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AHP-SWOT Analysis of Strengths, Weaknesses, Opportunities, and Threats of Implementing Green Innovation

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Abstract

Green innovation means applying innovation to achieve sustainable and environmentally friendly development goals. Green innovation is a new concept in many developing countries. This research analyzes the strengths, weaknesses, opportunities, and threats (SWOT) when implementing green innovations in Vietnam. We interviewed 58 experts and entrepreneurs who have experience with green innovations by Vietnamese firms. The data were analyzed using the hybrid SWOT-AHP method. Eigenvectors were calculated for local factor priority (within each factor) and global factor priority (for all factors). Results show that external factors are predominant in fostering the implementation of green innovation. The potential benefit that green innovation generates is its strength. However, the belief that innovation is challenging to apply hinders the effort. The developing innovation ecosystem provides a new positive signal, but the current unstable economic environment is a significant negative external factor. This study sheds light on policy approaches for promoting green innovation. Remarkably, the SWOT-AHP analysis provides the strategic approach for potential measures to prioritize the limited resources available in developing countries. Finally, this research provides input for future quantitative research.

Keywords: Green innovation, sustainable development, AHP-SWOT, Vietnam

JEL Classifications: O30, O38, Q55

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1. Introduction

Nowadays, the word "green" is commonly combined with different concepts to refer to environmentally friendly activities. Green economic development (also known as green growth) is the key to a prosperous future and sustainable development (OECD, 2011). Aghion et al. (2009) claimed that there is "no green growth without innovation." Indeed, green innovation or eco-innovation is considered an effective solution to improve environmental performance and simultaneously a significant potential source of business opportunities for enterprises.

Modern environmental management believes nations can only achieve sustainable development goals with the voluntary participation of all economic and social actors (Sachs et al., 2019). Among them is the enterprise,one of the significant sources of pollution and hence a crucial stakeholder in solving the world's environmental issues. In the green innovation process, enterprises play multiple roles. Enterprises generate environmental impact (green performers), create green innovation (eco-innovators), implement the green innovation outcome (eco-adopters), and are, at the same time, the investor and beneficiary from that process (eco-entrepreneurs) (OECD, 2015).

In developing countries, enterprises, especially small and medium-sized enterprises (SMEs), are often unaware of the attractive financial opportunities for environmental improvement and associate environmental protection with technical complexity and a cost burden. Even when these businesses are aware of the potential of environmental performance to improve their competitiveness, they may lack the skills and expertise to act on mutually beneficial opportunities. At the same time, the lack of resources often results in SMEs being risk-averse and less willing to invest in new technologies, partly due to uncertainty over payback periods (OECD, 2021).

Vietnam is among the top countries facing severe environmental issues and suffering the massive impact of global climate change (World Bank, 2021, 2022). According to the 2022 environmental performance index, Vietnam ranked 178 out of 180 countries (Wolf et al., 2022). Like other developing countries, Vietnam relies heavily on natural resources to develop, but this growth model endangers the environment. Maintaining competitiveness with low environmental impact remains a challenge for domestic enterprises (World Bank, 2020). This circumstance requires businesses to strengthen their capacity for technological innovation and the competitiveness of green technology nationally and internationally.

Although green innovation is a contemporary matter of academic concern worldwide, it is still absent from the policies of many developing countries like Vietnam. The lack of uniform regulation and promotion institutions for different industries hinders the widespread adoption of green strategies. Only with the institution's leadership can the reward for green investment be determined. Furthermore, the unclear polluter/user pay principle distorts the competitiveness of green innovators compared to polluters. Such reasons also cause many enterprises to choose a wait-and-see attitude toward green innovation (Z. Huang et al., 2019). Therefore, this article focuses on identifying which factors may encourage or hinder firms from investing in green innovation and establishing some order of priority for those factors.

We used the analytical hierarchy process (AHP) method to accomplish this research objective. AHP is a popular qualitative analysis method to assess the importance of factors and facilitate inferential decision-making. In addition, hierarchical analysis provides a logical basis for selecting optimal solutions to complex and ambiguous problems (Saaty, 1980, 1990). Similarly, the SWOT (strengths, weaknesses,

opportunities, and threats) analysis method is widely and effectively used in strategic analysis to assess the internal and external influences that have an impact, either positive or negative, on the studied issue (Leigh, 2010). However, SWOT analysis is often qualitative, based on the participants' perception, experience, and understanding. Therefore, AHP effectively supports SWOT analysis. Furthermore, the hybrid AHP-SWOT approach provides a scientific basis for SWOT analyses that are otherwise based solely on subjective judgments (Brudermann et al., 2015; Kurttila et al., 2000).

In addition to the first part, which provides an overview, the next part of the study presents the theoretical basis of green innovation and summarizes previous studies. Section 3 presents the research methodology, and Section 4 presents and discusses the research results. Section 5 concludes.

2. Literature Review

2.1 Innovation vs. green innovation

Innovation has been the driver of economic development (Schumpeter & Backhaus, 2003). Rogers et al. (2008) define innovation as the degree to which an individual or entity adopts new ideas earlier than any other system member." Thus, the entity participating in the innovation process will generate more robust success (Teixeira & Werther, 2013).

Sustainable economic development is still challenging for many countries worldwide (Imasiku, 2021), even though the costs of environmental problems have burdened many economies (UNCTAD, 2022). In the past decades, many debates have arisen on the moral and practical issues of choosing growth over environmental protection (Beckerman, 1992). Though there are still challenges, one potential solution to this dilemma is green innovation. "Green innovation is a form of innovation that contributes towards sustainable development through the development of ecological improvement" (Xavier et al., 2017, p. 1). Further, Kemp and Pearson (2007) define green innovation as the production, assimilation, or exploitation of products, production processes, services, or management or business methods that are new to the organization, where the organization can develop or adopt these methods themselves to deliver results in reducing risk, environmental pollution, and other negative impacts of resource use (including energy use) compared to other relevant alternatives.

Green innovation includes three main categories: green product innovation, green process innovation, and green management innovation (Y.-S. Chen et al., 2006; Y.-S. Chen, 2008). Green product innovation is the introduction of new or significantly improved products in response to environmental concerns (e.g., non-toxic raw materials, green product design, energy saving, pollution prevention, waste recycling, and waste minimization). Product innovations are also described by four characteristics: greenness, novelty, relative advantage, and product cost (Driessen, 2005). Green process innovation is modifying production processes and systems to create environmentally friendly products that meet ecological goals (energy saving, pollution prevention, and waste recycling). Green management innovation refers to the company's strategy and operations aligning themselveswith environmental trends (green strategy, business model, and environmental management system) (Calza et al., 2017). Later authors added another category: green marketing innovation (Kumar Kar & Harichandan, 2022; Ottman & Books, 1998; Sarkar, 2012; Vaccaro, 2009).

2.2 Core factors for implementing green innovation

Until recently, many businesspeople considered investing in environmental activities an expense or a cost burden (Ghosh Ray, 2019). Nonetheless, strict environmental regulations and the dissemination of environmental issues to the public have changed companies' rules and competition models (Koval et al., 2020; Leal Filho et al., 2020; N. P. Nguyen & Adomako, 2022). As a result, green innovation has become an essential strategic tool to achieve sustainable development in manufacturing industries faced with increasing environmental pressure. However, during the research process, the authors have not found any research that directly mentions the strengths, weaknesses, opportunities, and threats related to implementing innovations—instead, several lines of evidence on each of these matters are listed below.

The green innovation capability of an organization depends on its innovation capacity. The absorptive capacity model proposed by Zahra and George (2002) states that a company's ability to innovate depends on its ability to perceive the value of new information, assimilate it, and apply it for commercial purposes. Absorbability emphasizes dynamic capabilities toward strategic changes and flexibility in the ability to receive and exploit external factors to form knowledge (Gluch et al., 2009). Such capability is created only with a green orientation and managerial mindset. The activation triggers, social integration mechanisms, and appropriability regimes are the moderators in this process (Mady et al., 2022).

Kawai et al. (2018) claimed that the pressure from stakeholder groups, including regulatory, market, and societal stakeholder pressure, is a proactive mechanism for green innovation. Regulations in many countries and consumer requirements on environmental issues are increasing (L. Zhang et al., 2015). The institution is always critical to fostering development solutions to overcome barriers. Especially when implementing a novel approach like green innovation, it requires the leadership and support of the appropriate institutions. Nonetheless, the strict regulations themselves do not guarantee environmental improvement, but the efficiency of implementing the regulations does (Omojolaibi & Nathaniel, 2022). Song et al. (2021) found that regulation has a U-shape impact on green product innovation. In addition, evidence in China shows that the command-and-control regulation does not solve environmental issues (Tang et al., 2020).

Green innovation acts as a competitive enabler because of its positive impact on competitive strength, corporate image enhancement, satisfaction, and market share (Sellitto et al., 2020). In addition, green innovation also creates a competitive advantage by reducing costs and making a difference. However, green process innovation creates competitive advantages, while green product innovation is the factor that creates competitive strength.

Zhang et al. (2020) surveyed 340 companies in China using the PLS-SEM model. The results show that businesses need technological, organizational, and environmental readiness to optimize sustainable development outcomes. Technological readiness includes technological capabilities and relative technological advantages. Organizational readiness includes innovation capacity and a concern for the environment. Finally, environmental readiness includes policies and market orientation.

Several authors claimed that the management system impacts green innovation performance. Li et al. (2019) showed the positive impact of applying an environmental system. Nonetheless, Li et al. (2018) found the negative impact of implementing a quality management system on green innovation. Soewarno et al. (2019) showed that companies should develop green innovation strategies that reflect their green organizational identity.

Since the economic renovation in 1986, Vietnam has maintained a high growth rate of 6- 6.5% on average. Nonetheless, the engine of growth depends on many resource-intensive industries. Vietnam is among the countries that suffer from the most severe

environmental problems. The environmental performance is low, except for the recycling rate (Table 1). Regarding frontier technology readiness, labor skills and investment in research and development are among the most significant weaknesses.

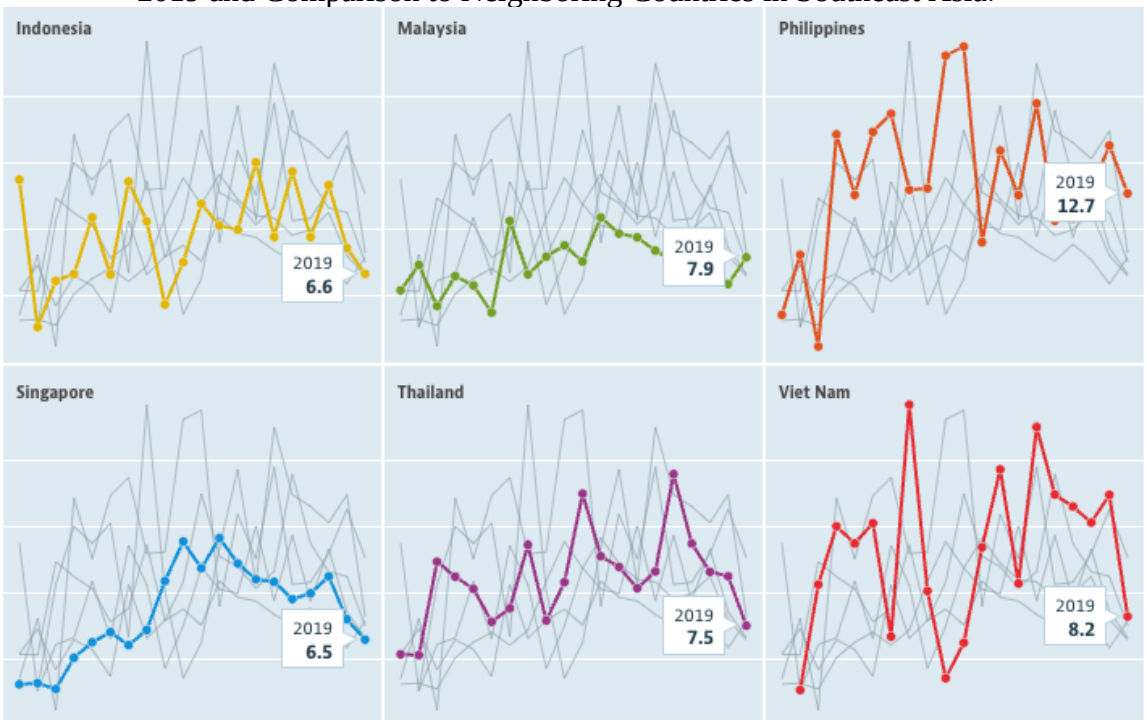
Table 1: Vietnam's Frontier Technology Readiness Index and Environmental Performance Rank in a Benchmark with Neighboring Countries

	Vietnam	Indonesia	Malaysia	Thailand	Singapore	Philippines
Frontier technology readiness index (2019)						
Overall index	0,486	0,403	0,707	0,593	0,952	0,604
Access to finance	0,881	0,586	0,857	0,901	0,860	0,714
ICT	0,537	0,390	0,811	0,628	0,971	0,529
Industry activity	0,740	0,563	0,805	0,686	0,879	0,896
Research and Development	0,291	0,381	0,490	0,446	0,603	0,410
Skills	0,286	0,285	0,457	0,388	0,817	0,395
Global environmental performance index (2022)						
Overall rank	178	164	130	108	44	158
Environmental Health	130	152	62	93	25	132
Tree cover loss	155	131	152	117	144	84
Air quality	130	152	62	93	25	132
Wastewater treatment	134	141	75	116	1	126
Wetland loss	131	-	-	145	-	-
Recycling rate	10	96	62	13	7	8

Source: Author's compilation from https://epi.yale.edu/epi-results/2022/component/tcl (accessed on 2/2/2023) and https://unctadstat.unctad.org/wds/TableViewer/tableView.aspx (accessed on 2/2/2023)

In 2012, the Vietnamese government launched the Vietnam Sustainable Development Strategy for the 2011−2020 period and, in the same year, the National Strategy on Green Growth, marking a commitment to environmental protection and efforts toward sustainability (Q. M. Pham et al., 2021). In 2016, the prime minister approved Project 844 to support the National Innovation Startup Ecosystem. The innovation capacity and environmental technology of enterprises in Vietnam need to improve. As illustrated in Figure 1, the rate of environmental patents issued in Vietnam fluctuated between 2000 and 2019. However, this diagram reflects that environmental technology attracts greater attention from innovators in Vietnam than in other countries.

Figure 1: Percentage of Environmental Technology Patents in Vietnam during 2000-2019 and Comparison to Neighboring Countries in Southeast Asia.



Source: OECD (2023)

Studies on green activities in the Vietnam context have been soaring recently. Among them are many articles about green construction (H. D. Nguyen & Macchion, 2022; H.-T. Nguyen et al., 2017; H.-T. Nguyen & Gray, 2016; T. T. H. Nguyen, 2022). Others focus on green practices for various industries like green tourism (Hieu & Rašovská, 2017), green supply chain (Do et al., 2020; T. Le, 2020), green agriculture (T. Nguyen et al., 2021), motorcycle (Lin et al., 2013), and banking and finance (Hac et al., 2022; Tu & Yen, 2015).

Green innovation has attracted the attention of scholars in Vietnam recently. Table 2 shows the summary of these articles. Most of them use survey data with the structural equation modeling method, reflecting the scarcity of secondary data on this matter, and focus on determinants of green innovation. Most of the evidence shows the rising interest of firms in green activities.

Table 2: Highlights Studies on Green Innovation in the Vietnam Context

PUBLICATION	METHODOLOGY	KEY TARGET	FINDINGS
Binh and Khang (2017)	Survey	Climate change	Foreign-owned companies have more activities to respond to climate change than Vietnamese companies.
Huang *et al*. (2019)	Interpretive structural modeling (ISM), interpretive structural modeling (ISM)	Barriers to green innovation implementation	Financial capability constraints and a lack of government support are the most decisive challenges.
Badir *et al*. (2020).	Survey	Innovation	Both external and internal knowledge sources are essential to employee innovation work output, but external knowledge resources are more vital in the case of Vietnamese enterprises.
Doan & Nguyen (2020).	Survey- SEM	green innovation	Green innovation, and green entrepreneurship and development
Nguyen Minh Ha (2021)	Survey	Green innovation	Governmental pressure, market changes, government support, and customer pressure have positive effects.
Nguyen & Adomako (2022)	Survey- SEM	Stakeholder pressure for eco-friendly practices	Environmental commitment is a mediator to stakeholder pressure on eco-innovation.
Ha *et al.* (2022).	Survey - SEM	Green Innovation	Relative advantage, compatibility, and simplicity significantly impacted green innovation.
Huang (2022)	DEA technique	Green economic recovery	The positive effect of green finance and industrial structure is positively related to green economic recovery.
Ngo (2022)	Survey - SEM	Greenmarket orientation, green innovation	Green innovation is positively related to firm competitiveness.
Le & Ikram (2022)	Survey- SEM	Geen innovation	
Cecere & Bernardi (2022)	Literature review	A green innovation study in Asia and Vietnam	Stakeholders are interested in green activities.
Hung (2023)	Quantile-on-quantile regression and wavelet coherence	Economic sustainability	Digitalization, green investment, and financial development positively affect economic sustainability.

Source: Author 's compilation

3. Research Methodology

3.1 The concept of the AHP method

The analytical hierarchy process proposed by Saaty (1980) is a multi-objective decision-making method. AHP is widely applied in many fields to help decision-makers choose the best solution among alternatives based on multiple criteria.

A hierarchical structure diagram begins with a goal to analyze in terms of primary and component criteria, and the final level usually includes possible alternatives. The evaluation process uses a pairwise comparison matrix with a 9-point scale, determines the weights based on the eigenvectors corresponding to the largest eigenvalues, and then checks the consistency coefficient. Finally, weights are calculated as a means to make the best decision.

AHP uses matrices to sort factors to arrive at a mathematically optimal solution and infers the scales from pairwise comparisons of factors and choices. These numerical techniques help determine quantitative values from verbal comparisons. The advantages of AHP lie in its ability to combine qualitative and quantitative factors to consider in making decisions and its flexibility in setting goals (Abdel-Basset et al., 2018). For example, decision-makers can include expertise, subjective preferences, and relevant information in a single analysis. In addition, AHP is easy to apply and understand, offering the benefit of improved decision-making.

The advantages of AHP are valuable features that complement SWOT analysis to reduce decision-maker subjectivity. This combination provides a sound basis for considering the current situation or holistically predicting the future, especially for new problems for which quantitative statistics are unavailable. Moreover, after making these comparisons, decision-makers will have new quantitative information about the decision-making situation, for example, whether a particular weakness requires all their attention or if the company faces any future threats that exceed its opportunities.

SWOT analysis is commonly used in general strategy formulation to analyze internal factors (strengths and weaknesses) and external factors (opportunities and threats) to help strategic planners grasp the key points for solutions appropriate to the decision-making context. However, SWOT analysis largely depends on the subjective feelings of the implementer and does not have clear grounds. Therefore, many scholars have tried to make SWOT analysis more quantitative and systematic. However, it was when incorporated with AHP analysis that SWOT analysis became a quantitative and systematic technique for decision-making.

Following the method stated by Kurttila et al. (2000); Shiwakoti and Regmi (2022), the authors implemented the combined AHP-SWOT method.

Step 1: Perform a SWOT analysis to identify the internal and external environmental factors that pertain to the strengths, weaknesses, opportunities, and threats.

Step 2: The decision-makers make pairwise comparisons of factors belonging to each group of strengths, weaknesses, opportunities, and threats based on the importance of each factor.

Step 3: The experts participating in the survey make a pairwise comparison of the importance of the four elements in the SWOT model (strengths, weaknesses, opportunities, and threats) in the relationship between these factors and the problem to be analyzed.

Step 4: Calculate the weight of each factor for the population. After forming the comparison matrix, we calculate the preference vector, which represent the relative rank of importance associated with the criterion or comparison.

Step 5: Evaluate the reliability of the results and assess the suitability of applying these results to provide governance implications for the problem to be analyzed.

The results give quantitative values that show the importance of the factors included in the SWOT analysis. These results help decision-makers obtain quantified information to support the decision-making process. From there, they can focus on the most critical factors and combine strengths and opportunities to find the right solutions. This method has many advantages in modeling uncertain and risky situations because it can derive scales for which conventional measures do not exist and supports group decision-making by breaking down a complex problem into its components. Furthermore, this method is flexible and checkable for inconsistencies. AHP reduces subjectivity in decision-making.

Many studies worldwide have used this method, mainly when dealing with newly implemented problems that have not been surveyed on a large scale. Therefore, many scholars have used this method to evaluate new technologies that have a beneficial impact on the environment, such as photovoltaic cells (Reinsberger et al., 2015), growing grass on the roofs of buildings (Brudermann et al., 2015; Sangkakool et al., 2018), space and satellite industry (Lee et al., 2021), biogas technology (Brudermann et al., 2015), and the electricity authority in Nepal (Shiwakoti & Regmi, 2022).

3.2 Research model

Even though companies are more enthusiastic about environmental initiatives and activities nowadays, the concept of green innovation is still alien to Vietnam. In this study, we aim to discover the context and room for green innovation by investigating which factors are the strengths, weaknesses, opportunities, and threats to enterprises in their green innovation activities. Therefore, the use of expert research methods is appropriate. Accordingly, the study was carried out as follows:

This is part of a multi-tasking project. We conducted an online survey among our industry contacts for the pilot study. We posed open questions, such as: Does his/ her business implement any environmentally friendly solutions within this year? If so, what are the advantages and disadvantages for enterprises of implementing these solutions? Which internal factors of enterprises positively impact green innovation (strengths)? What factors from within the enterprise harm innovation (weaknesses)? Which external factors of the enterprise positively impact green innovation (opportunities)? What factors from outside the enterprise harm innovation (threats)? Based on the survey responses, we grouped responses into four groups regarding strengths, weaknesses, opportunities, and threats. The factors were selected based on the frequency of occurrence of a given element in the responses. For each conceptual field of the SWOT model, the strengths group will list favorable and internal factors that the enterprise can control. Factors within the business that create disadvantages are weaknesses, and factors external to the business that bring advantages are opportunities. Finally, adverse external factors are threats. For each concept field, we chose three factors with the highest frequency in the survey. The research team also cross-checked the chosen item through a literature review before finalizing the factors to include in the research model, as shown in Table 3 below. The qualitative process is demonstrated in other published papers.

Table 3: Elements of the SWOT Analysis

Group	Factor	International reference	Vietnam context reference
Strengths	S1 Improve the image of the business	(Chen, 2008)	Nguyen & Pham (2022)
	S2 Optimize resource use	(Sellitto *et al*., 2020)	Truong and Le (2023)
	S3 Reduce environmental costs	(Tariq *et al*., 2017, 2019)	Truong and Le (2023)
Weaknesses	W1 Difficult to determine the effectiveness	(Meidute-Kavaliauskiene *et al*., 2021)	Huang *et al.* (2022)
	W2 Difficult to do due to incompatible resources	(Cuerva *et al*., 2014; Zhang *et al*., 2020)	Huang *et al.* (2022)
	W3 Difficult to convince the stakeholders	(Weng *et al*., 2015)	Huang *et al.* (2022)
Opportunities	O1 The formation of the startup ecosystem	(D. D. T. Pham et al., 2019)	Pham and Hampel-Milagrosa (2022)
	O2 Consumers increase environmental awareness.	(Liu *et al*., 2012; L. Zhang *et al*., 2015)	Nguyen and Adomako (2022); Le Van *et al.* (2019)
	O3 Institutional environmental pressure increases	(Pham *et al*., 2019)	Nguyen and Adomako (2022)
Threats	T1 The volatility of the economic environment	(Gu *et al*., 2021)	Huang *et al.* (2022);
	T2 Inconsistent administration and control of environmental issues	(X. Chen *et al*., 2018; Gollakota *et al*., 2020)	Huang *et al.* (2022); Nguyen and Adomako (2022)
	T3 Consumers have not prioritized choosing green products.	(Nekmahmud & Fekete-Farkas, 2020a; L. Zhang *et al*., 2019)	Huang *et al.* (2022)

Source: Author 's proposes based on the literature review and qualitative analysis

3.3 Data collection method

The research team surveyed businesses with outstanding green innovation activities to collect data. We gathered information about green innovation initiatives and activities from specialized environmental journals, the information page of the National Office of Intellectual Property, the Alumni network, and postgraduate students of Dalat University and the University of Economics in Ho Chi Minh city. We contacted over one hundred businesspeople, government officers, and entrepreneurs via email. However, 66 people accepted to attend the interview face-to-face via Google Meet. However, after screening for validation of the expert's experience and responses, 58 samples were included in the data for analysis. They are top and middle managers of various scale enterprises, governmental administration officers, managers or mentors of entrepreneurship and innovation incubation, innovators and researchers, environmental engineers, and entrepreneurs whose businesses relate to eco-innovation. The data were collected between March and June 2021.

Table 4: Summary of Respondent's Information

	Classification	Number
Age	18-39 years	33
	40-60 years	25
Positions	Top-level manager	30
	Middle-level manager	28
Gender	Male	43
	Female	15
Field of business	Governmental office and E&I incubation	6
	Agricultures	4
	Manufacturings and constructions	17
	Services	31
Business Scale	Startup	9
	Small and medium-sized company	21
	Large scale company	28
Ownership mode	State-owned enterprise	9
	Foreign-owned enterprise	7
	Joint-venture	3
	Private company	33
	Governmental office and E&I incubation	6

Source: Author's calculations from data

The respondents were asked to compare the importance of factors according to strengths, weaknesses, opportunities, and threats. The AHP scale given in Table 5 was used to form the comparison matrices:

Table 5: Hierarchical Scales

Scale (A_{ij})	Hierarchy	Reciprocal (decimal)
Absolutely more important	9	1/9 (0.111)
Much more important	7	1/7 (0.143)
More important	5	1/5(0.200)
Partly more important	3	1/3(0.333)
Equally important	1	1(1.000)
*2,4,6,8 are the interval value of the above hierarchies correspondingly		

Source: Author's proposal based on Kurttila et al. (2000)

Besides considering the importance of the factors in each group, the respondents also compare the influence of the strengths, weaknesses, opportunities, and threats groups overall.

4. Research Results

4.1 Analysis results for local factor priority

As Saaty (1980) suggested, the local factor priority is the relative priority level for each SWOT factor. After performing the initial data from the response and the calculation from Table 3, each cell is made according to the selection divided by the total cell value of the matrix. Then, the relative priority level p is the mean of each row, divided by the total number of criteria ($0 < p < 1$ and $\sum_{i=1}^{n} p_i = 1$). Then, use this weight and do a similar calculation to find the second eigenvector. This process will stop if the difference in the weights at the later calculation time is tiny compared to the previous result. Then, the weights of the second calculation are accepted as the result of the evaluation. The results are in Table 6 below. If the CR values of all factors are less than 10%, the result is valid (Saaty, 1980). Some key points can be drawn from the results in Table 6.

Among the factors that are favorable due to the internal conditions of businesses, the factor "reduces environmental costs" is considered the most critical ($p = 65\%$), followed by "improves the image of the business" (p=27,86%) and "optimizes resource use" ($p = 7{,}14\%$). This weighting method shows the awareness and efficiency that enterprises have gained from green innovation activities. Compared with the qualitative responses that the research team has collected, it also shows that most businesses are implementing environmentally friendly activities by reducing the amount of energy used or by conducting digital transformations to reduce administrative and printing procedures. At the same time, the above results also show that the financial benefits of saving resources are tangible and are the driving force when businesses think about lowering their environmental impact. Furthermore, improving the business's image is also an existing benefit to the awareness and interest of businesses. This result is also consistent with several studies that have demonstrated the positive impact of environmentally friendly activities in general on corporate image (Chen, 2008).

The most significant disadvantage is that green innovation activities are challenging to implement ($p = 86.56\%$). This is not surprising, given that green innovation activities have only been introduced in Vietnam recently. As a result, when enterprises think of innovation, they often think of it as a sublime thing they cannot currently do. Another point, with a weight of 23,2%, is that it is difficult to determine the specific effects of implementing green innovation. Although the above benefits are recognizable, the measurement method for obtaining specific results is a limitation that prevents businesses from boldly implementing them.

Regarding opportunities, the most critical factor is the emerging startup ecosystem. The experts in the survey considered this to be a key factor, with a high consensus on its importance. The ecosystem will create an environment for incubating innovations to be effectively implemented, including green innovation.

An unstable economic environment is the most crucial threat factor (p = 69,07%). The consumer's choice for green products (p = 21,59%) follows, and last is the institution ($p = 7{,}48\%$). Although these figures indicate the importance of each factor, these are the three most important factors that affect the implementation of green innovation in each SWOT category. Customers are at the core of all business activities. Although there are increasing concerns about environmental issues, customers are still strongly affected by reasons other than the green image. This result is in line with the previous literature. Thus, a positive consumer attitude toward environmentally friendly products is still essential to policies promoting green innovation.

Institutional policies are crucial for promoting innovation, including green innovation (Mady et al., 2022; Majid et al., 2020). To date, there has been a significant improvement in policies on environmental issues. However, it is not only the policy itself and the laws or regulations but the way to make these policies practical (Chen et al., 2018; Gollakota et al., 2020).

4.2 Priority of factors

The calculation results for the hierarchy of the overall factors of strength, weakness, opportunity, and threat are in Table 7.

The results in Table 7 show that external factors have the most substantial impact on the implementation of green innovation, in which the element of opportunity plays the most critical role (weight is 0.343). This figure shows the recognition of business leaders that green innovations bring opportunities and have much potential to be explored and developed in the future. It also shows the belief that forming an innovation ecosystem will be a driving factor for fostering green innovation. Thus, it reflects that recent information about the movement of entrepreneurship and innovations in Vietnam has also spread and generated a positive attitude in the business community. Moreover, external risk factors are also driving forces of concern.

Businesses at the time of the survey suffered from the epidemic's effects, so the respondents deeply felt the threat of the volatile business environment. This result is in line with Gu et al. (2021). These impacts, on the one hand, show that businesses face many difficulties in forming long-term plans. On the other hand, the volatile business environment caused by the epidemic raises concerns about environmental issues and sustainable development. These concerns make businesses pay more attention to solving challenges to sustainable development. In addition, the role of consumers in choosing green products is an essential factor that motivates businesses to pursue green innovation actively. The fact that consumers have yet to prioritize choosing green products in their shopping choices (Sharma, 2021; Young et al., 2010) is an obstacle to green innovation. For many reasons, consumers in developing countries, although interested in environmental issues, hesitate to pay higher prices to buy environmentally friendly products (Nekmahmud & Fekete-Farkas, 2020b; H. V. Nguyen et al., 2019). Figure 2 demonstrates the visuals of the above results.

Table 6: Result for Local Factor Priority

	Initial Matrix			Multiplied Matrix			Sum	Eigenvector 1	Multiplied Matrix Repetition			Sum	Eigenvector 2	Difference
Strengths	S1	S2	S3	S1	S2	S3			S1	S2	S3			
S1	1	5	0,33	2,99	12,31	1,36	16,66	0,277	29,098	112,930	12,364	154,393	0,278	(0,001)
S2	0,2	1	0,14	0,82	2,98	0,346	4,146	0,069	7,456	29,008	3,173	39,638	0,071	(0,002)
S3	3	7	1	7,4	29	2,97	39,37	0,654	67,884	263,644	28,918	360,446	0,650	0,004
Mean λmax = 3,0537. Consistency index CI= (λmax -n)/ (n-1) = 0,0268/ Reliability Index (RI) (for n=3) = 0,58. Consistency ratio (CR) = CI/RI = 0,04626 = 4,626%														
Weaknesses	W1	W2	W3	W1	W2	W3			W1	W2	W3			
W1	1	0,2	3	2,99	26,2	3,358	32,548	0,233	55,273	2072,8	244,12	2653,011	0,235	0,003
W2	5	1	7	12,31	75	8,79	96,1	0,687	163,353	6024,7	710,50	7707,303	0,684	0,002
W3	0,33	0,14	1	1,36	8,79	1,128	11,278	0,081	19,625	704,80	83,104	901,712	0,080	(0,0005)
Mean λmax = 3,0946. Consistency index CI= (λmax -n)/ (n-1) = 0,0473/ Reliability Index (RI) (for n=3) = 0,58. Consistency ratio (CR) = CI/RI = 0,085276 = 8,151%														
Opportunities	O1	O2	O3	O1	O2	O3			O1	O2	O3			
O1	1	7	4	2,98	30	9,75	42,73	0,701	29,490	273,862	90,105	393,457	0,696	0,005
O2	0,14	1	0,25	0,342	2,98	1,06	4,382	0,072	3,165	29,490	9,678	42,333	0,074	(0,003)
O3	0,25	4	1	1,06	9,75	3	13,81	0,227	9,678	90,105	29,670	129,453	0,229	(0,002)
Mean λmax = 3,0676. Consistency index CI= (λmax -n)/ (n-1) = 0,0338. Reliability Index (RI) (for n=3) = 0,58. Consistency ratio (CR) = CI/RI = 0,058276 = 5,8276%														
Threats	T1	T2	T3	T1	T2	T3			T1	T2	T3			
T1	1	6	4	3,02	24	9,98	37	0,695	29,340	219,570	92,139	341,050	0,690	0,004
T2	0,17	1	0,33	0,422	3,01	1,34	4,772	0,090	3,901	29,250	12,256	45,407	0,091	(0,002)
T3	0,25	3	1	1,01	7,5	2,99	11,5	0,216	9,239	69,240	29,069	107,548	0,217	(0,002)
Mean λmax = 3,0594. Consistency index CI= (λmax -n)/ (n-1) = 0,0297. Reliability Index (RI) (for n=3) = 0,58. Consistency ratio (CR) = CI/RI = 0,051177 = 5,1177%														

Source: Author's calculation

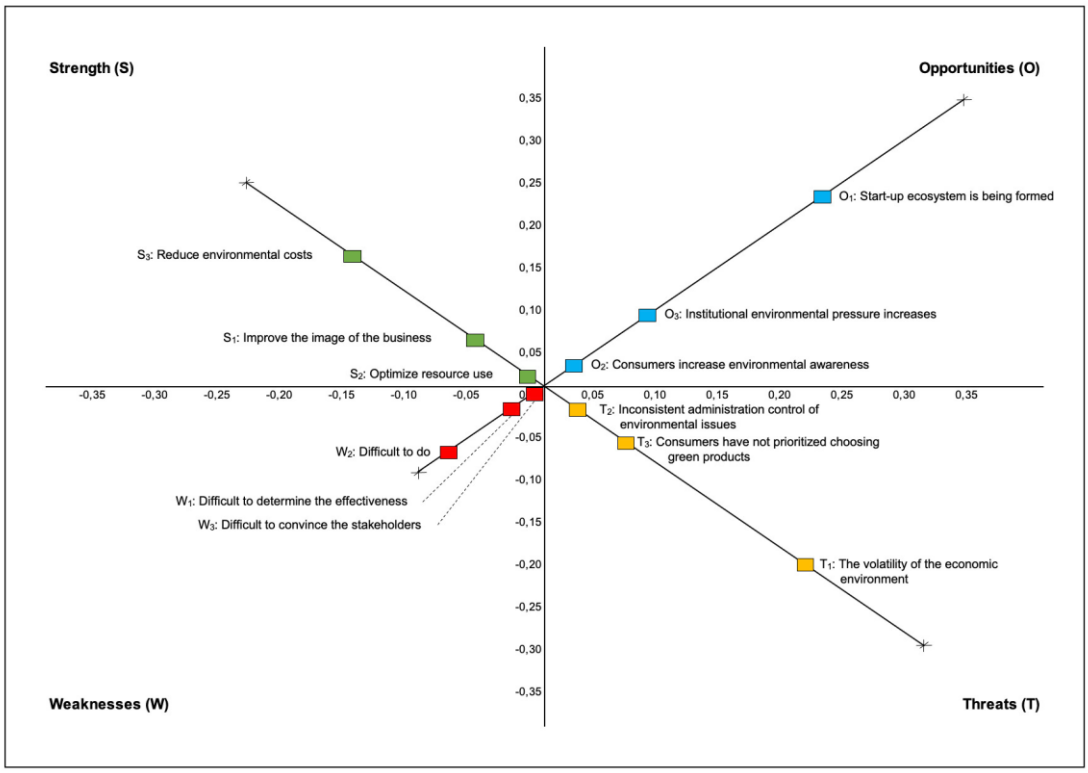
Table 7: Calculation of Global Priority

	Multiplied Matrix									**Eigenvector 1**	**Multiplied Matrix Repetition**					**Eigenvector 2**	**Difference**
	S	**W**	**O**	**T**	**S**	**W**	**O**	**T**	**Sum**		**S**	**W**	**O**	**T**	**Sum**		
S	1,00	5,00	0,33	5,00	3,99	13,30	2,36	27,31	46,960	0,306	81,220	235,037	41,821	432,947	791,026	0,295	0,010
W	0,20	1,00	0,20	3,00	1,60	3,99	0,89	8,40	14,876	0,097	27,652	81,220	14,289	149,544	272,706	0,101	(0,004)
O	3,00	5,00	1,00	7,00	8,40	27,31	3,97	44,00	83,680	0,546	149,544	432,947	77,909	808,168	1468,569	0,549	(0,002)
T	0,20	0,33	0,14	1,00	0,89	2,36	0,41	3,97	7,628	0,049	14,289	41,821	7,453	77,909	141,473	0,052	(0,003)

Mean λmax = 4,21. Consistency index CI= (λmax -n)/ (n-1) = 0,0725. Reliability Index (RI) (for n=3) = 0,9. Consistency ratio (CR) = CI/RI = 8,06%

Source: Author's calculation from research data

Figure 2: Graphical Representation of the Global and Group Priority



Source: Author composed based on results

The above results provide a plausible approach for the policy. Several potential strategic practices may appear in the SWOT analysis. Since innovation is the core of green innovation, enhancing enterprise innovation capability is the key to green innovation achievement. Besides investment in R&D and innovation at each firm, increasing the innovation capability of the whole economy is crucial. Second, developing an innovation and entrepreneurship ecosystem is a synthetic measure since all innovation actors are interrelated. The interaction in the innovation ecosystem may improve the capacity of each partner. Third, building up the investment network for green innovation outcomes helps with the dissemination of green technology and the expansion of the green business model.

Although the government has launched a policy to build up the innovation ecosystem in Vietnam, the roles of the actors still need to be completed. The policy currently focuses on innovation and entrepreneurship overall. Accounting for essential social impact, green innovation is a unique element of the ecosystem, and that mindset sets the best solution. The burgeoning new industry requires a launch platform to take off.

In tandem with improving innovation capability, the authority should build up the framework, instructions, or manuals to evaluate the effectiveness of green innovation in firms. Good green innovation practitioners should be recognized and publicized to the community via an award or network, along with a sponsorship. Similar measures should also include eco-innovation users. Green innovation may be initiated through social innovation if the authority provides a platform for community ideas pooling. Moreover, from the social innovation achievements of the firm will come green enterprise innovation.

There is no way to negate the crucial role of environmental performance institutions in fostering a green innovation ecosystem. The green performance of a firm should be an important factor in investment decisions. Further, a good surveillance and

control system for the environmental performance of economic actors will solidify the implementation of institutional legitimacy.

5. Conclusion

The research method used was the hybrid AHP-SWOT analysis, a sophisticated refinement of the AHP method. The research results add to the scientific basis for policy proposals promoting green innovation by enterprises. From a macro perspective, it is possible to see the current picture of the application of green innovation in Vietnam, which suggests appropriate solutions. In micro terms, the research results answer the issues affecting innovation management, especially green innovation. Furthermore, they contribute to improving the awareness and approach of enterprises to aspects of sustainable development and help businesses better understand the multifaceted impacts of caring for the environment.

This study has analyzed the external and internal factors relevant to implementing green innovation in enterprises in the Vietnam context through a hybrid SWOT–AHP analysis. The findings show that the overview of green innovation is positive. The strengths outweigh the weaknesses.

Further green innovation is more of an opportunity than a threat. Moreover, the tendency of the overview of stakeholders is to focus more on external factors than internal factors. The analysis suggests that 'reducing environmental costs" is the most potent target of green innovation. Meanwhile, the fear of implementation leans on the thought that green innovation is difficult to apply due to the weakness of resources. For the external factor, the overall view leans on the hope of raising the startup ecosystem built recently. Finally, the primary threat is the uncertainty of the economic environment.

Efforts to increase acceptance of green innovation should consider these critical factors. First, the enterprise should simultaneously take advantage of green innovation by enhancing innovation and addressing environmental issues. Second, the institution should provide the platform to launch green innovation by building a favorable innovation ecosystem. Third, the government should build a recognition system to reward green innovation pioneers based on their environmental performance. Finally, it is also essential to provide access to resources to increase the innovation capability of firms.

The paper provides an overall managerial attitude toward green innovation. However, the AHP-SWOT approach also has limitations. Future research may improve using a fuzzy AHP method. In addition, future research may use large-scale surveys to validate these factors empirically. If collected well, data related to green innovation should be necessary for future analysis and be another basis for green innovation policy.

We collected data during the spread of Covid-19 when most businesses focused on survival. Such circumstances may impact attitudes toward the economic environment and their decisions to implement green innovations. So the readers should raise awareness of these in the explanation of the results.

Integrating a SWOT analysis with the AHP to rank the criteria or factors is efficient for the organization's decision-making and strategy selection. Future research can improve on this approach by analyzing cases with uncertainty.

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References

Abdel-Basset, M., Mohamed, M., & Smarandache, F. (2018). An extension of neutrosophic AHP–SWOT analysis for strategic planning and decision-making. *Symmetry*, *10*(4), 116.

Aghion, P., Hemous, D., & Veugelers, R. (2009). *No green growth without innovation*. Bruegel Policy Brief-2009/07 Retrieved from http://aei.pitt.edu/12218/

Badir, Y. F., Frank, B., & Bogers, M. (2020). Employee-level open innovation in emerging markets: Linking internal, external, and managerial resources. *Journal of the Academy of Marketing Science*, *48*(5), 891–913.

Beckerman, W. (1992). Economic growth and the environment: Whose growth? whose environment?. *World Development*, *20*(4), 481–496.

Brudermann, T., Mitterhuber, C., & Posch, A. (2015). Agricultural biogas plants – A systematic analysis of strengths, weaknesses, opportunities and threats. *Energy Policy*, *76*, 107–111.

Calza, F., Parmentola, A., & Tutore, I. (2017). Types of green innovations: Ways of implementation in a non-green industry. *Sustainability (Switzerland), 9(8),1301.*

Cecere, R., & Bernardi, P. (2022). Cultural entrepreneurship and green innovation in ASEAN: A focus on SMEs and Vietnam area. In V. Ratten (Ed.), *Cultural Entrepreneurship: New Societal Trends* (pp. 109–119). Singapore: Springer Nature Singapore.

Chen, X., Yi, N., Zhang, L., & Li, D. (2018). Does institutional pressure foster corporate green innovation? Evidence from China's top 100 companies. *Journal of Cleaner Production*, *188*, 304–311.

Chen, Y.-S. (2008). The driver of green innovation and green image – green core competence. *Journal of Business Ethics*, *81*(3), 531–543.

Chen, Y.-S., Lai, S.-B., & Wen, C.-T. (2006). the influence of green innovation performance on corporate advantage in Taiwan. *Journal of Business Ethics*, *67*(4), 331–339.

Cuerva, M. C., Triguero-Cano, Á., & Córcoles, D. (2014). Drivers of green and non-green innovation: Empirical evidence in Low-Tech SMEs. *Journal of Cleaner Production*, *68*, 104–113.

Do, A. D., Nguyen, Q. V., Le, Q. H., & Ta, V. L. (2020). Green supply chain management in Vietnam industrial zone: Province-level evidence. *The Journal of Asian Finance, Economics and Business*, *7*(7), 403–412.

Doan, A. T., & Nguyen, T. T. (2020). Green innovation, green entrepreneurship, and Vietnamese SME development: the role of market turbulence. In Nguyen, D.P. et al, *Recent Developments in Vietnamese Business and Finance*: Vol.1 (pp. 337–381). Singapore: World Scientific.

Driessen, P. H. (2005). *Green product innovation strategy*. (Doctoral thesis, Tilburg University, Tilburg). Retrieved from https://research.tilburguniversity.edu/en/publications/green-product-innovation-strategy

Ghosh Ray, K. (2019). Green cost calculus for corporate environmental responsibility. *Social Responsibility Journal*, *15*(6), 819–836.

Gluch, P., Gustafsson, M., & Thuvander, L. (2009). An absorptive capacity model for green innovation and performance in the construction industry. *Construction Management and Economics*, *27*(5), 451–464.

Gollakota, A. R. K., Gautam, S., & Shu, C.-M. (2020). Inconsistencies of e-waste management in developing nations – Facts and plausible solutions. *Journal of Environmental Management*, *261*. 110234

Gu, K., Dong, F., Sun, H., & Zhou, Y. (2021). How economic policy uncertainty processes impact on inclusive green growth in emerging industrialized countries: A case study of China. *Journal of Cleaner Production*, *322*, 128963.

Ha, N. M., Nguyen, P. A., & Phung, N. B. H. (2022). Technological factors affecting green innovation: Evidence from the manufacturing sector in Vietnam. *Ho Chi Minh City Open University Journal Of Science - Economics And Business Administration*, *12*(1), 3–19.

Hac, L. D., Trang, N. T. T., & Minh, L. X. (2022). Green credit development: current status and policy recommendations in Vietnam. *International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies*, *13*(3), 1–12.

Hieu, V. M., & Rašovská, I. (2017). A proposed conceptual model of green practices impacting on the tourism business and their performances: A case of Phu Quoc island Vietnam. *Business Trends*, vol.7, no. 1, p. 76-87.

Hoang Duc, B., & Do Ba, K. (2017). Business responses to climate change: Strategies for reducing greenhouse gas emissions in Vietnam. *Asia Pacific Business Review*, *23*(4), 596–620.

Huang, S.-Z. (2022). Do green financing and industrial structure matter for green economic recovery? Fresh empirical insights from Vietnam. *Economic Analysis and Policy*, *75*, 61–73.

Huang, Y.-F., Chen, A. P.-S., Do, M.-H., & Chung, J.-C. (2022). assessing the barriers of green innovation implementation: Evidence from the Vietnamese manufacturing sector. *Sustainability*, *14*(8), 4662.

Huang, Z., Liao, G., & Li, Z. (2019). Loaning scale and government subsidy for promoting green innovation. *Technological Forecasting and Social Change*, *144*, 148–156.

Hung, N. T. (2023). Green investment, financial development, digitalization and economic sustainability in Vietnam: Evidence from a quantile-on-quantile regression and wavelet coherence. *Technological Forecasting and Social Change*, *186*, 122185.

Imasiku, K. (2021). Organizational insights, challenges and impact of sustainable development in developing and developed nations. *Sustainable Organizations—Models, Applications, and New Perspectives; Sánchez-García, JC, Hernandez-Sanchez, B., Eds*, 1-20.

Kawai, N., Strange, R., & Zucchella, A. (2018). Stakeholder pressures, EMS implementation, and green innovation in MNC overseas subsidiaries. *International Business Review*, *27*(5), 933–946.

Kemp, R., & Pearson, P. (2007). Final report MEI project about measuring eco-innovation. UM Merit, Maastricht, 10(2), 1-120.

Koval, V., Mikhno, I., Trokhymets, O., Kustrich, L., & Vdovenko, N. (2020). Modeling the interaction between environment and the economy considering the impact on ecosystem. In *E3S Web of Conferences* (Vol. 166, p. 13002). EDP Sciences.

Kumar Kar, S., & Harichandan, S. (2022). Green marketing innovation and sustainable consumption: A bibliometric analysis. *Journal of Cleaner Production*, *361*, 132290.

Kurttila, M., Pesonen, M., Kangas, J., & Kajanus, M. (2000). Utilizing the analytic hierarchy process (AHP) in SWOT analysis—A hybrid method and its application to a forest-certification case. *Forest Policy and Economics*, *1*(1), 41–52.

Le, T. (2020). The effect of green supply chain management practices on sustainability performance in Vietnamese construction materials manufacturing enterprises. *Uncertain Supply Chain Management*, *8*(1), 43–54.

Le, T. T., & Ikram, M. (2022). Do sustainability innovation and firm competitiveness help improve firm performance? Evidence from the SME sector in vietnam. *Sustainable Production and Consumption*, *29*, 588–599.

Le Van, Q., Viet Nguyen, T., & Nguyen, M. H. (2019). Sustainable development and environmental policy: The engagement of stakeholders in green products in Vietnam. *Business Strategy and the Environment*, *28*(5), 675–687.

Leal Filho, W., Wolf, F., Lange Salvia, A., Beynaghi, A., Shulla, K., Kovaleva, M., & Vasconcelos, C. R. P. (2020). Heading towards an unsustainable world: Some of the implications of not achieving the SDGs. *Discover Sustainability*, *1*(1), 1-11.

Lee, J., Kim, I., Kim, H., & Kang, J. (2021). SWOT-AHP analysis of the Korean satellite and space industry: Strategy recommendations for development. *Technological Forecasting and Social Change*, *164 (C).*

Leigh, D. (2010). SWOT Analysis. In K. H. Silber, W. R. Foshay, R. Watkins, D. Leigh, J. L. Moseley, & J. C. Dessinger (Eds.), *Handbook of Improving Performance in the Workplace: Volumes 1-3* (pp. 115–140). Hoboken: John Wiley & Sons, Inc.

Li, D., Tang, F., & Jiang, J. (2019). Does environmental management system foster corporate green innovation? The moderating effect of environmental regulation. *Technology Analysis & Strategic Management*, *31*(10), 1242–1256.

Li, D., Zhao, Y., Zhang, L., Chen, X., & Cao, C. (2018). Impact of quality management on green innovation. *Journal of Cleaner Production*, *170*, 462–470.

Lin, R.-J., Tan, K.-H., & Geng, Y. (2013). Market demand, green product innovation, and firm performance: Evidence from Vietnam motorcycle industry. *Journal of Cleaner Production*, *40*, 101–107.

Liu, Z. (Leo), Anderson, T. D., & Cruz, J. M. (2012). Consumer environmental awareness and competition in two-stage supply chains. *European Journal of Operational Research*, *218*(3), 602–613.

Mady, K., Abdul Halim, M. A. S., Omar, K., Abdelkareem, R. S., & Battour, M. (2022). Institutional pressure and eco-innovation: The mediating role of green absorptive capacity and strategic environmental orientation among manufacturing SMEs in Egypt. *Cogent Business & Management*, *9*(1), 2064259.

Majid, A., Yasir, M., Yasir, M., & Javed, A. (2020). Nexus of institutional pressures, environmentally friendly business strategies, and environmental performance. *Corporate Social Responsibility and Environmental Management*, *27*(2), 706–716.

Meidute-Kavaliauskiene, I., Çiğdem, Ş., Vasilis Vasiliauskas, A., & Yıldız, B. (2021). Green innovation in environmental complexity: the implication of open innovation. *Journal of Open Innovation: Technology, Market, and Complexity*, *7*(2). Retrieved from: https://www.mdpi.com/2199-8531/7/2/107

Nekmahmud, M., & Fekete-Farkas, M. (2020a). Why not green marketing? determinates of consumers' intention to green purchase decision in a new developing nation. *Sustainability*, *12*(19). Retrieved from: https://www.mdpi.com/2071-1050/12/19/7880.

Ngo, Q.-H. (2022). the adoption of green market orientation in logistic industries—empirical evidence from Vietnamese SMEs. *Journal of Open Innovation: Technology, Market, and Complexity*, *8*(4), 199

Nguyen, H. D., & Macchion, L. (2022). Exploring critical risk factors for green building projects in developing countries: The case of Vietnam. *Journal of Cleaner Production*, *381*, 135138.

Nguyen, H. V., Nguyen, C. H., & Hoang, T. T. B. (2019). Green consumption: Closing the intention-behavior gap. *Sustainable Development, 27*(1), 118–129.

Nguyen, H.-T., & Gray, M. (2016). A review on green building in Vietnam. *Procedia Engineering, 142*, 314–321.

Nguyen, H.-T., Skitmore, M., Gray, M., Zhang, X., & Olanipekun, A. O. (2017). Will green building development take off? An exploratory study of barriers to green building in Vietnam. *Resources, Conservation and Recycling, 127*, 8–20.

Ha, N. M., Nguyen, P. A., & Phung, N. B. H. (2022). Technological factors affecting green innovation: Evidence from the manufacturing sector in Vietnam. *Ho Chi Minh City Open University Journal of Science-Economics and Business Administration, 12*(1), 3-19.

Nguyen, N. P., & Adomako, S. (2022). Stakeholder pressure for eco-friendly practices, international orientation, and eco-innovation: A study of small and medium-sized enterprises in Vietnam. *Corporate Social Responsibility and Environmental Management, 29*(1), 79–88.

Nguyen, T., Nguyen, D., Phan, T., Luong, T., Nghiem, T., & Doan, T. (2021). Green supply chain integration and environmental performance in Vietnam agricultural industry. *Uncertain Supply Chain Management, 9*(4), 1107–1126.

Nguyen, X., Nguyen, H., Nguyen, K., & Nguyen, T. (2022). The Green Innovation of Construction Enterprises in Vietnam. *International Journal of Innovation and Sustainable Development, 13*, 2022. https://doi.org/10.7176/JESD/13-8-01

OECD. (2011). *Towards Green Growth* | Retrieved from Oecd-Ilibrary.Org. https://read.oecd-ilibrary.org/environment/towards-green-growth_9789264111318-en

OECD. (2015). *the innovation imperative: contributing to productivity, growth and well-being*. Retrieved from Oecd-Ilibrary.Org. https://read.oecd-ilibrary.org/science-and-technology/the-innovation-imperative_9789264239814-en

OECD. (2021). *SME and Entrepreneurship Policy in VietNam*. Retrieved from https://www.oecd.org/publications/sme-and-entrepreneurship-policy-in-viet-nam-30c79519-en.htm

OECD. (2023). *Patents on environment technologies (indicator)*. Retrieved from https://data.oecd.org/envpolicy/patents-on-environment-technologies.htm

Omojolaibi, J., & Nathaniel, S. (2022). Assessing the potency of environmental regulation in maintaining environmental sustainability in MENA countries: An advanced panel data estimation. *Journal of Public Affairs, 22*(3), e2526.

Ottman, J., & Books, N. B. (1998). Green marketing: Opportunity for innovation. *The Journal of Sustainable Product Design, 60*(7), 136–667.

Pham, D. D. T., Paillé, P., & Halilem, N. (2019). Systematic review on environmental innovativeness: A knowledge-based resource view. *Journal of Cleaner Production, 211*, 1088–1099.

Pham, Q. M., Briesen, D., & Nguyen, T. T. T. (2021). *Environmental policy in Vietnam*. Hanoi: Thanh Nien Publishing House.

Reinsberger, K., Brudermann, T., Hatzl, S., Fleiß, E., & Posch, A. (2015). Photovoltaic diffusion from the bottom-up: Analytical investigation of critical factors. *Applied Energy, 159*, 178–187.

Rogers, E. M., Singhal, A., & Quinlan, M. M. (2014). Diffusion of innovations. In *An integrated approach to communication theory and research* (pp. 432-448). Abingdon: Routledge.

Saaty, T. L. (1980). *The analytic hierarchy process: planning, priority setting, resource allocation*. New York: McGraw-Hill.

Saaty, T. L. (1990). How to make a decision: The analytic hierarchy process. *European Journal of Operational Research*, *48*(1), 9–26.

Sachs, J. D., Schmidt-Traub, G., Mazzucato, M., Messner, D., Nakicenovic, N., & Rockström, J. (2019). Six transformations to achieve the sustainable development goals. *Nature Sustainability*, *2*(9), 805-814.

Sangkakool, T., Techato, K., Zaman, R., & Brudermann, T. (2018). Prospects of green roofs in urban Thailand – A multi-criteria decision analysis. *Journal of Cleaner Production*, *196*, 400–410.

Sarkar, A. N. (2012). green branding and eco-innovations for evolving a sustainable green marketing strategy. *Asia-Pacific Journal of Management Research and Innovation*, *8*(1), 39–58.

Schumpeter, J., & Backhaus, U. (2003). The theory of economic development. In J. Backhaus (Ed.), *Joseph Alois Schumpeter: Entrepreneurship, Style and Vision* (pp. 61–116). New York: Springer US.

Sellitto, M. A., Camfield, C. G., & Buzuku, S. (2020). Green innovation and competitive advantages in a furniture industrial cluster: A survey and structural model. *Sustainable Production and Consumption*, *23*, 94–104.

Sharma, A. P. (2021). Consumers' purchase behaviour and green marketing: A synthesis, review and agenda. *International Journal of Consumer Studies*, *45*(6), 1217–1238.

Shiwakoti, S., & Regmi, S. (2022). Strategic analysis of the Nepal electricity authority: a SWOT-AHP analysis based on stakeholders' perceptions. *International Journal of the Analytic Hierarchy Process*, *14*(1), https://doi.org/10.13033/ijahp.v14i1.944

Soewarno, N., Tjahjadi, B., & Fithrianti, F. (2019). Green innovation strategy and green innovation: The roles of green organizational identity and environmental organizational legitimacy. *Management Decision*, *57*(11), 3061–3078.

Song, M., Xie, Q., & Shen, Z. (2021). Impact of green credit on high-efficiency utilization of energy in China considering environmental constraints. *Energy Policy*, *153*, 112267.

Tang, K., Qiu, Y., & Zhou, D. (2020). Does command-and-control regulation promote green innovation performance? Evidence from China's industrial enterprises. *Science of the Total Environment*, *712*, 136362.

Tariq, A., Badir, Y., & Chonglerttham, S. (2019). Green innovation and performance: moderation analyses from Thailand. European Journal of Innovation Management, 22(3), 446-467.

Tariq, A., Badir, Y. F., Tariq, W., & Bhutta, U. S. (2017). Drivers and consequences of green product and process innovation: A systematic review, conceptual framework, and future outlook. *Technology in Society*, *51*, 8–23.

Teixeira, E. de O., & Werther, W. B. (2013). Resilience: Continuous renewal of competitive advantages. *Business Horizons*, *56*(3), 333–342.

Truong, T., Le, B (2023) Barrier perceived by companies and potential solutions to foster green innovation in Vietnam, *Thailand and the world economy, 41(3)*.

Truong Thinh, P., & Aimee, H.-M. (2022). *Vietnam's ecosystem for technology startups*. Retrieved from Asian Development Bank. https://www.adb.org/sites/default/files/publication/807121/viet-nam-ecosystem-technology-startups.pdf

Tu, T. T. T., & Yen, T. T. H. (2015). Green bank: International experiences and Vietnam perspectives. *Asian Social Science*, *11*(28), 188-199

UNCTAD. (2022). *Four key challenges facing least developed countries*. Retrieved from. https://unctad.org/news/four-key-challenges-facing-least-developed-countries

Vaccaro, V. L. (2009). B2B green marketing and innovation theory for competitive advantage. Journal of systems and Information Technology, 11(4), 315-330.

Weng, H.-H., Chen, J.-S., & Chen, P.-C. (2015). Effects of green innovation on environmental and corporate performance: a stakeholder perspective. *Sustainability*, *7*(5), 4997–5026.

Wolf, M. J., Esty, D. C., de Sherbinin, A., & Wendling, Z. A. (2022). *2022 Environmental Performance Index*. Retrieved from Yale Center for Environmental Law & Policy. https://epi.yale.edu/epi-results/2020/country/vnm

World Bank. (2020). *Vibrant Vietnam Forging the Foundation of a High-Income Economy.* Retrieved from https://documents1.worldbank.org/curated/en/745271590429811414/pdf/Vibrant-Vietnam-Forging-the-Foundation-of-a-High-Income-Economy-Main-Report.pdf

World Bank. (2021). *Vietnam: Science, technology, and innovation report 2020*. Retrieved from https://openknowledge.worldbank.org/handle/10986/36207

World Bank. (2022). *Vietnam-Country climate and development report*. Retrieved from https://openknowledge.worldbank.org/bitstream/handle/10986/37618/Vietnam%20REVISED.pdf?sequence=18

Xavier, A. F., Naveiro, R. M., Aoussat, A., & Reyes, T. (2017). Systematic literature review of eco-innovation models: Opportunities and recommendations for future research. *Journal of Cleaner Production*, *149*, 1278–1302.

Young, W., Hwang, K., McDonald, S., & Oates, C. J. (2010). Sustainable consumption: Green consumer behaviour when purchasing products. *Sustainable Development*, *18*(1), 20–31.

Zahra, S. A., & George, G. (2002). Absorptive capacity: a review, reconceptualization, and extension. *Academy of Management Review*, *27*(2), 185–203.

Zhang, L., Wang, J., & You, J. (2015). Consumer environmental awareness and channel coordination with two substitutable products. *European Journal of Operational Research*, *241*(1), 63–73.

Zhang, L., Zhou, H., Liu, Y., & Lu, R. (2019). Optimal environmental quality and price with consumer environmental awareness and retailer's fairness concerns in supply chain. *Journal of Cleaner Production*, *213*, 1063–1079.

Zhang, Y., Sun, J., Yang, Z., & Wang, Y. (2020). Critical success factors of green innovation: Technology, organization and environment readiness. *Journal of Cleaner Production*, *264*, 121701.