The Role Of Eco-Innovation Commitment, Cooperative Culture, And Green Technology Adoption In Enhancing Eco-Innovation Of Vietnamese Smes

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Abstract

The debate on decoupling economic growth from environmental degradation has intensified, highlighting the importance of eco-innovation. The findings and recommendations may help enterprises, especially SMEs, enhance resource efficiency, reduce costs, and open up new market opportunities.

Research purpose:

This study aims to investigate the factors influencing eco-innovation in Vietnamese small and medium-sized enterprises (SMEs), focusing not only on external factors but also on some internal factors, including eco-innovative commitment, cooperative culture, and green technology adoption.

Research motivation:

The increasing demand to separate economic growth from environmental harm has led to a growing interest in how Small and Medium Enterprises (SMEs) can support a sustainable green economy through eco-innovation. Eco-innovation is essential for helping businesses gain a competitive advantage while contributing to environmental sustainability. This research identifies key factors that drive the eco-innovative performance of SMEs, thereby helping them provide environmentally-friendly solutions and respond to growing consumer demand for sustainability.

Research design, approach, and method:

The research utilizes Partial Least Squares Structural Equation Modeling (PLS-SEM) with a sample of 122 respondents to analyze the impact of eco-innovative commitment, cooperative culture, and green technology adoption on eco-innovation performance in the context of Vietnamese SMEs.

Main findings:

The PLS-SEM analysis identifies significant factors influencing eco-innovation performance in organizations, including External Pressure, Eco-Innovative Commitment, Cooperative Culture, and Green Technology Adoption. External pressures from regulations and customer demands drive eco-innovation, while a strong sustainability commitment enhances performance. A collaborative environment promotes knowledge sharing and adopting advanced technologies supports sustainable practices.

Practical/managerial implications:

To promote sustainability and eco-innovation, governments should establish incentive programs like tax breaks and subsidies for businesses investing in eco-friendly practices. Clear regulations setting sustainable standards across industries and fostering dialogue among stakeholders are essential. Additionally, investing in research and development can accelerate the adoption of sustainable technologies.

Businesses should create a collaborative environment that encourages teamwork and knowledge sharing to enhance creativity in sustainable practices. Integrating eco-innovation into their strategic framework, setting clear sustainability goals, and maintaining regular communication with stakeholders will help firms adapt effectively. By investing in research and development, businesses can significantly advance eco-innovation and sustainability.

Keywords: Eco-Innovation, eco-innovative commitment, cooperative culture, green technology adoption, SMEs.

1. INTRODUCTION

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Eco-innovation, also known as "green innovation" or "environmental innovation," refers to the development and application of new or significantly improved products, services, processes, or business models that aim to reduce or eliminate negative environmental impacts (OECD, 2009). Unlike conventional innovations, eco-innovation focuses specifically on addressing environmental issues such as global warming, pollution, and climate change.

Eco-innovation has gained significant importance for businesses due to its ability to provide environmental education, professional experience, sustainable competitive advantages, improve working conditions, and enhance economic and environmental performance (Abdesselam, Kedjar, & Renou-Maissant, 2024). Businesses are acknowledging the benefits of eco-innovation and are prioritizing it for various reasons, including competitive pressures, community pressure, corporate culture and values, investor expectations, innovation experience, internationalization, supplier and customer relationships, economic performance, managerial awareness, public administration, internal resources, enterprise size, and corporate social responsibility.

Eco-innovation can help businesses stay ahead of their competitors by offering environmentally-friendly solutions (Schumpeter, 1943). Meanwhile, heightened social awareness and consumer demand for sustainable products and services are driving businesses to adopt eco-innovative practices (Ahmad & Wu, 2022; Porter & Linde, 1995). Conversely, companies that are deeply committed to sustainability are more inclined to integrate eco-innovation into their corporate culture and values (Bansal & Roth, 2000). At the same time, investors are placing greater emphasis on environmental, social, and governance (ESG) factors in their investment decisions, creating incentives for businesses to engage in eco-innovation (Windolph et al., 2014).

Businesses with prior experience in innovation are more likely to have the capabilities and resources to engage in eco-innovation (Triguero et al., 2013). In addition, expanding into global markets can expose businesses to stricter environmental regulations and consumer preferences, prompting them to invest in eco-innovation (Horbach, 2008). Conversely, collaboration with environmentally-conscious suppliers and customers can facilitate the development and adoption of eco-innovative solutions (Dangelico & Pujari, 2010). Consequently, eco-innovation can lead to cost savings, improved resource efficiency, and enhanced market opportunities, positively impacting a business's financial performance (Horbach, 2008).

Managers who are knowledgeable about the benefits and strategies of eco-innovation are more likely to champion its implementation within their organizations (Cai & Zhou, 2014; Karimi Takalo et al, 2021). Likewise, supportive government policies, incentives, and regulations can encourage businesses to invest in eco-innovation (Triguero et al., 2013). In contrast, the availability of financial, technological, and human resources within a business can enable the successful adoption of eco-innovative practices (Kesidou & Demirel, 2012). Moreover, larger businesses often have more resources and capabilities to engage in eco-innovation, while smaller enterprises may face technological and managerial hurdles (Horbach, 2008). Ultimately, businesses that prioritize corporate social responsibility are more inclined to integrate eco-innovation as part of their sustainability efforts (Dangelico & Pujari, 2010).

By analyzing the various factors that affect the adoption of eco-innovation, companies can develop targeted strategies to enhance their sustainability and bolster their competitive edge in the market. In Vietnam, SMEs in many fields such as agriculture, consumer goods, waste treatment, energy, and food processing are increasingly interested in green innovation. Recognizing the need for transformation to align with changing consumer preferences and international market demands, both the government and enterprises are promoting eco-friendly economic models like forest economy, circular economy, regenerative tourism, eco-tourism, green agriculture, and green transportation. However, green innovation activities among SMEs remain limited. The level of technology application and updating in enterprises is still quite low, the products produced have low added value. The popular green innovation method implemented by many SMEs is to primarily adjust existing products rather than develop new ones. The prevalent approach to green innovation often involves minor adjustments or process improvements rather than significant technological advancements. While there is a growing interest in green innovation, promoting innovation and green innovation in most localities often focuses on promoting innovative start-up activities, without paying due attention to promoting science, technology, and innovation activities of existing enterprises (CIEM & Embassy of Denmark in Vietnam, 2024).

To address the challenges faced by Vietnamese SMEs, it is essential to answer the following question: How do internal and external factors influence eco-innovation in Vietnamese SMEs?

2. LITERATURE REVIEW

2.1. Eco-innovation

Existing literature on eco-innovation has largely concentrated on large, energy-intensive companies, creating a notable gap in our understanding of small and medium-sized enterprises (SMEs) within this context (Hoogendoorn et al., 2015; Klewitz & Hansen, 2014; Passaro, 2022). This oversight is significant, as SMEs represent the majority of businesses worldwide and are essential contributors to numerous production systems (Bos-Brouwers, 2010; Revell et al., 2010).

Recent studies have begun to explore the eco-innovation practices of Vietnam’s enterprises. Regarding Vietnamese enterprises in general, the studies of Lam et al (2022), Hung (2022), Lang & Dat (2017), and Huang et al (2022) can be

mentioned. These studies demonstrated the multifaceted nature of eco-innovation in Vietnam, from CSR-driven strategies and consumer influence to the critical role of collaboration in industrial symbiosis. Lam et al. (2022) explored the impact of CSR on eco-innovation in agro-food enterprises, highlighting how environmental and supplier-focused CSR initiatives have significantly contributed to the promotion of eco-innovation. Meanwhile, Hung (2022) focused on how consumer perceptions of environmental sustainability, lifestyle choices, and green purchasing behavior influenced eco-innovation in the furniture industry. As demand for green products increases, the study underscored the importance for furniture companies to innovate in both product design and marketing to align with green consumer trends, emphasizing the growing role of consumer-driven innovation. Expanding the focus to cross-industry collaboration, Lang & Dat (2017) presented a hierarchical approach to identifying key attributes of eco-innovation within industrial symbiosis networks, particularly in Vietnam's textile sector. The study stressed the importance of collaboration, regulation, and waste management synergies in driving eco-innovation. It highlighted the need for coordination across firms and industries, suggesting that eco-innovation extends beyond individual company efforts and requires broader cooperation across supply chains and industry networks. The study by Huang et al. (2022) investigated the barriers faced by manufacturers in Vietnam when adopting green innovation practices. The significant obstacles included financial constraints, lack of government support, and shortages of skilled personnel in green technologies. These findings reflect the broader structural challenges businesses face in fostering eco-innovation, indicating that overcoming internal limitations and improving external support systems are crucial to driving green innovation across sectors. Regarding SMEs, we can refer to a study by Nguyen & Adomako (2021), which investigated the impact of stakeholder pressures on the eco-innovation investment decisions of Vietnamese SMEs. They found that regulatory, customer, and competitor pressures were key drivers of eco-innovation adoption, highlighting the importance of external factors in shaping SMEs' sustainability efforts.

The findings from the literature review indicate a need for additional studies on Vietnamese SMEs that take into account both internal and external factors influencing eco-innovation.

Recently, various studies have highlighted key internal factors influencing organizational performance. For instance, if Rennings (2000) discussed the significance of strong organizational commitment to eco-innovation, emphasizing how it drives investments in sustainable practices and R&D, then Horbach et al. (2012) and Kesidou and Demirel (2012) elaborated on how this commitment was reflected in resource allocation and strategy implementation. Furthermore, while Huang et al. (2016) focused on the role of cooperative culture in fostering knowledge sharing and collaboration, which enhances eco-innovation solutions, Triguero et al. (2013), Ghisetti and Pontoni (2015), and Cuerva et al. (2014) emphasized how the adoption of advanced technologies catalyzed improving environmental efficiency and sustainability. Likewise, Rehfeld et al. (2007) investigated the drivers of eco-innovation in German manufacturing SMEs and identified technological capabilities as a critical factor. They argued that SMEs often face significant technological and managerial barriers in implementing eco-innovative practices, highlighting the need for targeted support and interventions to address these challenges. Additionally, Hojnik et al. (2018) underline the importance of integrating stakeholder relationships to leverage external knowledge, thereby addressing complex environmental challenges. Studies such as Henriques and Sadorsky (1999) and Sendawula et al. (2021) also highlight how a strong environmental commitment improves brand reputation and aligns with consumer demands.

To fill the research gap, this study aims to elucidate the role of eco-innovative commitment, cooperative culture, and technology adoption along with external factors in promoting eco-innovation among Vietnamese SMEs.

2.2. Theoretical foundations

The conceptual foundations of eco-innovation draw from various complementary theories and theoretical frameworks.

2.2.1. Schumpeter's Theory of Creative Destruction

Schumpeter's theory emphasizes that innovative activities can disrupt existing market structures and pave the way for more sustainable solutions to replace them (Schumpeter, 1943). According to Schumpeter, this process is crucial in driving economic development and social progress. Schumpeter's theory of creative destruction is particularly relevant to the understanding of eco-innovation. The process of "creative destruction" is the key driver of economic development, where innovative green activities disrupt existing market structures and lead to the emergence of new, more efficient and sustainable solutions (Schumpeter, 1943; Shuliang et al, 2024).

In the context of eco-innovation, this theory provides valuable insights: Schumpeter's concept of creative destruction suggests that eco-innovations can be disruptive in nature, challenging and replacing existing technologies, products, or business models that are less environmentally sustainable (Rennings, 2000; Andersen, 2008). These disruptive eco-innovations can create new market opportunities and drive the transition towards a more sustainable economy. The competitive dynamics described by Schumpeter can also be observed in the context of eco-innovation. Firms engaged in eco-innovation may compete to develop and introduce novel, greener products or processes that can outcompete and eventually replace existing, less sustainable alternatives (Bammens & Hünermund, 2020; Hockerts & Wüstenhagen, 2010). Schumpeter highlighted the significance of entrepreneurship in driving innovation and economic transformation. In a similar vein, eco-entrepreneurship, focused on establishing new, environmentally-friendly business ventures, can be essential in the development and dissemination of eco-innovations (Ahmad & Wu, 2022; Gibbs, 2006). The concept of

creative destruction can help explain the dynamics of sustainability transitions, where eco-innovations disrupt and replace incumbent, unsustainable technologies and practices, leading to the development of more sustainable socio-technical systems (Geels, 2005; Markard et al., 2012).

2.2.2. Resource-Based View (RBV)

The resource-based view asserts that a firm's distinct resources and capabilities can facilitate eco-innovation and contribute to sustainable competitive advantage (Barney, 1991). Essential resources, such as technology, knowledge, and management skills play a critical role in this process. According to RBV theory, firms can attain sustainable competitive advantage by leveraging their unique, valuable, and difficult-to-replicate resources and capabilities (Barney, 1991). In the context of eco-innovation, RBV provides an essential framework for understanding how companies develop and leverage green resources and capabilities to create environmentally-friendly products, services, and processes (Dangelico, 2016).

Previous studies have shown that green resources and capabilitie, such as green technology, environmental management skills, and an eco-friendly organizational culture, can serve as vital assets for firms seeking sustainable competitive advantage in their industries (Hart, 1995; Teece, 2007). For instance, unique green technology enables a firm to produce goods at a lower cost and with reduced environmental impact compared to its competitors. Additionally, dynamic capabilities, such as the ability to adapt, learn, and reconfigure, are essential for developing and leveraging a firm's green resources and capabilities (Ahmad & Wu, 2022; Teece, 2007). These capabilities allow firms to continuously update, reorganize, and recombine their resources to address evolving market conditions and environmental regulatory demands (Wang et al, 2023).

While Schumpeter's theory highlights the importance of innovation in driving economic progress, RBV shifts the focus from external market forces to internal firm resources and capabilities, considering firm-specific resources as the source of competitive advantage.

2.2.3. Natural Resource-Based View

The Natural Resource-Based View (NRBV) builds on the Resource-Based View (RBV) by integrating environmental factors into strategic management. The NRBV highlights the role of natural resources in shaping the strategic orientation and eco-innovative behavior of firms (Hart, 1995). Firms can leverage unique natural resources to develop eco-innovative solutions. The NRBV is an extension of the traditional Resource-Based View (RBV) theory, which focuses on the role of natural resources and environmental management as sources of competitive advantage (Hart, 1995). The key premises of the NRBV are: (i) natural resources are becoming increasingly important as sources of competitive advantage; (ii) firms can develop valuable, rare, inimitable and non-substitutable (VRIN) environmental capabilities and resources that allow them to achieve sustainable competitive advantage (Aragon-Correa & Sharma, 2003); (iii) firms can pursue three key environmental strategies based on their VRIN environmental resources and capabilities, as identified by Hart (1995). Firstly, pollution prevention involves proactively reducing pollution and waste through process innovations and efficiency improvements. Secondly, product stewardship focuses on minimizing the environmental impact of products throughout their entire life cycle. Lastly, sustainable development requires aligning the firm's operations and strategies with the principles of sustainable development. These strategies enable firms to enhance their environmental performance while leveraging their unique resources and capabilities especially at global level (Wang et al., 2023).

Developing these environmental strategies and capabilities requires dynamic capabilities, such as the ability to sense environmental trends and reconfigure resources (Teece, 2007). Studies have found that integrating natural environmental issues into strategic planning, as suggested by the NRBV, is positively correlated with firms' financial and environmental performance (Judge & Douglas, 1998). Additionally, the development of VRIN environmental capabilities can lead to improved environmental and financial performance (Sharma & Vredenburg, 1998). Furthermore, the NRBV can be integrated with stakeholder theory to explain how firms can develop environmental strategies and capabilities to address the demands of various stakeholders (Buysse & Verbeke, 2003).

These theories are not mutually exclusive; instead, they complement each other. Schumpeter's concept of Creative Destruction highlights the significance of innovation in fostering economic progress and shaping market dynamics. Meanwhile, The RBV builds on this by shifting focus to internal firm resources and argues that sustained competitive advantage arises from internal resources that are unique, valuable, and hard to replicate. The NRBV further expands RBV by incorporating environmental considerations. It maintains the focus on internal resources but adds the dimension of natural resource management and sustainability as sources of competitive advantage.

3. HYPOTHESIS DEVELOPMENT

External pressures, including regulatory requirements, customer demands, and competitive forces, significantly drive organizations to enhance their eco-innovation efforts, ultimately improving their energy efficiency and eco-innovation performance (Calvo et al, 2022). Regulatory pressures, manifested through environmental policies and standards, compel firms to engage in eco-innovation activities to comply with regulations and avoid penalties (Ketata et al., 2015; Rennings, 2000; Horbach et al., 2012; Cai & Zhou, 2014). When regulations are well-defined, they provide clear guidelines that encourage companies to adopt eco-innovation practices, leading to the development of environmentally friendly products

and processes (Zhao et al, 2023).

Additionally, effective regulations create an environment conducive to research and development. By offering incentives such as tax breaks or grants for eco-innovative projects, firms are motivated to invest in sustainable technologies. Furthermore, regulatory quality facilitates access to markets that prioritize sustainability, enabling companies that meet high standards to maintain a competitive edge (Sinatoko Djibo et al., 2023).

On the other hand, the rule of law provides a stable legal framework that fosters trust among businesses. When firms believe their rights will be protected, they are more likely to invest in long-term eco-innovation strategies. The rule of law ensures that environmental regulations are enforced fairly and consistently, deterring non-compliance and encouraging firms to adopt sustainable practices to avoid penalties. Additionally, it protects intellectual property rights, allowing firms to innovate without fear of theft or imitation, which further encourages investment in eco-innovative solutions (Sinatoko Djibo et al, 2023).

Customer demands for environmentally friendly products significantly motivate firms to develop innovative green solutions (Cuerva et al., 2014; Rehfeld et al., 2007). The impact of demand and customer factors on eco-innovation performance is significant and multifaceted. Increasing consumer awareness of environmental issues drives demand for eco-friendly products, prompting companies to innovate their offerings to meet these expectations, which can enhance market performance and create a competitive advantage (Hojnik & Ruzzier, 2016). Direct feedback from customers provides valuable insights into desired product features and improvements, guiding firms in their eco-innovation efforts. Engaging customers in the innovation process can lead to more sustainable products that cater to specific market needs (Passaro, 2022). As customers demand more sustainable options, they also advocate for stricter environmental regulations, which encourages companies to adopt eco-innovation practices to satisfy customer expectations and comply with emerging regulations (Nguyen, 2022). Involving customers in the innovation process allows firms to develop products that better meet consumer demands, leading to enhanced eco-innovation outcomes; co-creation with customers can foster the development of sustainable solutions (Hojnik & Ruzzier, 2016). Companies that successfully implement eco-innovations can enhance their brand reputation, leading to increased customer loyalty and long-term profitability, as a strong commitment to sustainability significantly improves relations with consumers (Hojnik & Ruzzier, 2016).

Competitive pressures from rivals who adopt eco-innovations prompt firms to invest in their own eco-innovation initiatives to maintain a competitive edge in the market (Horbach, 2008; Kesidou & Demirel, 2012). The presence of strong competitors often compels firms to innovate to maintain or enhance their market position. Firms facing intense competition are more likely to adopt eco-innovations as a means to differentiate themselves and gain a competitive edge. This competitive pressure can lead to increased investments in environmentally friendly technologies and practices (Hojnik and Ruzzier, 2016). Companies often use competitors as benchmarks for eco-innovation best practices, leading to "mimetic behavior," where firms adopt similar strategies to align with industry standards. This pressure can enhance overall eco-innovation performance (Han & Chen, 2021). In some cases, competitors collaborate on eco-innovation projects, sharing knowledge and resources that facilitate the development of innovative solutions. Such alliances can accelerate eco-innovation and drive significant advancements across the industry (Passaro, 2022). Furthermore, competitors shape market dynamics that influence eco-innovation performance. Firms that create eco-friendly products often generate new market opportunities, prompting competitors to respond and further promoting eco-innovation industry-wide (Hojnik & Ruzzier, 2016).

In summary, external pressures from regulatory requirements, the rule of law, customer demands, and competitive forces collectively drive firms to enhance their eco-innovation practices. These factors compel compliance with regulations, foster trust and stability in the business environment, and promote the development of sustainable solutions, all contributing to improved eco-innovation performance. Thus, we hypothesize:

H1: External pressures on eco-innovation have a positive impact on the eco-innovation performance of the organization.

When an organization is strongly committed and proactive toward eco-innovation, it will invest more in environmentally friendly product development, processes, and technologies, leading to enhanced eco-innovation performance. A strong organizational commitment to eco-innovation is reflected in the allocation of resources, implementation of eco-innovation strategies, and integration of environmental considerations into the firm's overall innovation activities (Rennings, 2000; Horbach et al., 2012; Kesidou & Demirel, 2012; Huang et al., 2016). This commitment enables the organization to develop and adopt novel green technologies, products, and processes more effectively, thereby improving its eco-innovation performance (Triguero et al., 2013; Ghisetti & Pontoni, 2015). According to Nguyen and Adomako (2021), strong environmental commitment enables firms to effectively respond to stakeholder pressures, fostering eco-innovation. Companies with robust environmental commitment invest in R&D to develop eco-friendly products and processes, leading to improved innovation outcomes (Hojnik et al., 2018). Additionally, such commitment encourages employee engagement in sustainable practices, fostering a culture of innovation (Henriques & Sadorsky, 1999). Firms that prioritize environmental sustainability are also more attuned to green consumer demands, enhancing their ability to innovate accordingly (Sendawula et al., 2021). Moreover, environmental commitment improves brand reputation and helps firms achieve international certifications, facilitating access to global markets. Overall, environmental commitment is essential

for driving eco-innovation performance, enabling firms to thrive in competitive and sustainability-focused landscapes. Based on previous studies, the following hypothesis is proposed:

H2: Organizational eco-innovative commitment has a positive impact on eco-innovation performance.

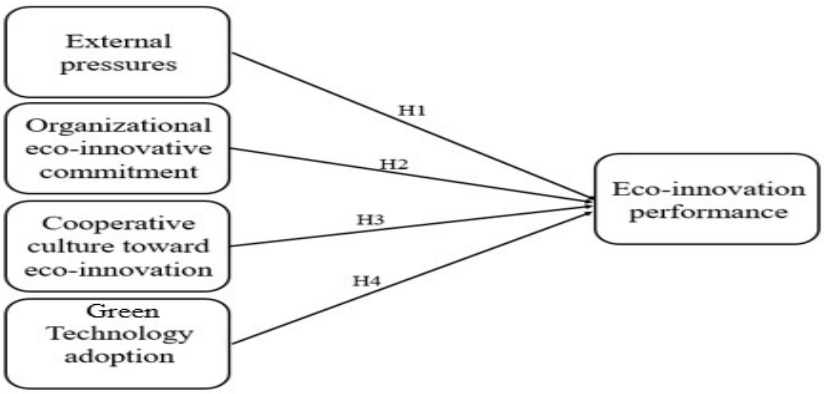
A cooperative culture that facilitates knowledge sharing and mutual support within the organization will promote the development and application of more effective eco-innovation solutions. A collaborative environment encourages the exchange of ideas, best practices, and technical know-how related to eco-innovation, which can enhance the organization's ability to overcome technological and organizational barriers (Kesidou & Demirel, 2012; Horbach, 2008; Del Río et al., 2016; Cainelli et al., 2015). Furthermore, a cooperative culture fosters cross-functional teamwork and interdepartmental coordination, enabling the integration of different perspectives and competencies to drive eco-innovation performance (Sáez-Martínez et al., 2016; Díaz-García et al., 2015). Research indicates that organizations with strong cooperative cultures facilitate better communication and teamwork, leading to increased creativity and problem-solving capabilities (Shahzad et al., 2017). When employees feel supported in sharing their insights and working together, they are more likely to engage in eco-innovative initiatives that align with sustainability goals. Moreover, cooperative cultures encourage the establishment of trust among team members, which is vital for effective knowledge sharing. Trust reduces the fear of negative judgment and criticism, allowing employees to propose unconventional solutions that may lead to eco-innovative outcomes (McDermott and O'Dell, 2001). Additionally, a cooperative culture enhances relational capital, which further supports eco-innovation. Organizations that focus on building relationships with stakeholders—such as suppliers and customers—are better equipped to incorporate external knowledge and resources into their innovation processes (Duan et al., 2023). This integration is crucial for addressing complex environmental challenges, as it allows organizations to leverage diverse perspectives and expertise. Thus, we suggest the following hypothesis:

H3: Cooperative culture toward eco-innovation has a positive impact on eco-innovation performance.

The adoption of new, advanced technologies will create favorable conditions for eco-innovation activities, thereby improving the organization's eco-innovation performance. Technological innovations, such as clean production technologies, renewable energy systems, and advanced waste management solutions, can enhance the environmental efficiency and sustainability of the organization's operations (Rennings, 2000; Ghisetti & Pontoni, 2015; Barbieri et al., 2016). Integrating these technologies into a firm's production and service delivery processes can result in the creation of innovative green products, processes, and business models, ultimately improving the organization's eco-innovation performance (Cuerva et al., 2014; Hojnik & Ruzzier, 2016). Green technology adoption facilitates the development of new eco-friendly products and processes. When firms invest in advanced technologies, they can innovate in ways that significantly reduce resource use and environmental impact. For instance, firms that implement green technologies often experience improved efficiency and a decrease in waste generation, leading directly to better eco-innovation outcomes (Hojnik & Ruzzier, 2016). Besides, green technology adoption encourages the integration of environmental considerations into the innovation process. By leveraging technologies such as data analytics and automation, firms can more effectively assess the environmental impact of their operations and make informed decisions about eco-innovations. This proactive approach not only enhances compliance with environmental regulations but also aligns with market demands for sustainable products (Zhang, 2022). Additionally, the adoption of green technology can create a culture of innovation within organizations. As firms embrace new technologies, they often foster an environment that encourages experimentation and knowledge sharing, which are crucial for developing eco-innovative solutions. This cultural shift can lead to increased collaboration among teams and stakeholders, further enhancing eco-innovation performance (Passaro, 2022). On the basis of the above studies, we hypothesize that:

H4: Green technology adoption has a positive impact on eco-innovation performance.

Based on the 4 hypotheses, we build a conceptual framework as follows.



Source(s): Authors' own creation/work

Figure 1. Conceptual model

H1: External pressures such as regulatory requirements, the rule of law, customer demands, and competitive forces are expected to significantly drive organizations to enhance their eco-innovation efforts.

H2: Organizational commitment to eco-innovation reflects a company's dedication to integrating sustainable practices into its core operations and strategic goals which can enhance eco-innovation performance.

H3: A cooperative culture toward eco-innovation significantly contributes to enhanced eco-innovation performance by fostering collaboration, knowledge sharing, and collective problem-solving.

H4: The adoption of green technologies refers to the integration of sustainable and environmentally friendly technologies into an organization's operations can significantly enhance eco-innovation performance.

4. RESULTS AND DISCUSSION

4.1. Data collection

This research employs primary data gathered through an online survey targeting Vietnamese SME firms. Business managers, representing their businesses, participated in our survey. To ensure the constructs' content validity and reliability, the questionnaire was carefully designed, drawing on established literature, a pilot test was also conducted, and measurement items were also revised. The survey was carried out over seven months, from February to December 2020, involving a total of 195 respondents. Participants received a comprehensive explanation of the survey's purpose and objectives, and they were compensated for their participation. After excluding unsatisfactory responses, a data-cleaning process resulted in 122 valid responses available for analysis.

Table 1: Measurement items

Factor/ Item		Loading	SD	T Statistics	P value
External Pressures					
"Customers' preferences for eco-friendly products change constantly and require the very latest technologies"	ExPr1	0.867	0.039	22.386	0.000
"Our competitors rapidly advance their eco-friendly product technologies"	ExPr2	0.797	0.055	14.603	0.000
"To what extent does the local government's requirement influence your strategies and the adoption of eco-innovative practices?"	ExPr3	0.771	0.057	13.543	0.000
Eco-Innovation Commitment					
"The leadership team demonstrates respect for your creative capacity in relation to eco-innovation"	ECom1	0.853	0.045	19.027	0.000
"You have a strong sense of connection to your firm's commitment to eco-innovation"	ECom2	0.846	0.030	27.855	0.000
"Prioritizing environmental sustainability helps your firm respond to green consumer demands"	ECom3	0.733	0.086	8.550	0.000
Cooperative Culture					
"In your company, you are willing to share our expertise regarding eco-innovation with each other"	CoCul1	0.891	0.031	29.199	0.000
"When setting up company's goal of eco-innovation, you encourage each other when someone is down"	CoCul2	0.843	0.057	14.701	0.000
"In your company's eco-innovation-oriented project, you try to act like peacemakers when there are disagreements"	CoCul3	0.748	0.108	6.936	0.000
Green technology Adoption *Green Technology may include Innovative Water Conservation Technologies, E-Waste Recycling Techniques, Eco-Friendly Materials, Green Construction, Electric Vehicles*					

Factor/ Item		Loading	SD	T Statistics	P value
"The green technologies involved in the contractor's R&D work were changing rapidly"	GTeA1	0.863	0.039	22.229	0.000
"Frequent adjustments in the contractor's plan of work were called for to incorporate new green technologies"	GTeA2	0.830	0.044	18.789	0.000
"Green technological breakthroughs developed in other areas altered how the contractor performed its work"	GTeA3	0.854	0.058	14.749	0.000
Eco-Innovative Performance					
"To what extent does the eco-innovation meet your expectations?"	EPer1	0.808	0.044	18.194	0.000
"To what extent are you satisfied with the total performance made by the eco-innovation?"	EPer2	0.767	0.067	11.391	0.000
"Your firm has integrated issues concerning the technology into your strategic eco-planning process"	EPer3	0.846	0.043	19.895	0.000

Notes: SD=Standard Deviation

4.2 Data analysis

This study utilized Smart PLS-SEM version 3.3.3 for data analysis. Initially, a descriptive analysis was performed to characterize the sample dataset, providing insights into the "typical" respondent and highlighting overall response patterns. Subsequently, the reliability and validity of the measurement instruments were evaluated through various tests, followed by an examination of the underlying structural relationships among the variables.

The demographic characteristics of the respondents are illustrated in Table 2.

Table 2. Demographic characteristics of the respondents (N=122)

Respondents' Profile	Items	Total	Percent (%)
Gender	Male	88	72.34
	Female	34	27.66
Age	21-25.9	3	2.46
	26-30.9	11	9.02
	31-35.9	21	17.21
	36-40.9	44	36.07
	41-45.9	19	15.57
	46-50.9	16	13.11
	50-55.9	5	4.1
	56-60	2	1.64
	>60	1	0.82
Job Title	Specialist/Expert	7	5.74
	Worker	1	0.82
	Frontline Employee	3	2.46
	Manager/Supervisor	20	16.39
	Business Center Manager	4	3.28
	CEO	86	70.49
	Planning Department Head	1	0.82
Experience (years)	Under 3 years	6	4.92
	3-6	37	30.33
	6-9	36	29.51
	9-12	26	21.31

	12-15	6	4.92
	15-18	2	1.64
	18-21	6	4.92
	Over 21	3	2.46
Annual Revenue (billion VND)	Less than 1	8	6.56
	1-3	60	49.18
	3-10	40	32.79
	10-20	3	2.46
	20-50	1	0.82
	50-100	2	1.64
	Over 100	8	6.56
Number of Employees	Less than 50	97	79.51
	50-249	15	12.3
	Over 249	10	8.2

Source(s): Authors' own creation/work

Assessment of Measurement Model

After evaluating the measuring model, this study focused on loading, convergent validity, internal reliability, and discriminant validity (Table 3).

Table 3. Assessment of loading, reliability, convergent validity, and discriminant validity

Constructs	CA	rho_A	CR	AVE	1	2	3	4	5
1. External pressure	0.741	0.747	0.853	0.660	0.812				
2. Eco-Innovation Commitment	0.741	0.755	0.853	0.660	0.611	0.813			
3. Cooperative Culture	0.772	0.788	0.868	0.688	0.485	0.703	0.830		
4. Green Technology Adoption	0.806	0.808	0.886	0.721	0.721	0.736	0.562	0.849	
5. Eco-Innovative Performance	0.733	0.737	0.849	0.652	0.671	0.783	0.644	0.737	0.808

The results indicate that all constructs achieved sufficient outer loadings, with values above the threshold of 0.70, confirming their adequacy for the analysis. Specifically, the Cooperative Culture construct has a loading of 0.830, Eco-Innovative Commitment is at 0.813, Eco-Innovative Performance shows a loading of 0.808, External Pressure has a loading of 0.812, and Green Technology Adoption reaches a loading of 0.849.

Convergent validity is also established, as all constructs exhibit average extracted variance (AVE) values greater than 0.5, specifically ranging from 0.660 to 0.721. Furthermore, the Composite Reliability (CR) and Cronbach's Alpha (CA) values for each construct exceed the minimum criterion of 0.7, indicating that the measurement model meets the reliability requirements. For instance, Green Technology Adoption has a CA of 0.806 and a CR of 0.886, further substantiating the reliability of the constructs.

Finally, there are no concerns regarding discriminant validity, as the square root of the AVE for each construct is greater than the correlations with other constructs, confirming that the constructs are distinct from one another. This robust measurement model supports the validity and reliability of the study's findings.

Assessment of Structural Model

Table 4 presents the results of a PLS-SEM analysis regarding the factors influencing eco-innovation performance. All H1, H2, H3, and H4 were supported. Firstly, the relationship between Cooperative Culture and Eco-Innovative Performance shows a T Statistics value of 2.130 and a P-Value of 0.034, indicating a statistically significant positive impact. This

suggests that a cooperative environment within the organization enhances the development and implementation of eco-friendly innovations. Secondly, the Eco-Innovative Commitment demonstrates a strong and significant effect on Eco-Innovative Performance, with a T Statistics of 4.721 and a P-Value of 0.000. This finding emphasizes that organizations with a high commitment to eco-innovation are likely to achieve better performance in this area. Additionally, External Pressure also contributes positively to Eco-Innovative Performance, evidenced by a T Statistics of 2.817 and a P Value of 0.005. This indicates that external factors, such as regulatory requirements and customer demands, can drive organizations to intensify their eco-innovation efforts. Lastly, Green Technology Adoption shows a positive relationship with Eco-Innovative Performance, with a T Statistics of 2.508 and a P-Value of 0.012. This highlights that adopting modern technologies can significantly enhance an organization's ability to innovate sustainably.

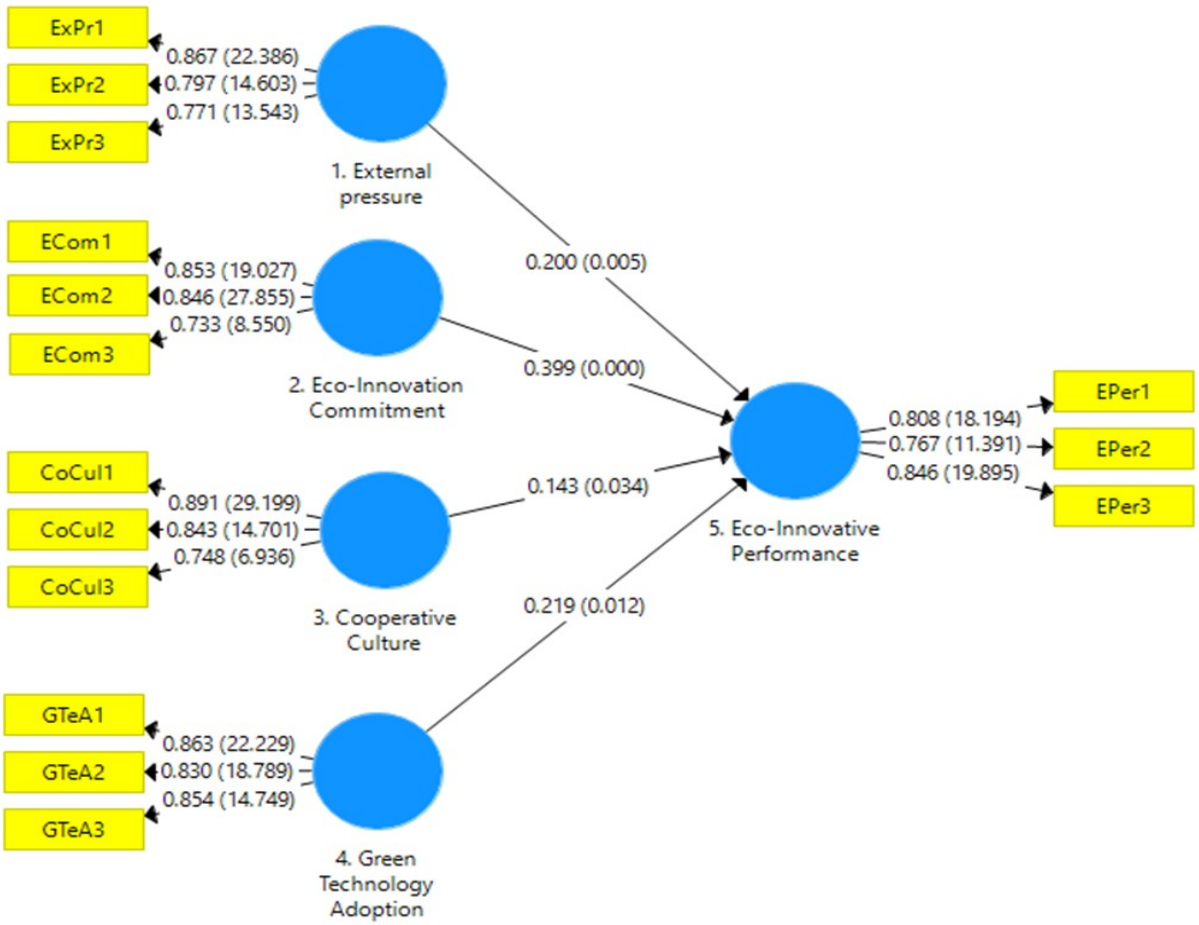
Table 4. Assessment of the structural model

Paths	Original Sample (O)	Sample Mean (M)	Standard Deviation	T Statistics	P Value
1. External pressure -> Eco-Innovative Performance	0.200	0.205	0.071	2.817	0.005
2. Eco-Innovation Commitment -> Eco-Innovative Performance	0.399	0.401	0.084	4.721	0.000
3. Cooperative Culture -> Eco-Innovative Performance	0.143	0.135	0.067	2.130	0.034
4. Green Technology Adoption -> Eco-Innovative Performance	0.219	0.218	0.087	2.508	0.012

In conclusion, all factors analyzed exhibit a positive impact on eco-innovation performance, underscoring the importance of fostering a cooperative culture, strengthening commitment to eco-innovation, responding to external pressures, and embracing new technologies to improve outcomes in this domain.

Table 5. Summary of SEM analysis

Hypothesis	Relationship	Results
H1	External Pressure -> Eco-Innovative Performance	Supported
H2	Eco-Innovative Commitment -> Eco-Innovative Performance	Supported
H3	Cooperative Culture -> Eco-Innovative Performance	Supported
H4	Green Technology Adoption -> Eco-Innovative Performance	Supported



Source(s): Authors' own creation/work

Figure 2. PLS-SEM results

5. CONCLUSION

5.1. Discussion

The findings from the PLS-SEM analysis reveal significant factors influencing eco-innovation performance in organizations. Key constructs such as Cooperative Culture, Eco-Innovative Commitment, External Pressure, and Green Technology Adoption demonstrate positive relationships with eco-innovation outcomes. A cooperative environment fosters collaboration and knowledge sharing, while a strong commitment to sustainability enhances organizational performance. Additionally, external pressures from regulations and customer demands drive firms to innovate, and the adoption of advanced technologies significantly contributes to sustainable practices. These insights highlight the critical importance of both internal organizational culture and external stakeholder engagement in achieving successful eco-innovation.

5.2. Theoretical Implications

The findings from the PLS-SEM analysis provide critical insights for organizations aiming to enhance eco-innovation performance.

The positive influence of External Pressure on Eco-Innovative Performance highlights the necessity for organizations to respond to external factors, such as regulatory requirements and customer expectations. These pressures can motivate organizations to innovate as they strive to adhere to regulations or fulfill consumer demands for more sustainable products (Weng et al., 2015).

The positive correlation between Cooperative Culture and Eco-Innovative Performance indicates that cultivating a collaborative environment is vital for promoting eco-friendly initiatives. Jansen et al. (2005) highlight that a cooperative culture encourages knowledge-sharing and collective problem-solving, both of which are essential for fostering innovation. When employees feel empowered to work together, they are more likely to generate innovative ideas that contribute to sustainable practices. This underscores the importance of teamwork and a shared vision in enhancing an organization's commitment to sustainability (González-Benito & González-Benito, 2005).

Moreover, the strong effect of Eco-Innovative Commitment on performance highlights the necessity for organizations to integrate sustainability into their core strategies. Porter and van der Linde (1995) argue that companies with a proactive approach to environmental management can achieve competitive advantages, as they are often better positioned to respond to regulatory changes and market demands. Organizations should articulate a clear commitment to eco-innovation by establishing specific sustainability goals and objectives. This proactive stance not only enhances performance but also builds a positive brand image in the eyes of consumers who increasingly prioritize sustainability.

Lastly, the significant relationship between Green Technology Adoption and Eco-Innovative Performance emphasizes the critical role of modern technologies in enhancing sustainability efforts. Geissdoerfer et al. (2018) assert that the integration of advanced technologies can lead not only to more efficient resource use but also to the creation of innovative sustainable products. Organizations should prioritize green technology scouting and partnerships with tech innovators to stay at the forefront of eco-innovation.

5.3. Practical Implications

To effectively promote sustainability and eco-innovation, governments should consider the following strategies. They should develop incentive programs that encourage businesses to invest in eco-innovation and sustainable practices, such as offering tax breaks or subsidies for companies committed to reducing their environmental impact. Additionally, regulatory agencies need to create clear and enforceable regulations that promote sustainable practices across industries, setting standards and guidelines that drive companies to align their operations with eco-friendly initiatives. To further support this, government agencies should foster platforms for dialogue between businesses, regulators, and other stakeholders, which can help identify emerging trends and regulatory needs, ensuring that policies are relevant and effective in promoting sustainability. Finally, investing in research and development is crucial; government funding for R&D initiatives can accelerate the adoption of sustainable technologies and encourage innovation in the development of new eco-friendly solutions.

For businesses, organizations should actively promote a collaborative environment that encourages teamwork and knowledge sharing. This can be achieved through team-building activities, cross-departmental projects, and open communication channels. By empowering employees to collaborate, organizations can stimulate creativity and innovation in sustainable practices. Additionally, firms should integrate eco-innovation into their strategic framework by setting clear sustainability goals and objectives, developing a sustainability policy that outlines their commitment to environmental responsibility, and investing in training programs that enhance employees' understanding of eco-innovation principles. Regular communication channels with stakeholders, including regulators, customers, and community members, should be established to help firms stay informed about market trends and regulatory changes, allowing them to adapt their eco-innovation strategies effectively. Companies are also encouraged to invest in research and development to explore cutting-edge technologies that facilitate eco-innovation; forming partnerships with technology firms or academic institutions can enhance their capacity to adopt innovative solutions that reduce environmental impact. By implementing these strategies, businesses can significantly contribute to eco-innovation performance and sustainability in a competitive market, which is considered to match with theories. A firm can simultaneously engage in creative destruction through innovation (Schumpeter), leverage its unique internal resources (RBV), and pursue sustainable practices (NRBV). For instance, a company might develop a groundbreaking eco-friendly product (aligning with Schumpeter's theory), utilize its proprietary technology and cooperative culture (in line with RBV), and implement sustainable manufacturing processes by eco-innovative commitment (adhering to the NRBV).

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