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Barriers Perceived by Companies and Potential Solutions to Foster Green Innovation in Vietnam

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Abstract

This study aims to identify barriers perceived by manufacturers and propose potential solutions to foster green innovation in Vietnam. A theoretical framework and the inductive case research method are used to analyze how companies in a less developed institutional context overcome barriers to green innovation. Results suggest that regulatory, technology, market, finance, costs, human resources, network, perception, and customer acceptance are significant barriers to green innovation by manufacturing companies in Vietnam. Through the analysis, the study also indicates companies' potential solutions that will help elucidate the barriers to green innovation. Implications and future research developments for promoting green innovation in Vietnamese companies are suggested.

Keywords: Green innovation, sustainable development, environmentally friendly, barriers, solutions, Vietnam
JEL classification: O31, Q55, Q56

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1. INTRODUCTION

Sustainable development is a significant consideration for businesses today due to the increasing economic challenges posed by environmental issues (Schaper, 2002). According to Park et al. (2017), green innovation is primarily related to sustainable development. The concept of green innovation emerged as an important pathway toward sustainable development). Rules and institutions for manufacturing industries are now more rigorous than before and vary frequently to prevent environmental degradation). Consumers and the public are more informed and favor environmentally friendly products). Globally, companies are pushed to adopt environmentally friendly practices, at the same time, to improve their competitiveness).

Although green innovation becomes an important strategic tool for business (Massoudi et al., 2019), many previous studies have reported that many barriers impede the development of green innovation (Lewis & Cassells, 2010; Madrid-Guijarro et al., 2009; Pinget et al., 2015). Within a company, some of these barriers will prevent them from green product innovation, while others may prevent them from green process innovation. Other companies fail to bring a new idea, product, or process to market because they cannot overcome barriers despite their efforts to innovate and invest in innovation). Al-Abdallah and Al-Salim (2021) claimed that effective green innovation depends on the ability of companies to overcome barriers. Determining barriers to green innovation in companies is important for the following reasons: (i) policymakers need to determine why companies are excluded from the competition for innovation (Woolthuis et al., 2005) and (ii) it provides important information for managers to formulate corporate strategies to overcome barriers to green innovation (D'Este et al., 2008).

Vietnam is a lower-middle-income transition economy located in dynamic East Asia and the Pacific. The economy has grown fast, with an annual growth rate of around 7% over the last three decades (World Bank, 2021). Similar to other developing countries, environmental issues are among the most vulnerable factors for the economy in the near future. According to the World Population Review (2022), Vietnam is among the top countries that release plastic waste and is also located in a region that suffers the dramatic effects of climate change (World Bank, 2022). The government has made sustainable development and green growth a priority in its strategic planning. Vietnam has committed to reducing carbon emissions by 2050. The Vietnamese government has also launched Decision No. 844/QD-TTg to propel the national innovative startup ecosystem in 2016. Nonetheless, green innovation is still absent from the official policy debate. Thus, Vietnam provides an interesting case-study for developing countries and implies meaningful policy measures to foster green innovation in a similar context.

To fill this literature gap, this study aims to identify the perceived barriers to green innovation by manufacturers in Vietnam. The results will help managers and development specialists identify significant barriers to green innovation in the manufacturing sector in Vietnam and recommend policies to reduce their impact. Overall, this paper is aimed at answering the following question: *What are the perceived barriers preventing Vietnamese companies from adopting green innovation?*

As is the standard for a research paper, besides the introduction, this paper contains a literature review, methodology, findings, discussion of results, and finally, the conclusion.

2. LITERATURE REVIEW

Green innovation, also known as eco-innovation or sustainable innovation, is an innovation capable of creating positive impacts on the ecological environment in particular and sustainable development in general (Rennings, 2000). The concept of "green innovation" emphasizes solutions that can be intentional or accidental to reduce environmental impacts.

Green innovation can be categorized into three groups: green product innovation, green process innovation, and green management innovation (Chen, 2008). Green product innovation introduces new or significantly improved products in response to environmental issues (e.g., safe raw materials, green product design, energy savings, pollution reduction, increased recycling, and reduced waste) (Chen et al., 2006). Companies that pursue product innovations are usually specified in four ways: being greener, being newer, being cheaper, or generating more benefits for customers (Driessen, 2005). The three latter categories may also result from earlier inclusive growth. Green process innovation means modifying production processes and systems to achieve energy savings, pollution prevention, and waste recycling and processing. Green process innovation includes improving existing processes or adding new materials to reduce environmental impacts (Cheng & Shiu, 2012). Finally, "green management innovation" refers to company strategies and operations regarding environmental trends (green strategies, business models, and environmental management) (Calza et al., 2017). Each type of innovation presents different potential barriers (García-Granero et al., 2018).

Research on green innovation barriers shows differences in different countries. These green innovation barriers may also be perceived differently by companies. Mohnen and Röller (2005) added barriers to green innovation in companies from Ireland, Denmark, Germany, and Italy. The authors identified four groups of barriers - risk and financial, knowledge, skills and knowledge outside the business, and regulation - and asserted that the lack of internal human capital complements all other barriers in most industries. In the Netherlands, Mohnen et al. (2008) showed that financial barriers significantly affect the green innovation projects of firms; but these financial barriers depend on the size of the companies and the economic situation.

Clausen (2008) explained that people who want to innovate tend to be more aware of barriers. This perception is positively related to the perceived barriers. Barriers to green innovation should be understood as a measure of how companies overcome them, not as barriers to innovation (Baldwin & Lin, 2002). In turn, the definitions of green innovation barriers can indicate how successfully a company has overcome those barriers. D'Este et al. (2008) similarly suggested that barriers are preventing firms from engaging in innovative activities, which then create a positive impact so that companies can provide potential solutions that overcome these barriers and innovate.

According to Pinget et al. (2015), the cost barrier reflects a company's financial difficulties and the lack of financial resources (internal and external) for implementing

green innovation projects. Knowledge barriers relate to human resources with limited knowledge and skills. Human resources support green innovation as a business strategy to gain a competitive advantage. Technology barriers can limit innovation activity. Technologies and markets associated with green innovation tend to be complex and rapidly evolving. Market barriers reflect the market structure and are demand-driven.

Many authors like Jaffe et al. (1995), del Río González (2009) and Mady et al. (2022) pointed out that environmental regulations create the initial motivation for companies to develop green innovation through standards, taxes, and/or certification (Wagner, 2003). However, return profits from investments in green innovation are difficult to obtain. The possibility of market failure leads to a higher need for policy interventions to promote innovation (Rennings, 2000). For SMEs, although regulation is a strong driver of green innovation, meeting environmental regulations is very difficult (Brammer et al., 2012), especially in a complex regulatory system involving multiple certifications, policies, or organizations. Zhu et al. (2012) found that vague laws or regulations, coupled with excessive taxation, have a deterrent effect on small businesses, in particular Chinese SMEs. Therefore, well-designed regulations must be appropriate and sufficient to support the green innovation processes of enterprises.

Madrid-Guijarro et al. (2009) also noted that bureaucracy has a negative effect on green innovation. The role of institutions cannot be limited to passively making regulations or suggesting incentives. For all of these interventions to be successful, they must consider the characteristics and actual needs of different businesses, such as their sector, location, size, economic trends, motivation, ambition, and perception. These differences strengthen the responsibility of policymakers (Castellano et al., 2022). As reported by D'Este et al. (2008), small businesses often face barriers related to costs and markets. Studies in developing countries report that insufficient financial resources, inadequate government support, and weak infrastructure are the main barriers limiting green innovation (Nassar & Faloye, 2015; Wellalage & Fernandez, 2019).

Previous studies conducted among European SMEs have shown inadequate financing ,resulting in financial risks and innovation costs ,and difficulties in recruiting qualified human resources are the two main barriers to innovation in developed countries (Madrid-Guijarro et al., 2009; Vigoroso et al., 2021). Furthermore, Hadjimanolis (2003) emphasized the role of managers because their awareness and positive attitude toward innovations are considered fundamental factors.

Previous literature also shows substantial barriers to green innovation in various sectors of the economy. In manufacturing, significant internal barriers to green innovation include economic and human resources, attitudes and perceptions of stakeholders (Oke, 2004), lack of technology and infrastructure, uncertain benefits (Ullah et al., 2021; Xia et al., 2019), lack of collaboration, and inadequate knowledge and information (Abdullah et al., 2016). External barriers include adverse policies, a lack of consumer acceptance, and a lack of government and consumer support (Oke, 2004). Kemp & Pearson (2007) identified three groups of obstacles to green innovation: (i) economic factors, including high cost, perceived risk, and lack of appropriate finance; (ii) enterprise factors, including lack of skilled workers and R & D; (iii) other factors, including lack of technology or institutional support. In developing countries, significant barriers to green innovation that companies often face include a variety of institutional, resource, and capacity barriers (Fu

et al., 2017); the lack of resources, consumer demand, government laws, and finance in Bangladesh (Tumpa et al., 2019) and the lack of different green innovation practices in manufacturing companies in Thailand (OECD, 2012). The institutional barrier is the direct pressure to apply green innovation to business (Liu & Yan, 2018).

In Vietnam, green innovation is still at an early stage. While Vietnam is a developing country with a dominant agricultural economy (Do et al., 2019), the manufacturing industry is still in its emerging stages and has significant negative environmental impacts (Fadly, 2020). Vietnam ranks among the top ten countries with the worst air pollution of 141 countries surveyed according to the 2020 Environmental Performance Index (Wendling et al., 2020). Government and stakeholders are looking for solutions to revert environmental pollution issues (NASATI, 2016; OECD, 2021). However, green innovation is still not a common practice in developing countries. Research on green innovation barriers in developing countries such as Vietnam is currently limited. It is not possible to deliver elements of existing barriers from other countries to Vietnam's situation. Therefore, qualitative studies are needed to address potential barriers to green innovation.

Table 1: Some Indicators Relates to Innovation Ecosystem Status in Vietnam from 2015 to 2021

	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Rank on Global Innovation Index	52	59	47	45	42	42	44
Rank among ASEAN nations	3	4	3	4	3	3	4
Number of ISO 14000 certificates	1198	1371	1443	1449	1487	1904	-
Number of ISO 9000 certificates	4148	5160	3897	3774	3735	4530	-
Number patents offered to Vietnamese authors	63	76	109	205	169	139	153
Number patents offered to foreign authors	1325	1347	1636	2014	2451	4180	3538
Number of useful solutions offered to Vietnamese authors	86	114	118	290	230	201	187
Number of useful solutions offered to foreign authors	31	24	28	65	72	77	63
Number of industrial designs offered to Vietnamese authors	841	877	1339	1277	1234	1110	1196
Number of industrial designs offered to foreign authors	545	577	928	1083	938	956	907
Number of trademarks offered to Vietnamese authors	14207	13672	15172	14492	22265	25659	25379
Number of trademarks offered to foreign authors	4133	4368	4229	4070	6555	8041	7621

Sources: WIPO(2022b), ISO(2022a), and CSHTT (2022)

According to the WIPO Global Innovation Index 2022 (2022b), compared to other lower middle-income countries, the Vietnam innovation ecosystem has many positive points. The political environment, information infrastructure, and trade liberalization are among its strengths. However, the investment and capital market, global innovation connection, service export, and environmental performance are the weaknesses. The institution for commercializing scientific research innovations from the academy to industry is not well functioning (Nguyen et al., 2018). Vietnam has made good progress on building the innovation ecosystem, providing intellectual property protection,

and building firm capability in technology but needs greater effort to improve the current situation (World Bank, 2021).

3. METHODOLOGY

To investigate the barriers to enterprise green innovation, we apply a qualitative and inductive approach with iterative comparisons and systematic coding of important barriers. in green innovation (Strauss & Corbin, 1998). The case studies were carried out according to the research method of Eisenhardt (1989). With limited information, the case study method attempts to generate theoretical and practical insights from empirical observations (Eisenhardt & Graebner, 2007).

Given limited information, the case study approach attempts to generate theoretical and practical insights from empirical observations (Eisenhardt & Graebner, 2007). This study analyzed multiple case studies to capture details of green innovation barriers that would otherwise go unnoticed in quantitative analyses. Multi-case studies can add to the validity and generalizability of the results (Cook & Campbell, 1976).

The study design consisted of four steps:

Step 1. Analyze the primary literature that helped form the general idea of green innovation in Vietnam. Regarding the study on green innovation policies by Jang et al. (2015), green innovation can be divided into natural resource management (including water, raw materials, energy, etc.), waste management, renewable energy, purchase or procurement, clean technology, climate change, etc. Open interviews with government officials and industry experts on the topic of green innovation helped to focus on certain industries such as agriculture (Sinh, 2019), waste treatment, chemicals, and natural forest products (Park et al., 2017). These industries were chosen because they are subject to regulatory pressure on safety, health, and environmental waste issues and generate prominent environmental and social impacts in Vietnam. Government intervention in agriculture and the food industry aims to reduce the environmental impact of climate change, soil loss, water pollution, fertilizer and pesticide use, and packaging.

Step 2. To determine the reach of 5–10 businesses from each industry and conduct semi-structured interviews on the topic of green innovation and practices and then combine the interview data with secondary data, company reports, and websites, this study narrowed down the sample to five: a top company from each selected industry. This study applied the random sample strategy to identify the respondents. Case studies were selected and screened according to the following criteria: (1) enterprises with new green innovations, (2) enterprises that applied green innovations for at least two years, and last, but not least, enterprises that agreed to participate. The smallest companies in the study have approximately 20 employees; the largest has approximately 1,000 employees. In addition, the identities of the interviewees and the company are kept anonymous. Otherwise, the companies will not agree to participate. The green innovation feature was categorized in the following table:

Table 2: Green Innovation Features and Company Responses to Barriers

Company	Green innovation features	Responses
Company A (Waste treatment)	Innovation initiatives/ processes/ Using green technology/Waste recycling technology	Owns a waste treatment solution patent and applies for their patent The company positions itself as a waste management leader. The improvement of existing waste treatment technology.
Company B (Furniture)	Innovative products/ Strategic Innovation products/technology Natural Resource Depletion	We aim to create a good environment using environmentally friendly materials and not destroy nature by using new, better materials than the old ones. The strategy has been to apply new technologies and materials to furniture production from the beginning. Technology development can compete directly with traditional furniture companies. Products are designed to reduce material usage, and synthetic material to replace natural wood is used.
Company C (Electrical cables)	Innovation initiatives Waste recycling technology	The manager also launched a proactive Kaizen program to promote employee innovation and reduce environmental impact. The program has been beneficial to the company in both financial and environmental aspects. Recycling and using scrap copper and recycling plastic packaging is a small part of greener production, as is recycling plastic to make packaging.
Company D (Organic agriculture and consultant	Innovation resources/ capabilities Green activities: Engage with communities and green innovation programs Waste recycling	*Capacity building*: We focus on niches and provide training and consulting packages to empower stakeholders on all aspects of best practices in sustainable production and organic agriculture, focusing on compliance with regulatory requirements (food safety, pesticide residues, etc.) This has developed farmers' skills, attitudes, and capacities; enhanced rural development; and ensured sustainable, participatory management. Farmers teach each other. This is more effective than communication. *Reduce waste materials*: by processing inferior products to make juices, dried products, or fertilizers. The processing company has its own brand. *Linking farmers to the market*: Organize distribution channels for farmers to increase income. Farmers participate in groups of 10-30 hectares, and the company sponsors the certificate. If it is less than 10 hectares, it is not large enough to pay for the certificate. Links are formed between farmers and processors. The company purchases

Company	Green innovation features	Responses
		and sponsors organic coffee, organic pepper, and other organic products. *Support programs*: Provide solutions and support for businesses and farmers: good agricultural practices, including VietGAP and other management certifications.
Company E (Food processing industry)	Green technology Innovation resources/capabilities Food security	*Strategy*: Environmental protection is voluntary and is considered in all corporate business decisions and the company's business plans and actions. This is the characteristic of the company that customers choose, building their reputation and trust. *Technology*: The company owns several patents on production techniques that reduce energy consumption while maintaining the quality of tropical fruits during drying. Company E prioritizes technology solutions that use less energy, are recyclable, and keep up to date with technology globally. The technology of drying jackfruit completely does not use chemicals, colorants, chemical additives, or preservatives. Processes and technology are always under standard control. *Materials*: the company prioritizes the selection of materials with the least environmental impact, develops local varieties that are more resilient and sustainable, and partners with suppliers from the farm systems, for example, to ensure green materials (requiring suppliers to address environmental issues). *Capacity building*: The company financially supports environmental initiatives. Anyone in the organization can find the best technology solution to get the job done. The company is always in favor of finding solutions that do the best work. Difficulties at work are seen as opportunities for improvement. Sustainability is at the core of our differentiation strategy. Possession of certification for Organic Processing, Organic Farming, and Organic Products according to USDA (US Department of Agriculture) and EU Organic (European Union) standards – the most prestigious organic certification for food, clean products, clean processing, and clean farming

Source: Authors'contribution.

Step 3. Data were collected from in-depth interviews with key company executives and documents provided by the companies. Detailed checklists were prepared for the interviewer with themes and subthemes corresponding to the identified topics.

Each theme represented a research question with a list of possible follow-up questions to allow the interviewer to acquire complete information. The interviews were conducted with Google Meet and lasted from one to two hours. The interviews focused on four topics: innovation activities, green innovation barriers and solutions, research and development, and general and environmental management. Afterward, 5- to 17-page interview reports were written, capturing key ideas and circumstances. The interviewees were also sent the interview reports for corrections and comments to improve data accuracy. Additional information sources included internal company reports, company profiles and websites, product portfolios, and field notes.

Step 4. Apply inductive analysis and ground theory (GT) to systematically organize the information obtained from interviews and secondary sources (Table 2). Additional interviews were arranged, and additional secondary or documentary data was collected as needed.

Following up with in-depth interviews with employees and decision-makers from selected companies helped identify the barriers affecting green innovation and find out the potential solution for the company. Formal interviews were recorded, transcribed, and data entered, coded, and analyzed (Smith and Firth, 2011; Strauss and Corbin, 1998). During the analysis, data were encoded, categorized, and compare among of the synthesized topics using Excel software (Figure 2). The main findings are presented in the following section.

The interviews aimed to collect data to understand the circumstances of green innovation by the companies. First, the study identified the barriers experienced by companies in achieving green innovations. Second, the study explored the problems and solutions used to overcome the barriers, such as access to financing and investment, information asymmetries, externalities, and infrequent decision-making. Lastly, the study explored the need for government support. The core content from the interviews related to the analysis is presented in Table 2.

Table 3**:** Existing Barriers to Green Innovation

	Barriers	**Problems**	**Responses**
1	Regulatory institutions	Inconsistent policies	A1: Mechanisms and institutions in Vietnam have tied up companies. It takes two years for a waste treatment plant project to be approved by the Ministry of Natural Resources and Environment. It costs a lot of money to get approvals from all levels of government. A2: In contrast, many enterprises take advantage of the institutional mechanisms. Enterprises set up projects to borrow and earn money. They earn money at the investment stage, not the exploitation stage.
		Lack of financial support (incentives, subsidies...)	A3: The institutions provide low-interest loans, but investment loans must have a bank guarantee, or after the investment, an audit must be completed to get a loan. D1: Government support is needed for the certificate cost.

	Barriers	Problems	Responses
		Implementation of policy	A4: Many enterprises take advantage of the institutional mechanisms for waste treatment. They set up projects to borrow and earn money. They earn money at the investment stage, not the exploitation stage...
			B1: Our government does not yet have institutions for stimulating demand to change materials for environmental reasons.
			C1: The primary pressure in my company is fear of paying the fine, not because we do not have money but because they take it seriously and realize that their side has found something wrong. Even when there was a mistake in the past that only resulted in an administrative fine of VND 800,000, although it is a very small amount, they asked us to explain repeatedly and report on it.
			D2: Farmers become traders because there is no one to care for them.
2	Technology and facilities	Poor technology	A5: Current waste treatment technology involves burying, burning, and using microorganisms.
			B2: An example is the failed policy implementation for unburnt bricks. Government policy requires that 70% of the materials be domestic and unburnt. However, unqualified, unburnt bricks cause construction problems for contractors. Therefore, the application has not been widespread. The government policy is appropriate to restrict using natural materials for burning, consuming energy, and causing environmental pollution, but it is very difficult to implement.
		Lack of infrastructure	A6: Non- classifying upstream waste, bad smells, leachate, and pollution occur due to organic waste (80% of upstream waste).
			C2: The environmental system, including the waste system, is poor, mainly for residential and hazardous waste. My customers only care about hazardous waste. Previously, my company cooperated with a company to buy recycled materials; they also collected the waste for free. No official waste collection yet.
3	Market	Lack of market demand	B3: People are unfamiliar with the new product and often prefer to use wood products.
		Marketing	C3: The company has no media coverage about its brand of environmental protection.
			E1: The usual difficulty is in understanding the new principles of market trends.
4	Finance	Lack of financial	A7: A waste treatment project is dependent on the government's budget and must be in accordance with the complicated process when using budget capital, including state inspectors and audits. Waste treatment may be granted a subsidy for an innovative project.

	Barriers	Problems	Responses
			A8: The treatment price for one ton of waste has a regular rate (200,000 VND/ton), but it is not such a simple matter. C4: Green innovation means expense. E2: The barrier is money. There must be enough money to invest correctly; then, the results will come.
5	Costs	High cost	A9: Companies incur many costs, such as costs for environmental monitoring, environmental policing, emissions monitoring, and wastewater monitoring. A10: ...you need to buy a license from an inefficient factory at a high price or combine it with inefficient licensed factories. C5: If I tell the situation to a factory manager, they think it is correct, but that it costs too much. They do not want to spend much. D3: Organic production is suitable for smallholder farmers with traditional knowledge and experienced farming systems in developing countries. However, costs are still higher than traditional farming methods due to the certificate cost. D4: The cost of an organic certificate is about 200 million VND. Farmers cannot get organic certificates because they do not know how and do not have the money for them.
6	Perception	Perception of leaders	B4: Our company is just a branch, so the director or head of the branch will change every three years. After completing his term, he will return home. The new leader will have a different opinion from the previous leader.
		Perception of workers	C6: The difficulty is mainly in the perception of the employees. They do not have a cooperative sense, and discipline does not effectively improve their behavior. D5: There is a lack of enthusiastic and ethical people. D6: From the farmers' perspective, they can do whatever they want if they have money. However, farmers forget that if they have money but no knowledge, it's like zero. So, they continue to use chemicals.
7	Human resources	Lack of human capacity	E3: The most challenging thing is human resources. In organic farming, the first step is perception; the second is moving from awareness to action. From action, you must be serious to follow the outlined path. That all comes from human resources. I posted organic farming methods to the public. Everybody knows it, but no one follows it. Vietnam has labor resources but lacks capacity. Human resources must be responsive to technology.

	Barriers	Problems	Responses
		Lack of knowledge and skills	E4: If you farm, you must have managerial knowledge. If you only know how to grow crops, you don't know the management skills from planning to cost and selling price calculations. If you don't know that, you will fall into an unsustainable situation. So, the meaning of sustainability does not mean "there".
8	Network	Lack of network	D7: Feel alone, without a community, because few people are aware of the need for environmental protection. Even if some people are concerned, they will be called crazy. Now everyone realizes the problem but does nothing.
9	Customer Acceptance	Customer Acceptance	B5: It takes a lot of time to explain to customers about new materials. Customers only care about, firstly, the product's price, and next, the uses and the durability of new materials. B6: The difficulty in switching to new materials is creating customer trust. Customers have doubts about the quality of the products we create. Some of the new materials are much better than the old ones, but the customers are unfamiliar with them. Current customers are mainly in the cities; customers in the countryside do not understand and have no access to technology.
		Lack of interest in environmental issues	B7: In common residential areas, people are not interested in benefiting from that environmental issue. D8: In Vietnam, people are only concerned with quality and price. They pay little attention to environmental protection and health.

Source: Authors' contribution.

4. RESULTS AND DISCUSSION

This study investigated barriers to green innovation among Vietnamese companies in the waste treatment, electrical cables, furniture, agriculture, and food processing sectors, which are considered to have an impact on the environment. This study identified nine significant barriers and company responses based on in-depth interviews with top managers from the five companies. Although only a small number of enterprises participated, this study provides some of the initial relevant insights into the barriers affecting companies in implementing green innovation and their solutions.

Perceived barriers

On the initial analysis, barriers to regulation; technology and facility; markets; finance; costs; human resources; networking, and customer acceptance appear to be significant obstacles to green innovation by companies in Vietnam (Table 1). However, these barriers to green innovation may not be perceived in the same way, especially for each company. Depending on the sector and size of participating companies, barriers are shown differently (Castellano et al., 2022).

Green innovation is hindered mainly by the availability of financial resources within the company and the ability to receive public grants. Galia & Legros (2004) found

that many companies give up green innovation projects due to economic barriers rather than technological or organizational barriers. As a result, companies without funding may be forced to forego the implementation of more expensive innovative technologies. This study also highlights the barriers for companies from existing technologies and infrastructure, the skills of human resources, and a lack of networks and partnerships with their stakeholders or partners. These types of barriers can also reduce the knowledge of support programs. In this study, there are inconsistencies between government institutions and their execution, or among different levels of administration, the policy implemented, time, and lack of financial support from the government that slow green innovation. This study also emphasized the implementation of government policy. The market is mentioned as a barrier in this study. Lack of market demand and uncertain marketing are mentioned by Vietnamese companies. As reported by D'Este et al. (2008), small businesses can often face barriers related to costs and markets. Studies in developing countries report that insufficient financial resources, inadequate government support, and weak infrastructure are the main barriers limiting green innovation (Nassar & Faloye, 2015; Wellalage & Fernandez, 2019).

The institution's role is not only to formulate the regulations or policies themselves but also the procedures to implement these policies as a practical matter. Unfortunately, in many cases, there are inconsistencies between government institutions and their execution or among different levels of administration that hamper green innovation (Company A).

One disadvantage for companies is the necessity to conduct green innovation with little or no external capital. Access to finance is a barrier because green innovations often entail high initial costs (Companies A, B, and D). In addition, some products and services are still relatively unfamiliar, and market acceptance is lacking. The development of synthetic materials to reduce the use of wood in furniture to protect forests and biodiversity is an example (Company C). Thus, a policy to trigger the "innovation machine" is necessary at the macro and micro levels. On the one side, the government needs to create a proprietary environment to foster green innovation. On the other hand, each organization should promote internal innovation as an engine of development. Specifically, waste reduction is an active step toward a green innovation program. Further, focusing on waste disposal can improve the importance of green technology. During this process, companies realize the defects and fix them to optimize production.

In the food and agriculture sectors, green innovation may result in new ways of organizing agricultural production. This process may involve specific technological innovations or changes in how production and marketing are organized. According to OECD (2012), innovation in agriculture occurs through reduced inputs and improvements that increase production or profitability. Potential barriers in this sector include farmers' skills, attitudes, and competency (Company D). They also lack connections to other stakeholders in the value chain, which limits the knowledge for improving production efficiency and increasing income. The case of Company D shows that the connection with other stakeholders, including the consultant, and linkage with food processing help reduce waste significantly.

Among the various factors that impact companies' pursuit of green innovation, the barriers can be grouped as innovation barriers, green core barriers, and institutional barriers.

Potential solutions

The companies in this study offer some potential solutions to the barriers faced in green innovation (Table 1). We also identified detailed steps needed to implement potential solutions by the companies surveyed in this study. These solutions should alleviate government concerns and positively impact the environment and society simultaneously while strengthening the financial position of businesses. Technology modernization is one solution, and companies must keep up to date with global technology. Company E prioritizes selecting technologies that use recyclable materials and less energy. Their technology is entirely free of chemical additives, and their processes and technology are always standard- controlled.

Company C applies the born "green" concept. Realizing the potential shortage of natural wood, this start-up identified creative designs and reduced material use as its core philosophy. Being greener is their difference from traditional furniture companies. In addition, environmental protection is considered in every business decision of the company's leadership, business plans, and behavior. These measures help build its reputation and generate customer trust.

Where technology and innovation are costly and limited, companies look for alternatives to reduce costs. One environmentally friendly way to reduce costs is to reduce waste (Companies B and C). Company C encourages internal innovation to find solutions for sustainable development. Company C provides a bonus to employees or teams at all levels who suggest valuable ideas. Internal innovation is also encouraged in Company E. Innovation is considered the weekly exercise of middle managers. They are also encouraged to film their solutions to share their knowledge efficiently among colleagues. Company E prioritizes selecting local materials with the least environmental impact. This approach is also more practical and cost- effective for businesses. For example, the company research team studies the local ecology to find the best local plant for their eco-farm. They believe that the indigenous plants are best adapted to the local environment. Hence, they are naturally organic and reduce human effort and involvement.

Furthermore, companies are trying to enhance their outside connections to overcome barriers. Company A is seeking a partner to join the venture to increase its potential to win a contract for building a waste treatment facility. Company D links the organic farmers in their cooperatives with food processing manufacturers to develop markets for products consumers might reject for purely aesthetic reasons. By enhancing the linkage between the manufacturer and other stakeholders in the supply chain, they can reduce waste materials and increase their income.

Company D aims to develop farmers' skills, attitudes, and competencies to enhance rural development. The idea is to support farmers more effectively by implementing innovations for their benefit. The company provides training and consulting packages to bring stakeholders up to speed on best practices in organic agriculture, focusing on compliance with regulatory requirements such as food safety and pesticide residues and enhancing traditional cultural and livelihood activities. In each region, they choose one representative for sustainable agriculture production and help

this farmer apply organic farming. The success of this representative is the best example of how to communicate with other farmers.

This study underlines the importance of linking innovation stakeholders. Although each company is trying to address the barriers with various solutions, each company's resources are limited and can hardly fulfill the need. Further, these barriers are related to many partners and are not solved solely by one effort. Overall, green innovation needs to nurture an ecosystem where production factors support each other. The value of green innovation has to be assessed based on its impact. All in all, the companies studied express that being green itself is a way to establish an identity different from other businesses. Being ecologically friendly is a way to communicate with customers, and green innovation provides a business opportunity for the pioneers.

The initiation of the green innovation may lead to another innovation. Furthermore, successful green innovations are highly dependent on the participation of different stakeholders in the development process. Adopting the entrepreneurship and innovation ecosystem model, the following proposed framework demonstrates entities related to the green innovation system. This model focuses on the ecosystem's stakeholders' roles in the innovation barriers indicated in the case studies.

The green innovation ecosystem is complicated, with many parties involved. Green innovation motivators include administrators, consumers, innovation entities, consultants, and investors. Their activities interact with each other, stimulating or constraining green innovation. The framework shows that human capital, R & D capability, and institutions are at the center and substantially impact other factors. Further, the development of green innovation requires the development of the ecosystem. Efforts to overcome these barriers require the combined efforts of all partners.

5. CONCLUSION

Vietnamese companies play a vital role in supporting green innovation, providing a sustainable example to customers, and benefiting the national economy. However, they often face serious environmental problems, so they expect many solutions from the government. Each company has its responses to overcome barriers. The case studies provide numerous examples of the measures to overcome barriers that inspire others to follow.

This study summarizes perceived barriers to green innovation and potential solutions, according to business executives, and provides recommendations. The significant barriers faced by companies include regulatory implementation barriers, technology, market, finance, costs, human resources, network, and perceptions of different stakeholders. However, these barriers may differ by company and context. In addition, these factors also interact with each other. Therefore, to promote green innovation, the development of all entities in the green innovation ecosystem is crucial.

Companies can develop green innovations if given clear and consistent institutions, subsidies, fees, and objectives. Providing businesses with better public policies on green innovation will enhance their competitive advantage and contribute to sustainable growth. Green innovation can take various forms, such as playing a decisive role and providing a supportive policy framework and requirements. Many companies hope that the government will prevent or help reduce their problems. Anticipating and eliminating potential barriers faced by Vietnamese companies is challenging for government programs to overcome, but the government should support companies by eliminating barriers to business development.

Therefore, policy regulations play an important role in raising awareness among companies, providing information (Porter & van der Linde, 1995), and reducing uncertainty. Policies are geared towards changing perceptions rather than simply providing incentives or control instruments. Efforts to support green innovation may involve information dissemination, technology transfer, or public partnerships because such commitments can reduce the presence of perceived barriers.

Finally, further research is needed to address the barriers in specific sectors instead of looking at the big picture. Future studies need to reach more respondents in broader terms that will help identify areas for targeted intervention to promote innovation in businesses in Vietnam. Other limitations are mainly related to the description of the study, as the results are not easily generalizable. Further research is needed to quantify and consolidate knowledge of the barriers to green innovation in emerging markets. This study also proposes a study of stakeholders, such as government and customers, on barriers to green innovation to be conducted.

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