and green project performance. This implies that proactive innovation is a vital channel via which leadership strategies become outcomes motivated by sustainability (Awwad et al., 2025; Mikhno, Koval, Shvets, Garmatiuk, & Tamošiūnienė, 2021; Pichlak & Szromek, 2021). Companies that promote proactive green innovation have more long-term environmental success (Chowdhury et al., 2022; Singh et al., 2020).

Finally, H7 is supported i.e. ($\beta = 0.109, T = 2.575, p = 0.000$), suggesting that green reactive innovation helps to moderate the link between green horizontal leadership and green project performance (Alnaim et al., 2022; Yang et al., 2019). This proves that companies run under green horizontal leaders are more successful in

implementing compliance-based sustainability projects, ensuring that companies stay in line with legal criteria and preserve operational effectiveness (de Medeiros et al., 2022; Voegtlin et al., 2022).

This paper extends the research on leadership and sustainability by including the resource-based view (RBV), organizational learning theory, and stewardship theory. Stewardship theory promotes the idea that long-term sustainability is oriented toward by green horizontal leadership. The theory of organizational learning helps to clarify how leadership promotes knowledge exchange and innovation motivated by sustainability. The RBV framework emphasizes the strategic benefit that green innovation offers, therefore orienting sustainability as a key component for competitive advantage. These theoretical contributions provide a thorough understanding of how, in environmentally conscious companies, leadership, creativity, and project performance interact.

6. Research Implications

6.1. Theoretical Implications

This research enhances the theoretical framework of leadership and sustainability studies by integrating key theoretical perspectives to elucidate the relationship between green horizontal leadership, innovation, and green project performance. According to stewardship theory, which posits that leaders ought to act as responsible stewards prioritizing long-term sustainability over immediate profits, this study highlights that leaders foster a sustainable culture that promotes green innovation and effective project implementation through stewardship.

The core principles of organizational learning theory elucidate how leadership fosters innovation. Team members are encouraged to contribute their ideas, experiment with innovative sustainable practices, and collaborate to discover unique solutions to challenges within an equitable, environmentally conscious leadership framework. The results reveal that performance and leadership also depend on organizations' capacity for learning and adaptation to environmental challenges. This holds true for both proactive and reactive innovation.

Moreover, the concept of the resource-based view (RBV) offers a necessary framework for assessing these outcomes. Studies show that companies with outstanding environmental leadership and creative capacity may develop a competitive advantage by properly applying their knowledge and resources to sustainability. A major intangible benefit of green innovation is its encouragement of regulatory conformity and constant environmental stewardship, thereby strengthening the competitive edge of a business. This study aims to enhance existing knowledge by outlining the essential steps for the effective implementation of green projects within companies, specifically examining the industrial landscape of Jiangsu Province.

This study elucidates the role of green proactive and reactive innovation as knowledge-enhancing intermediates that link green horizontal leadership to the success of green initiatives. Although earlier studies have explored the direct effects of leaders on sustainability, there is a scarcity of research focusing on the mechanisms through which leadership affects environmental outcomes. This study contributes to the current understanding by illustrating that green innovation serves as a crucial avenue through which leadership fosters enhanced environmental performance. The findings are consistent with earlier studies suggesting that organizations aiming for a competitive edge in sustainability need to pursue proactive innovation. This study highlights the essential importance of reactive innovation in promoting corporate efficiency while ensuring compliance with environmental regulations.

This study enhances the existing knowledge of leadership and sustainability by evaluating the circumstances in Jiangsu Province. The findings offer valuable insights tailored to the region, stemming from the province's economic importance and its pivotal role in China's environmental regulations, potentially guiding future inquiries and policy formulation.

6.2. Practical Implications

The findings of this study hold significant implications for organizations, particularly in Jiangsu Province, where the pursuit of sustainability must align with economic progress. The study examines how leadership strategies within organizations align with sustainable innovation to enhance both long-term economic and environmental results.

This study emphasizes two strategic imperatives: ethical responsibility and the importance of sustainable horizontal leadership. Companies have to go beyond appearances and include environmental consciousness in all aspects of their operations. As such, businesses must start owning the results of their activities and stop thinking about sustainability as a side effect. Organizations that embrace innovative concepts and sustainable leadership will benefit both ecologically and financially, thereby establishing a competitive advantage in the long run. This raises questions about the notion that sustainable living is expensive.

The study highlights the importance of cultivating leadership qualities that prioritize long-term organizational resilience and sustainability. Projects aimed at developing leadership abilities that support sustainability-oriented thinking should be supported by organizations so that leaders may drive innovation while remaining committed to environmental protection. Those who are dedicated to sustainability create settings that support both proactive and reactive innovation in environmentally friendly methods, thereby enabling companies to meet standards and create competitive environmentally friendly solutions.

Organizations might consider integrating sustainable horizontal leadership into their human resource frameworks. Organizations must identify and empower leaders who recognize it as their moral and ethical responsibility to contribute positively to society. Highlighting the importance of leadership skills focused on

sustainability, fostering collaboration, and ensuring that decision-making processes reflect a commitment to environmental responsibility, training programs should prioritize this focus. Additionally, educational institutions in Jiangsu Province ought to integrate sustainability leadership training into their business curricula to ensure that future leaders recognize the essential role of green innovation in achieving business success. This study also implies, among other important things, the requirement for companies to establish an environment that supports ongoing education and creativity. Businesses have to promote honest communication, help knowledge sharing, and enable staff members to be involved in decision-making. Companies that support cooperation with government agencies, research institutes, and colleges will have access to innovative sustainable technology and regulations, thereby enhancing their capacity to meet market demands and legal constraints.

All things considered, the findings of this study highlight how green horizontal leadership, encouragement of green innovation, and development of a sustainability-oriented corporate culture help companies increase their competitiveness. Businesses in Jiangsu Province must adopt sustainable leadership as a fundamental part of their operational strategy since the preservation of natural resources and the reduction of climate change are desperately needed. This will help them ensure long-term environmental and economic sustainability in a globally competitive market by attaining both corporate success and a positive social effect.

6.3. Limitations and Directions for Future Research

This study offers valuable insights; however, it is important to recognize its limitations. The initial study was carried out exclusively in Jiangsu Province, which may restrict the applicability of the results to other areas with varying economic and regulatory environments. Future studies should broaden their focus to encompass additional provinces in China and facilitate cross-country comparisons to corroborate these findings.

Secondly, while the study employed survey data, future research might incorporate longitudinal data collection to assess the lasting effects of green horizontal leadership on project performance. Qualitative studies can offer profound insights into the connection between leadership, innovation, and performance through the examination of organizational case studies.

By addressing these limitations, subsequent investigations can expand upon the existing findings and enhance our comprehension of the interplay between leadership, innovation, and sustainability across various industrial settings.

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