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Green innovation practices: a case study of Vietnamese manufacturing companies

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ABSTRACT

Green innovation is among the most potential approaches to resolve the world's current environmental pollution issues. This study explores green innovation practices from developing countries with the perspective of Vietnamese manufacturing companies as background. The case study method was conducted based on in-depth interviews with key respondents from five enterprises. Businesses were selected based on their use of innovative green concepts to produce environmentally friendly products. Outcome proposes a typological framework to identify green innovation practices of enterprises and identifies motivations for green innovation, such as technology, enterprise characteristics, products, regulatory mechanisms, human resources, market pressures; and connections.

IMPACT STATEMENT

In the process of economic development today, environmental challenges are taken very seriously. However, for sustainable development, it is key to construct green growth models; that is, to promote economic growth and development while ensuring that resources are guaranteed for long-term use. In this development, industries have a responsibility to safeguard the environment and ensure the availability of natural resources for future generations. Firms are expected to reduce the negative impact of their environmental footprint by controlling production activities. The proliferation of new and innovative business models in nongreen industries demonstrates that environmentalism is not only a regulatory trend or a marketing issue, but a way to create value and build or maintain a competitive advantage. This article also contributes practical knowledge for practitioners. When enterprises practice green innovation, society as a whole will benefit from an improved quality of life, and that future generations will not suffer from pollution or a scarcity of natural resources. By committing to green innovation, companies can create a win-win situation. The result of adopting green innovation is profit and less pollution to the environment.

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Introduction

In the process of economic development today, environmental challenges are taken very seriously. Therefore, the goal of sustainable development is of prime importance, not just growth or development. However, for sustainable development, it is key to construct green growth models; that is, to promote economic growth and development while ensuring that resources are guaranteed for long-term use (Carrillo-Hermosilla et al., 2010). In this development, industries have a responsibility to safeguard the environment and ensure the availability of natural resources for future generations. Firms are expected to reduce the negative impact of their environmental footprint by controlling production activities (Handfield et al., 1997).

Manufacturing enterprises have started paying attention to the environmental aspects of their production activities. The production process has to deal with various challenges in managing business

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resources and environmental, economic, and social sustainability concerns. Although it is important to understand how firms manage these challenges, very few studies have focused on this issue (Fernando et al., 2016). However, the situation has changed. Due to increased environmental awareness, more responsible business practices are needed (Wagner, 2010). Currently, business pressures on a manufacturing enterprise come not only from employees, customers, suppliers, and business partners, but also from government, competitors, and society. All these stakeholders continuously monitor business practices in line with sustainability aspects (Weng et al., 2015).

Numerous studies on the motivation for green innovation have been published. Particularly research on green innovation in developing and emerging countries is increasing attention; In these countries, where attribute imbalances (Wang et al., 2023), resource bricolage (Abid et al., 2023), public environmental demand, and government environmental governance (Zhang et al., 2023) seem far from supportive to green practices of business yet provide an important notice on sustainable source. However, little research has focused on green innovation in the context of Vietnam. Le et al. (2019) explored the influences of stakeholders on the implementation of horizontal and vertical green product diversification. Their results show that foreign customers play a significant role in driving companies to adopt a strategy of green product diversification. Vietnamese companies often face serious environmental problems, so they need the considerable attention of researchers and practitioners in the field of green innovation practices to find business solutions (Truong, 2023).

This article explores green innovation concepts and practices of manufacturing enterprises in Vietnam. The findings encourage businesses to continuously innovate their production processes in an environmentally friendly manner. Green products are not widely available in emerging market countries due to consumer ignorance, limited purchasing power (due to expensive product prices), and lack of government subsidies. Consumers have not yet considered purchasing green products as part of their responsibility to protect the environment for future generations.

This paper first clarifies the driving force of green innovation for a better understanding. Since this is a case study, information about the companies is briefly presented. Next, the methodology and tools used to analyze the data are presented. In the last section, the results are discussed and limitations, recommendations, and conclusions are presented. This study contributes to the existing literature by expanding on existing green innovation concepts and practices and exploring how Vietnamese businesses can achieve sustainability by adopting environmentally friendly practices in their business activities.

Green innovation practices

The important motivation for green innovation practices is extracted and determined from the literature. The motivation for green innovation is similar to theoretical innovation in that it includes both external motivation that businesses can achieve and internal motivation based on their development (Calza et al., 2017). In this regard, Díaz-García et al. (2015) explain the main factors as supply-side factors (such as the organizational capacity of enterprises) and demand-side mechanisms (such as customer and social requirements for corporate social responsibility). These factors also act as push-and-pull factors in business operations. Green innovation is often driven by a combination of factors such as technology, product development, enterprise characteristics, mechanisms and regulations, and market pressures.

Technology

Technological motivation is essential in the early development of green innovation (Horbach, 2008). Green process innovation is the improvement of existing production processes and the use of environmentally friendly technologies to produce goods and provide services with less harm to the environment (Wong et al., 2012). This motivation refers to the ability of businesses to gain core competencies or increase profits through new products or services resulting from the adoption of new technology. Technology comes from an investment in knowledge, which results in more innovation (Baumol, 2002). Therefore, many large enterprises allocate budgets to research and development (R&D) departments to acquire more knowledge. Businesses also need to ensure that employees are skilled enough to use

technology in their business operations because a lack of knowledge will hinder the production process. A delay in one part will diminish the performance of other parts. The time allocation of every process should be recorded and can later be used as a standard (Fernando et al., 2016).

Enterprise characteristics

Factors such as size and organizational capacity have an impact on the performance and innovation of companies (Díaz-García et al., 2015). Compliance can be tied to business characteristics such as the source of raw materials, the number of suppliers, the type of technology, or the number of buyers. It is also important to recognize that small businesses with flexible decision-making, lean organizational structures, and less bureaucratic communication can better respond to changes or developments. Managers with environmental concerns will have a positive impact on the adoption of environmental innovation strategies. It is more likely that they will pursue green innovation, thereby improving company efficiency and performance (Qi et al., 2010). Furthermore, Dangelico et al. (2017) argue that considering environmental aspects from the outset is a critical success factor in green product innovation. Green absorptive capacity is the moderator in the process of transforming eco eco-institutional pressure of government into eco-innovation practices of enterprises (Mady et al., 2022).

Product

Product innovation involves using novel or cleaner inputs with less impact on the environment than using recyclable materials, reducing or optimizing the use of raw materials, changing the composition of raw materials, and producing products that have a longer shelf life and are recyclable (García-Granero et al., 2018).

Mechanisms and regulations

Strict regulations and policies encourage business decisions to engage in green innovation. Two main views exist regarding the impact of regulations on corporate performance. In the first view, policymakers make green innovation policies a condition for business conduct. If enterprises do not carry out green innovation or comply with environmental regulations, they may not be granted business licenses (Weng et al., 2015). The second, cost-based view holds that if environmental management is profitable, firms will seek to pursue green innovation to maximize profits and increase shareholder wealth (Jaffe et al., 1995).

Market pressure

Díaz-García et al. (2015) consider the motivation of customers and social requirements for corporate social responsibility. Green innovation is often driven by a combination of factors such as competitive advantage and customer pressure. Aggressive competition forces businesses to be more creative and innovative to increase demand or market share. The strategy of differentiating green products or services from conventional products or services helps businesses enhance their uniqueness in the market. Jansson et al. (2011) also found that customer perception is an important indicator of innovation adoption in the marketing of green products or services to customers. Market pressure pushes businesses to adopt greener production practices (Ketikidis et al., 2013). Naruetharadhol et al. (2021) claim that green management practices need to link with open innovation to solve the consumers' pain points.

Nguyen et al. (2021) studied the social impact of innovative green enterprises. Their study suggests that such businesses have the potential to generate broader social impacts in addition to the usual positive business outcomes. The main arguments stem from the triple helix model of government, universities, and businesses, which proposes a cooperative approach between these organizations. The conceptual framework identifies (1) how different actors have supported firms to implement green innovations, and (2) to what extent green innovation creates a social impact through a triple helix model. Authors show

that forming a conceptual framework of the social impact helps governments maximize public benefits by supporting green innovation projects initiated by businesses. Although their research focuses on green products and social impact, it does not focus on the green innovation activities of businesses for sustainable development.

Research methods

Case studies can capture details of green innovations that would otherwise go unnoticed in aggregated top-down quantitative analyses. This approach entails carrying out multiple case studies to generalize the findings (Cook & Campbell, 1976). This study uses qualitative research methods in which case studies are used to collect and interpret data. To achieve the research objectives, businesses were selected through referrals from personal relationships and then screened according to the following criteria: (1) enterprises with innovative green activities, (2) green innovation solutions that have been implemented for at least two years, and (3) agreement to participate. The identities of the respondents and their companies are kept anonymous; otherwise, the companies would not have participated in this study. The companies are referred to as Company A, B, C, D, and E (The smallest companies in the study have approximately 20 employees; the two largest have approximately 1000 employees), and can be described as follows:

- Company A: This firm is the inventor of a household waste treatment technology. The company has been granted a patent from the National Office of Intellectual Property of Vietnam for its waste treatment technology. The advantage of the technology is that it can effectively treat domestic waste without garbage source pre-treatment and with no garbage, odour, leachate, bacteria, or daily waste treatment. These characteristics are very suitable for the conditions in Vietnam, where regulations on waste classification at the source have not been implemented, many current waste treatment technologies are not effective, and waste treatment capacity is not sufficient, which wastes resources and causes environmental pollution. Changing public awareness and forming a habit of garbage classification remains a difficult problem in many localities and requires much time, resources, and new policy mechanisms to be implemented.
- Company B: The company's main activity is to provide solutions to support farmers growing organic pepper and coffee according to Global GAP, HACCP, ISO22000, Fairtrade, ETI, and organic standards. The company also helps connect farmers with organic fertilizer producers so that farmers no longer depend on chemical fertilizers from businesses that supply chemical fertilizers and pesticides for crops. In addition, the company provides a solution for market produce that does not meet accepted standards of appearance. Specifically, about 60% of fresh produce meets the standards and can be sold, while the 40% that does not meet the preferences of consumers is sold to processing enterprises to make juice, dried, or powdered products. This company can sustain its business due to the owner's philosophy, which is to assist farmers in developing sustainable agriculture. Through these activities, Company B maintains relationships with suppliers and customers.
- Company C: This company specializes in designing and manufacturing furniture for households, hotels, luxury villas, and resorts. The company uses alternative materials that are environmentally friendly and do not destroy forests. In particular, the company uses synthetic wood or alternative materials rather than natural wood. The company pioneered green-oriented furniture, targeting 4-star and 5-star hotels as well as the resort market. Company C starts with a strategy to solve environmental problems by implementing green practices step by step. At the establishment stage, the firm planned to implement green practices in furniture manufacturing as a strategic approach to competitiveness. Company C combats deforestation by reducing the use of natural wood in the production of furniture. Conventional manufacturing leaves forests with insufficient time to regenerate so natural forests are shrinking. With the aim of high profits, some furniture manufacturing companies obtain raw materials from the illegal logging of forests and the illegal timber trade. The company claims that this practice harms society.

- Company D: This company operates in the electric cable industry. It began operating in the Vietnamese market in 2006 with a total investment capital of about 40 million USD and more than 600 employees. The factory is equipped with a modern closed production line system imported from Europe to create quality products that meet international standards. Currently, the company has obtained ISO 9001, ISO 14001, and ISO 45001 certifications. Company D is a subsidiary of a multinational company. company with many branches that specialize in manufacturing construction cables. Korean Mother headquarters considers eco-friendly practices a priority in their strategy. The company applies various management measures to achieve Net Zero by practicing eco-friendly material purchase, and eco-friendly product development. This policy is also embedded in the requirements of their foreign subsidy, including company D. The company recycles, and uses scrap copper from faulty cables as part of a clean production strategy. The company also launched a program to mobilize the entire workforce to contribute ideas to reduce raw material use or reduce costs while ensuring product quality. The company removes the insulation from faulty cables and melts them. The company can recycle and reuse 100 tons of copper per month instead of selling it as copper scrap.
- Company E: This company is a food processing company with more than 1000 employees. The company is the leading producer and most prestigious brand in Vietnam of dried and freeze-dried agricultural products. Initially, the company focused on improving product value, minimizing losses, and preserving local produce. The company prioritizes the use of materials with low environmental impact, uses energy-efficient technology, and requires suppliers to address environmental issues. The company has obtained HACCP, Halal food, Kosher, ISO 9001:2008, FDA, USDA Organic, and EU Organic certificates. The company has also adopted traceability and environmental standards. The company's leaders are increasingly interested in developing sustainable, environmentally friendly products. The company values the philosophy of sustainable development, as reflected in the company's behaviour from seed selection to the moment the product is put on the consumer's table. The company constantly improves and applies biotechnology to bring fresh products to customers without using colorants, chemical additives, or preservatives. With a macrobiotic philosophy, the company is continuing to develop technologies to make products that are delicious and healthful.

The data collection process was carried out by a variety of methods to gain a deeper understanding of the current situation of green innovation. In particular, the authors conducted in-depth interviews combined with field trips to relevant working establishments. The interviews aimed to explore the leadership's policies, the conditions to support innovative start-ups, action programs, and strategic views on the development of innovative start-ups. The authors also searched for relevant information on websites, patent applications, and environmental news. These are basic but effective methods for investigating the research problem.

After screening, the research team approached and conducted interviews with these companies. To collect data, the authors used semi-structured interviews and personal interviews. Due to geographical distances and the COVID-19 epidemic, all interviews were arranged through the Google Meet app at a convenient time for the respondents. The interviews were conducted during the business day and lasted one to two hours. Additionally, the respondents provided secondary data (company documents related to green innovation) after each interview to support the data analysis. Respondents were selected and interviewed to determine the understanding and practice of green innovation in manufacturing enterprises (Table 1). To understand the definition and practice of green innovation at five green manufacturing companies, interview questions were asked about the determinants of green innovation from an environmental perspective. Other questions related to how the firms carry out green innovations and the challenges and markets for green products.

Before conducting the interviews, a brief introduction about the research team, research objectives, and a commitment regarding the intended use of the information was presented to the respondents. The research team also requested the respondents' permission to use the firm's information for analysis and permission to record the interview. Both audio recording and handwritten notes were used throughout the interview. After the first interview, the interview questions were revised and suggestions were added for the following interviews.

Table 1. Methods of collecting information from respondents.

Method	Occupation	Required information
In-depth interviews, observations, recordings, notes	Chairman of the Board of Directors – General Director	Understand the definition and practice of innovation for the whole company.
	CEO	Understand the definition and practice of innovation for the whole company.
	Finance and logistics staff	Understand the definition and practice of green innovation at the relevant departments.
	Production staff	Supervising green innovation practices at the production plant.
Observations	Quality control staff	Supervising green innovation practices at the production plant.
		Determine the difference between the company's green innovation activities in Vietnam and the results of the literature review.
Short survey		Emailing some employees of the company to collect information related to their awareness and understanding of the company's implementation of green innovations.

After the interview, the research team typed the entire interview records into a text script. Responses from each interview were carefully summarized in a tabular form. At the same time, following Saunders et al. (2009), the main points in the responses to each question were aggregated and interpreted into topics and subtopics, making data processing and analysis easier. The interview content was then combined and rearranged to make across-group factor comparisons. Factors Analysis examines the differences and similarities across the different groups. To gather a complete understanding of the key factors affecting green innovation between companies. To analyze the interview data, the study proposed diagrams and two analytical tools were used. The diagrams aim to explain the factors related to green innovation that manufacturing companies consider the most important and to sort them based on their impact on the company. The impacts were identified from the findings of a literature review. According to Arundel and Kemp (2009), no single instrument is sufficient to measure green innovation. The first analytical tool used is a research framework developed by the Organization for Economic Co-operation and Development (OECD, 2009) called green innovation typology. This framework is used to position green manufacturing companies based on their understanding and practices. The taxonomy framework is an analytical framework for examining green innovation goals and mechanisms. According to the framework, the goals of green innovation are products and processes, organizations and marketing methods, institutions, and the mechanisms for green innovation are improvement, redesign, substitution, and creativity. By categorizing the positioning of companies by goals and mechanisms, this study can determine the level of green innovation and the improvements that companies need to focus on. The second analytical tool used in this study was a tree diagram of the main thematic analysis of green innovation motivation from the point of view of the interviewed firms (Arundel & Kemp, 2009).

Results and discussion

Overall, this study finds that green innovation concepts and practices are consistent with those described in the existing literature. Based on the research results, the understanding of green innovation from the point of view of five manufacturing companies is quite similar to that of previous research (Kemp & Pearson, 2007; OECD, 2009). During one interview, the director of Company E explained the current activities of green innovation, providing us with an understanding of green innovation. From the collected data, the research team found the following views about green innovation.

Company E: 'Environmental protection is considered in every business decision of the company's leadership. Talking the environment, it is always taken care of, not just when the decision begins to be of concern. We include environmental goals in business plans and in the behaviour the company has already adopted, not just in plans. We seek to create an environmentally friendly brand image. We use product and service suppliers, and input suppliers, that have requirements for environmental assurance. Exactly, because it is the way for me to keep my reputation in the market. Environmental protection is the responsibility of enterprises.

'Long-term stable development is more important. Because if we want to think about sustainability, we have to put less emphasis on immediate benefits and more priority on life; the balance has to

Table 2. Green innovation activities of manufacturing companies.

Company	Green innovation activities
A	Improved waste treatment system
B	Sustainable agriculture reduces the waste of raw materials
C	Substitute materials with less environmental impact, reduce resource use and deforestation
D	Recycles makes use of scrap
E	Uses materials with low environmental impact, uses energy-efficient technology, requires suppliers to address environmental issues

improve. Compliance with the law helps businesses develop sustainably. Environmental issues have a great influence on the company's fortunes. Exactly, because it is the way for me to keep my reputation with the market. Environmental protection is the responsibility of enterprises. Environmental management is a mandatory requirement for a company to export its products. It's voluntary on the part of the company, and it's the trust that customers choose'.

Company B: 'Green innovation brings greater economic efficiency. I work in the field. If it doesn't cost, I've saved about 20%. The second reason is the money for health costs, for the environment. You don't have to worry about the cost of going to the doctor. The savings for farmers are great. The third one is when they make the product. The price is the result of your achievements and efforts. Farmers can create a field that is free of chemicals and environmentally friendly. Sincerely, its reputation for morality is said to attract people to visit. Polite, friendly environment, competitive prices, they say. Due to dedication and environmental friendliness, customers will buy in quantity and the price will rise. The price is only high when I bring value to the customer; then the customer will pay me a high price'.

Company C: 'Green innovation is mainly the production of synthetic wood products to replace natural wood, resulting in a good environment. The second benefit is the use of environmentally friendly materials. The third is the preservation of nature, and the fourth is that these innovative materials have many advantages over the old materials'.

To better understand the current applications of green innovation in case studies, green innovation activities were reviewed based on the OECD (2009) research framework (Table 2). These examples illustrate green innovation processes and the different contexts of its realization.

The agriculture and food technology industries have taken steps to reduce the amount of chemicals used, producing clean products, especially concerning environmental impact (Company B). Along with the growing demand for organic food, green innovation initiatives have focused on sustainable agricultural production, sustainable product development, environmentally friendly products, and environmental protection. Although most of the industry's green innovation initiatives are focused on technological product and process innovations, the industry's involvement in various institutional arrangements has laid the groundwork for much of this development. For example, with the development of traceability and environmental standards desired by customers, Company B has obtained HACCP, halal food, kosher, ISO 9001:2008, FDA, USDA Organic, and EU Organic certificates. Company E has also applied traceability and environmental standards. Similarly, developments in these areas have built on institutional and organizational green innovation arrangements.

In recent years, the Vietnamese industry has significantly enhanced its environmental performance through the redesign of various manufacturing processes. These are often driven by strong external pressures to reduce pollution and by rising prices and scarcity of raw materials. For other industries, most green innovations have been realized through technological advances, typically in the form of product or process modification and redesign, such as waste technology efficiency (Company A), by ideas contributed to reduce raw material use or reduce costs while maintaining product quality (Company D), or by reducing the use of wood by using alternative materials in furniture production (Company C). The company is also looking for more efficient ways to dispose of its scrap. A notable example is the use of discussion groups throughout the company to tap into the innovative ideas and knowledge of employees (Company D). There are signs that the understanding of ecological innovation in this area is expanding. Alternative business models and production methods are being explored, as well as new methods to deal with pollutants from the manufacturing process.

In summary, the main focus of green innovation today in manufacturing companies tends to be on products or processes as the goal of green innovation and with modification or redesign as the main

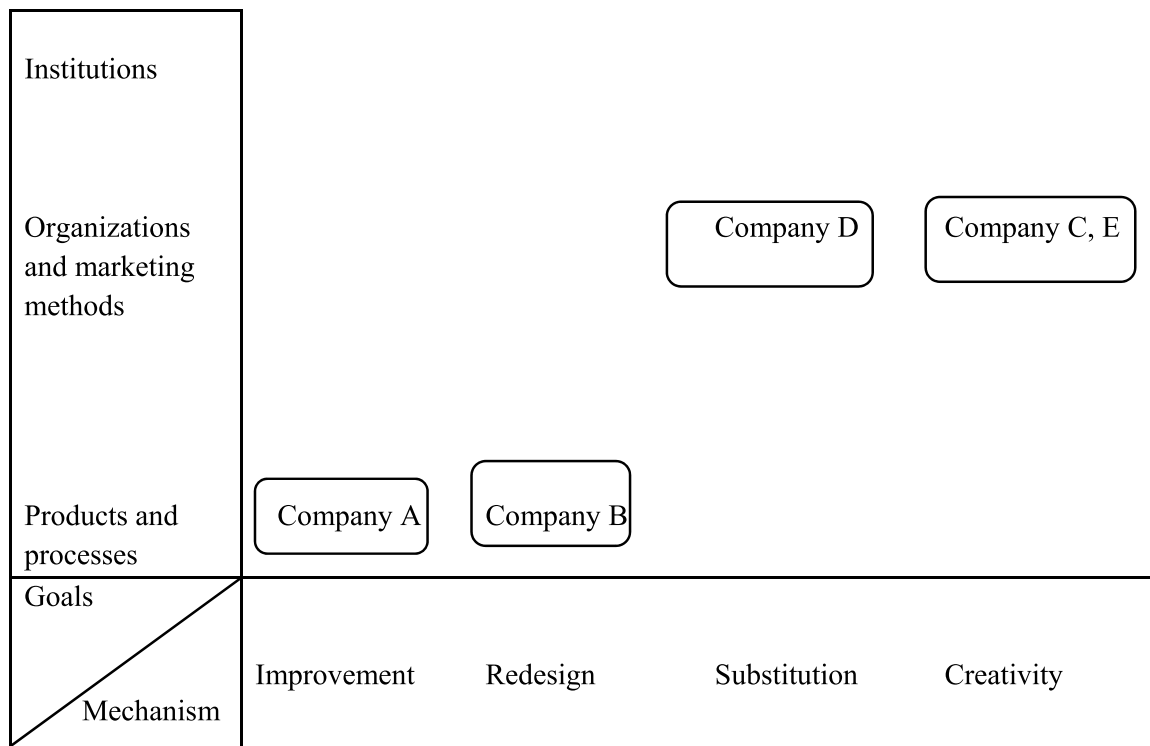


Figure 1. Diagram of types and origins of green innovation in manufacturing companies. This diagram shows only the main objectives and mechanisms for green innovation that the companies follow. Each company incorporates different innovation processes involving different goals and mechanisms.

mechanism (Figure 1). However, even with the focus on the process and products, several additional changes serve as key motivations for these developments. In some enterprises, the changes are organizational or institutional, such as the establishment of separate environmental departments to improve environmental performance and direct R&D.

Thus, the heart of green innovation is not necessarily fully represented by a set of institutional and objective features. Instead, green innovation is best observed and developed using a range of characteristics, from modification to innovation, across products, processes, organizations, and institutions. Furthermore, the characteristics of a particular ecological innovation depend on the point of view of the observer. The analytical framework can be seen as the first step towards a more systematic analysis of green innovation.

Except for Company C, which exports goods to the US, Singapore, and the EU, and Company E, which has an export rate of more than 50%, the companies in the study focus on the domestic market. However, the domestic market is quite different from the international market, as the level of acceptance and awareness of environmentally friendly products is still in its infancy. Therefore, companies need to develop a new strategy and put more effort into raising the awareness of local consumers about buying green products. Figure 1 helps identify the type of green innovation and the components or processes that enable green innovation in the interviewed companies.

For the waste treatment enterprise (Company A), 'the improvement of existing technology helps create a '6 No' environment: no upstream waste segregation, no visible garbage, no bad garbage odour, no leachate, no disease-causing germs, and no burning gas odour. The process consists of putting garbage into concrete boxes, shredding it to speed up decomposition, adding micro-organisms, and sealing the two ends of the concrete boxes so that the odour and wastewater cannot escape. After 30 d, the organic waste has decomposed into humus and sludge. Inorganic garbage, such as bottles and plastic bags, is still intact. The garbage no longer smells and can be put through the classification sieve'. This technological process helps waste companies operate more efficiently.

As in other studies, the perception and philosophy of the company come first. This factor is shown very clearly in the explanation given by Company E's leaders:

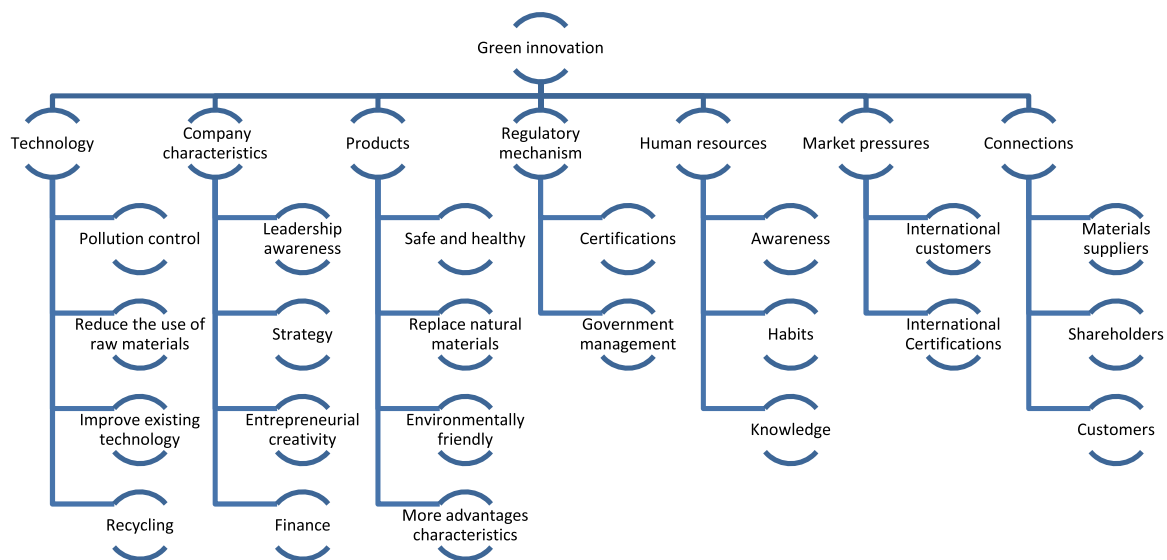


Figure 2. Motivation for green innovation in Vietnam enterprises.

'Certainly, the first is the philosophy, the second is the process, the third is the technology, and the fourth is human resource training. It must all follow that common direction. It is impossible to go off track; if it goes off track, it won't come out with that philosophy'.

Green innovation also considers the concepts of cost management and recycling without any negative impact on the environment (driving the market to be cost-effective and efficient in production and to not harm the environment) (Companies A and D).

In green innovation, the final product meets safety and health criteria (Companies B and E), does not use natural materials (wood), is environmentally friendly, and has many advantages over traditional products (Company C). The end product also needs to be approved and certified by the respective authority (environmental regulations, social and economic benefits) and is aimed at local and international markets that need the product (market pull) (Companies B and E).

Mechanisms and regulations have been identified in Figure 2 as among the key factors in the application of green innovation. This finding is similar to the results of several empirical studies, including Khanna et al. (2009) and Kammerer (2009) who found that customer requirements play an important role in green innovations when a product brings added value to the customer.

Market pull, or demand, is another factor that influences a company to adopt green innovation (Horbach, 2019; Naruetharadhol et al., 2021).

The introduction of green production into a business is initially a means to survive. However, the green manufacturing company may be restricted mainly to the local market where there is limited knowledge about environmental issues. Supplying products to international markets requires manufacturing companies to obtain certification. For the agriculture and food processing industry, certificates include Global GAP, HACCP, ISO 22000, Fairtrade, ETI, Kosher, FDA, and Organic Agriculture. In addition, ISO 45001:2018 certification on occupational health and safety management also applies to many industries. These certificates are a condition for green manufacturing companies to penetrate the global market. This places market pressure on companies because achieving these certifications requires high costs, much time, and compliance with very strict regulations. Similarly, Organic Agriculture certification is a process that strictly adheres to the concept of health and the environment as the main focus rather than profit. Green innovation is also the premise to achieve these certificates.

One factor that green production companies mentioned is the linkage between actors. The association with suppliers contributes to the successful sustainability of manufacturing companies. Agriculture companies also emphasize the importance of networking, knowledge sharing, and opportunities among suppliers, companies, distributors, and customers. Although not included as a determinant, suppliers are identified as the most important post-regulation factor because suppliers are linked together by regulation and company-specific factors. Therefore, managing these factors can help green manufacturing

companies maintain their business as these companies are also part of the customer network of manufacturing companies (Companies B and E).

The leaders of Company B explained the reasons why farmers did not readily switch to organic farming, as follows:

'The first is that they have almost no market niche, which means that all products are the same. The second is that they can't achieve the certifications because they don't have the knowledge and money to do so. The third is due to no cooperation, and no community support. Because it is environmental protection, few people are aware. The fourth is that they won't do it because they don't have a love for nature. Finally, in the family, the difficulty is that the husband may want to do it but the wife doesn't, because if he does it, then where does he get the money to raise the family' (Company B).

The green innovation factors found in this case study confirm the findings of previous studies. However, new insights from the interviews contribute to the body of knowledge regarding additional new factors in green innovation. The new element in green innovation is the linkage between actors. The link should be embedded as a driving force or green innovation practice, especially with today's stiff competition between supply chains. The entire ecosystem of the manufacturing process begins with a partnership between the supplier's network and the customer's network, which shows that knowledge and innovation matter to keep businesses afloat.

Previous findings have recognized that chain activity is potentially a key vehicle and driver for promoting green innovation and should therefore be practiced from the outset of a business and throughout the entire production process. However, the linkage factor is mentioned more in the agricultural sector. In the linkage, companies will support farmers to achieve certifications. As the company continues to reap the benefits through its green network/chain, this motivation becomes an integral part of the green innovation motivation to keep the industry green, especially in emerging markets. It is difficult for businesses to maintain a green business if they do not fully use the green chain to market their products, as this mechanism helps to reduce production costs and reach a broader target market.

It can be argued that the definition of a green network lies between a network and a green supply chain. However, that definition should not be confused with a green supply chain because a green network involves sharing knowledge, communicating, and promoting relationships between a company's suppliers and customers to maintain success in the industry. That network may come from external partners in the value chain such as input suppliers or customers as pressure to be involved in green requirements (Company B). It may also be the internal network among stakeholders; or from mother headquarters to foreign subsidiary (Company D). In this case, the green spirit, green policy, and green know-how of the mother company when transferred to subsidiaries can turn into green spillovers to the host countries. The same focus can be found in Wang et al. (2021) and Zhao et al. (2020). Carrillo-Hermosilla et al. (2010) argue that the diverse contexts with different meanings of green innovation can ultimately reduce its practical value. Thus, more research is needed on green networks as a driving force for green innovation in the future. The expectation is that this concept will be much clearer, especially in the corporate environment.

It is necessary to know which factors contribute most to the success of businesses to compare the results with prior knowledge. Previous studies have found several factors that influence and contribute to green innovation, such as regulations, technology, and specific characteristics of the company, product, and supplier (Driessen, 2005; Fernando et al., 2016). However, what is considered important to one company may not be important to another. Horbach (2019) concluded that demand is an important factor regarding product innovation (energy consumption, pollution reductions of air, water, soil, noise, and recycling) but energy consumption is a specific regulation factor. This article helps solve this problem by ranking the factors according to their importance from the viewpoint of green manufacturing enterprises, as based on interviews and observations. The tree diagram in Figure 2 shows the determinants of green innovation for a company.

We use this tool because it can show the sequence of events or themes that green innovation practices at green manufacturing companies can cover. The diagram was developed to capture the concept of green innovation from the perspective of companies and the influence of the factors identified in the literature review.

The tree diagram indicates that the companies mentioned technology in the interviews as an influencing factor for green innovation and that the technology used in these companies has a large impact

on the process. In the case of Company E, because the freeze-drying technology used in processing agricultural products is expensive, not all manufacturers are willing to invest. Currently, only one Japanese factory has this drying technology. However, this technology is more efficient as it uses less energy, and creates more diversified and uniform products in terms of quality. Therefore, the manufacturing company interviewed attributes great importance to this technology.

Other motivations for green innovation, such as regulation, supplier, promoter (technology), and pull factor (market demand), suggest that these factors are essential parts of the definition of green innovation, as these factors are consistent and similar to those identified in the literature review. The contribution of this paper to the literature is that manufacturing companies can improve performance and achieve better sustainability through green networks.

Although the results from the five companies interviewed on green production processes and practices are similar to those in the existing literature, this study also shows that green innovation is considered a part of the current production concept. Green innovation can be seen as a means of responding to logging, product recycling (low-quality products), and current garbage disposal methods that cause soil and water pollution.

Theoretical and practical implications

As the level of environmental awareness is still very low and the green industry in Vietnam is in its infancy, this paper utilizes the case study approach to examine the motivation for green innovation. Many companies in Vietnam implement green innovation without clear guidance on green processes or compliance. However, the diagram developed in this paper can assist companies in understanding their position in the market and provide a basis for planning greener product design and manufacturing processes. This study may represent a starting point for an in-depth look at the relationship between the green innovation model and the mode of development. In addition, this paper also contributes to the existing literature by describing the motivational factors for implementing green innovations.

Policymakers can also consider the implications of this case study. Environmental regulation is not the only way to promote environmental stewardship by companies. In contrast, standards and regulatory pressures often push companies to adopt compliant behaviour rather than push them toward more proactive solutions to complex environmental problems. Regulators should establish policies that not only support a firm's internal ecological innovation efforts, but also their interactions with external actors and knowledge sources, as in the environmental context, internal and external knowledge are more complementary than other contextual factors.

This article also contributes practical knowledge for practitioners. Companies need to continuously add value to their products or services by considering current and future consumer trends and needs. This case study shows that businesses need strong regulatory and policy support from the government to drive them to innovate. The lack of proper infrastructure and support has resulted in green manufacturing companies undertaking green innovation activities on their own and paying for certificates. The success of a green supply chain formed between a green manufacturing company and its suppliers and customers helps all stakeholders continue to succeed in green business. By practicing green innovation, it is expected that society as a whole will benefit from an improved quality of life and that future generations will not suffer from pollution or a scarcity of natural resources. Both researchers and practitioners have shown that by committing to green innovation, companies can create a win-win situation. The result of adopting green innovation is profit and less pollution to the environment.

Conclusions

The proliferation of new and innovative business models in nongreen industries demonstrates that environmentalism is not only a regulatory trend or a marketing issue, but a way to create value and build or maintain a competitive advantage. Green innovation not only means complying with environmental regulations but also applying innovation to business strategies.

The study also has some limitations. Due to the descriptive nature of the study, the results are not generally applicable or generalizable. In the future, more research is needed to quantify and consolidate

knowledge about green supply chains. In addition, green supply chains need to be combined more extensively with green innovation to strengthen this relationship because green networks contribute to the sustainability of businesses. Furthermore, more research is needed in emerging markets, where technology and investments in R&D and innovation are costly and limited. As a result, companies are looking for other alternatives to reduce costs. One way to reduce costs while innovating and considering the environment is to practice lean management (reducing waste) while continuing to improve and innovate by listening to customer needs. This approach is also more practical and cost-effective for businesses.

Last but not least, more research is needed on the contribution of businesses to green innovation and its impact on society as a whole. This is needed because businesses have a responsibility to improve the quality of life of society and are seen as the engine of a country's economic growth. With the right direction, a country like Vietnam also has the potential to become one of the leading green product producers. As a country in rapid transformation, with many small and medium-sized companies and a large population, it makes a lot of sense to pursue a sustainable development strategy through green innovation. Therefore, further studies are needed in this area.

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