The adoption of green manufacturing practices in Vietnamese Dairy Enterprise: A Case Study of Vinamilk

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Abstracts

The thesis aims to conduct an in-depth analysis of the current green manufacturing practices in a case study of Vinamilk Vietnam. The target of the thesis is supported by the case of a real company, Vinamilk Vietnam. From that, the thesis evaluates this impact of the current green manufacturing practices and suggests some recommendations to enhance the manufacturing practices of Vinamilk.

The theoretical framework of the thesis provides a conceptual foundation to understand how green practices are integrated into the process of manufacturing. The framework includes the theory related to supply chain management practices, green supply chain management, the impact of green manufacturing on the environment and business performance.

The thesis takes the qualitative method as the main form of research method. The qualitative method utilizes the current sustainability reports and documents of the company to identify the impacts of the green manufacturing practices. The qualitative method also collects data through a survey with 41 respondents to analyze the manufacturing practices of Vinamilk and its impact on the environment and the company's performance.

The result shows that Vinamilk has currently adopted several green manufacturing practices including waste management, closed-loop manufacturing practices, energy efficiency manufacturing, water efficiency and sustainable sourcing materials. It is also found that there is a positive relationship between company’s green manufacturing practices and the environment and business performances.

Key words

Sustainability, sustainable practices green supply chain management, green manufacturing practices, environment, Vietnamese diary industry.

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1 Introduction

1.1 Background of the topic

Environmental issues are undeniably connected to the growth of industrialization and the emerging activities of business operations. With the sweep of the current economy and industries, the environment is seriously suffering, leaving several interrelated issues behind. Factories with the emission of CO2 and PM10 have weakened the biodiversity. There is also compelling proof that chemical exposure influences cancer-related variables in health (Abhishek et al. 2019). However, “green manufacturing addresses these environmental issues on a systemic scale, a growing industrial trend with a long-term, feasible, sustainable future” (Abid et al. 2023, 2). In other words, there is a strong connection between the green manufacturing of businesses and the solution to the current environmental situation.

Businesses with green manufacturing practices, in their own volume and their own right, can leverage their influence to advance environmental issues. Currently, companies are striving to incorporate sustainable practices through the integration of green manufacturing into supply chain management. There are also studies considering green manufacturing as “a modern manufacturing mode taking comprehensive account of environmental impact and resource consumption, which aims to make minimum negative impacts on the environment” (Ping & Gang 2016, 263). The main point of green manufacturing asserts the idea of reducing negative impacts on the environment during the process of production. Another definition that highlights the relationship between green manufacturing and the environment mentions green manufacturing as a method to reduce waste and pollution by utilizing materials that are not only environmentally friendly but also safe for employees during the production process (Cameron & Sohail 2021, 11838). From these perspectives, green manufacturing is necessary for improving the impact of businesses on the environment and the overall supply chain management during all the steps of the manufacturing session, from material procurement to energy consumption and waste disposal and recycling.

Besides the fact that green manufacturing enhances the environment, there is also an underlying motivation that promotes companies to adopt green manufacturing practices. With the increasing awareness of customers about the environment, companies with the implementation of green manufacturing considerably retain competitive advantages. By matching companies’ green practices with the value of an eco-aware customer base, companies with a commitment to green supply chain management tend to gain trust while improving the overall brand image. Many reports have mentioned the connection between sustainability and brand equity. Accordingly, more than 50% of global consumers prefer products from environmentally responsible companies (Alexsandar & Olija 2017, 81). Therefore, incorporating green practices is not only a commitment from the companies

to make positive impacts on the environment but also an effort of the company to showcase the market as a responsible enterprise. Even though the green manufacturing concept is good for the environment, it also creates a win-win situation where the companies present themselves as eco-conscious brands to an environmentally friendly customer base. In other words, it is commonly understandable that applying green manufacturing puts a core on the environment and the benefits of an environmentally friendly customer base. However, the underlying motivation is also for the companies to promote brand image and gain profits.

Given such information readily, the thesis conducts an in-depth analysis of the current green manufacturing practices in a case study of Vinamilk Vietnam. The main point of the thesis is to research the most effective green manufacturing of a real case study of Vinamilk while evaluating the impact of the current green manufacturing practices on the environment to give some suggestions to improve the manufacturing practices for Vinamilk and the businesses in the dairy industry in general. The thesis also highlights the benefits that green manufacturing practices bring to Vinamilk, the environment and society. Green manufacturing practices not only make a positive effect on the environment but also improve brand image and reduce operational costs for the overall case study company.

1.2 Research questions

This thesis aims to conduct an analysis of the current green manufacturing practices in a case study of Vinamilk Vietnam. The specific objective of the thesis is to identify green manufacturing practices and to analyze the impact of these practices on the environment and the company. The thesis also suggests some recommendations to enhance the green manufacturing practices of Vinamilk.

The international aspect of this thesis is covered by the fact that firstly, Vinamilk is a Vietnamese company exporting products to more than 60 different international markets. By the first quarter of 2024, exports of Vinamilk have increased by 14%. Secondly, the thesis also analyzes how the green manufacturing strategies in Vinamilk Vietnam adhere to international sustainability and green manufacturing standards such as ISO142001:2015 and ISO 50001:2018.

The research question (RQ) of this thesis is what are the economic and environmental impacts of Vinamilk's current green manufacturing practices? The research question was divided into investigative questions (IQ) as follows:

In a research-based thesis,

IQ 1. What are the current green manufacturing practices of Vinamilk?

IQ 2. How do these practices impact the company and the environment?

IQ 3. What recommendations for improving the current green manufacturing practices of Vinamilk and the dairy industry?Table 1 below presents the investigative questions, theoretical framework components, research methods and results chapters for each investigative question.

Table 1a: Overlay matrix for research-based thesis

Investigative question	Theoretical Framework	Methods	Interview/survey questions	Data analysis/Results
IQ 1. What are the current green manufacturing practices of Vinamilk?	Green manufacturing practices. Closed- loop manufacturing.	Literature review	1. What are the current manufacturing practices of the company? 2. Are these strategies sustainable?	1 & 2.1, 2.2, 2.3, 2.4, 2.5, 2.6 & 4.1
IQ 2. How do these practices impact the company and the environment?	Business performance Environmental effects	Review of companies' report Questionnaire	1. What is the impact of the current strategies to the environment? 2. What is the impact of the current strategies to the company performance?	2.7, 2.8 & 4.2
IQ 3. What recommendations for improving the current green manufacturing practices of Vinamilk and the dairy industry?		Internet search	1. What recommendations for improving current green practices of Vinamilk and the dairy industry?	6

1.3 Demarcation

The research question (RQ) of this thesis is what are the economic and environmental impacts of Vinamilk's current green manufacturing practices? This research question is demarcated by several factors. The research question focuses on the green practices of Vinamilk. However, the **focus** is not on general green practices but specifically on the current manufacturing practices. While the thesis clearly clarifies the key manufacturing practices, the central theme is the effect of these practices on the environment and the company. It should show the link between the current green manufacturing practices and the environment, and the company's performance. The thesis topic also acknowledges that Vinamilk is the main analyzed company in this case.

1.4 Benefits

The thesis contributes to the benefits of the company and the dairy industry in general. For the company, the thesis focuses on analyzing current green manufacturing practices and providing recommendations for improving these practices to enhance the environmental aspect. The thesis topic provides a comprehensive view of green manufacturing practices within the industry of the company and contributes to providing a benchmark for other companies in the same industry when it comes to green manufacturing practices. Through the implementation of green practices, the thesis considers that the organization in the industry has the potential for cost efficiency. By utilizing the knowledge and recommendations in the thesis, the case company can apply the most suitable green manufacturing practices, resulting in a decrease in organizational cost and a gain in the sustainable world.

The thesis also allows Vinamilk's B2C and B2B customers aware that the products provided by the company in the researched industry are aligned with sustainable standards. In the current context customers increasingly pay attention to environmental and sustainable development, the thesis strengthens customers' trust in the company and enhances brand recognition. Sourcing from a well-trusted company, customers indirectly gain competitive advantages, establishing the image of a company that values sustainability and ethical sourcing.

It is understandable that the thesis not only offers an opportunity for the author to apply the specialized knowledge but also allows the author to have a deeper insight into green manufacturing practices with a real case of an international company. Simultaneously, the thesis extends the author's research ability on a certain topic. This ability further leads to valuable experiences and assists in the future academic and professional path. Through the thesis, the author exposes global manufacturing viewpoints due to their relevance to internationality.

1.5 Risks and risk management

The thesis about the dairy company Vinamilk involves some hidden risks. Some green manufacturing practices are internal information and thus are related to confidential issues. Sticking to confidential concerns can potentially lead to a lack of data, which later affects the validity and reliability of the thesis. Moreover, since the dairy industry is a large and long-standing industry, green sustainability policies of the case company in the industry have the tendency to evolve frequently to adhere to the short-term and long-term development goals and orientations of the industry. This fact creates a barrier that renders the comprehensive collection of relevant information and data.

1.6 Key concept

Green supply chain management

Green supply chain management is the process of involving environmental aspects into all steps of the supply chain management to minimize the negative effects to the environment (Thoo, Huam & Zuraidah 2015, 695). A green supply chain significantly contributes to enhancing the overall sustainability performance of a company.

Green manufacturing

Green manufacturing is the manufacturing process where environmental factors are taken into consideration to minimize waste and pollution (Cameron & Sohail 2021, 11838). It includes but is not limited to minimizing resources and reducing pollution by decreasing the use of energy and controlling the waste during the production process.

Environmental sustainability

(Philip 2004) states environmental sustainability as the ability to maintain valuable physical environmental qualities. It includes actions toward the environment, the adoption of eco-friendly programs, the reduction of C02 and the utilization of renewable resources.

1.7 Case company

The thesis examines the main case study of Vinamilk Vietnam. Vietnam Dairy Products joint–stock company, or Vinamilk for short, is a Vietnamese-based company with headquarters in Ho Chi Minh City in Vietnam. Established in 1976, the company has grown to be one of the leading companies in the dairy industry of Vietnam. Vinamilk mainly focuses on the manufacturing and production of

dairy products involving fresh and nutritious milk, yogurt drink, ice cream, cheese, and other dairy-based items. In 2019, the company was listed among top 40 world dairy producers with the highest turnovers. Currently, Vinamilk has exported products to over 60 countries including China and the Middle East.

Since 2006, the company has been aware of its influence on the environment and society. Vinamilk has placed an emphasis on corporate social responsibility and sustainability by initiating several programs to align with human nutrition, environment and energy use, employee healthcare, and community development. “With its legitimate interests and practical activities, Vinamilk has been known as the brand for the community” (Vinamilk 2023). Towards the path to a sustainable future, Vinamilk places the core on three aspects including People, Products, and Environment. Several programs of Vinamilk focus on human development, and minimizing carbon footprint while researching and producing safe and environmentally friendly products. Vinamilk also announced its long-term targets towards Vinamilk Pathways to Dairy Net Zero 2050 programs. As a result, by 2023, Vinamilk has gained major trust from stakeholders and integrated sustainable best practices across governance framework and material areas. Products are manufactured in a sense that is in line with international standards on sustainable agriculture, reducing greenhouse gases and moving towards net zero. In fact, 100% of Vinamilk farms are certified with Global G.A.P. standards, which certify sustainable agriculture in all the farms of the company. Moreover, the "Stand Tall Vietnam Milk Fund" program in the last 16 years has allowed underprivileged children in remote areas to have free milk every day to secure physical development. In return, through its sustainable development programs, Vinamilk has established a unique position in the hearts of consumers. Evidence shows that Vinamilk is the most chosen dairy brand by Vietnamese consumers for the continuous 11 years. It can be safely said that being a company with green practices allows a competitive advantage to all stakeholders involved with the case company. However, the decision on sustainability is not a spontaneous decision. Rather, it is a decision made in consideration of all relevant factors in the production process from raw material selection to product manufacturing and waste management.

2 Theoretical framework

In this chapter, the theoretical framework will be discussed in a respective order. The framework starts with green supply chain management practices before continuing with green manufacturing practices. After that, it continues waste management, energy efficiency manufacturing, water efficiency, and closed-loop manufacturing. The thesis then explains green manufacturing and business performance before coming to green manufacturing and the environment. Fig 1 illustrates the research process and the theoretical framework.

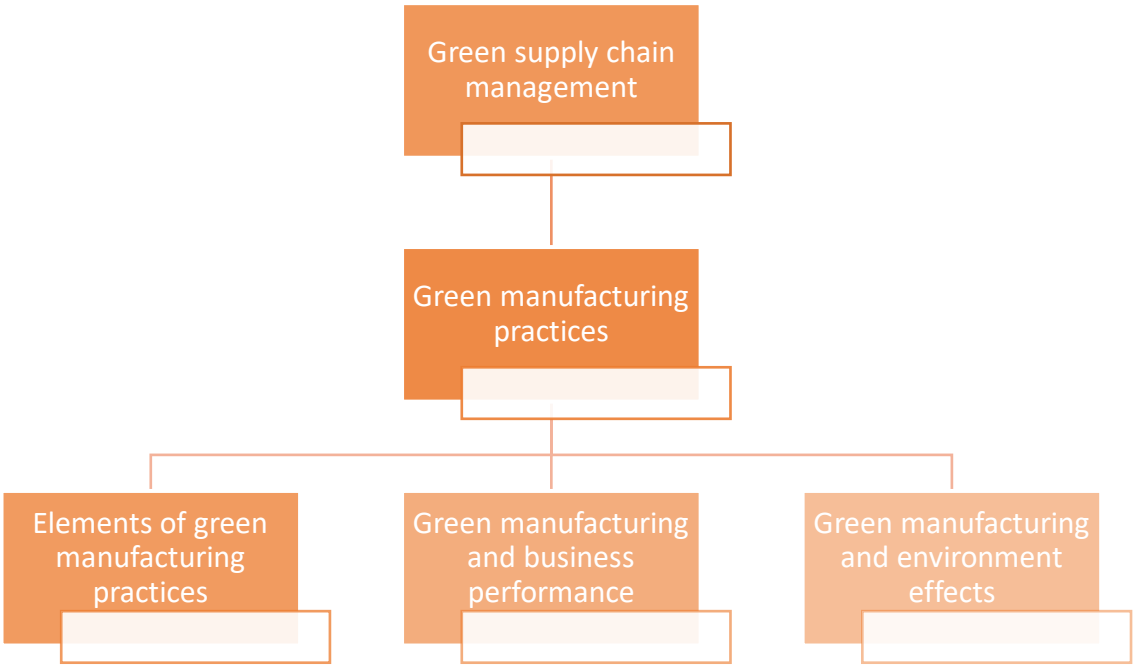

Figure 1 Theoretical Framework (Author 2024)

2.1 Green supply chain management practices

Green supply chain management practices put forward the idea of integration of environmental awareness into regular supply chain management in an efficient and effective way. As such, the outcomes are to decrease energy consumption and pollution while increasing recycling and waste control. Green supply chain management is not merely a step but a process starting from material procurement to product manufacturing to delivery and waste disposal and management.

Green supply chain management practices involve green procurement, green design, green operations, green manufacturing, and waste management (Cyrus et al. 2013, 51).

Figure 2 gives the idea of five elements of green supply chain management.

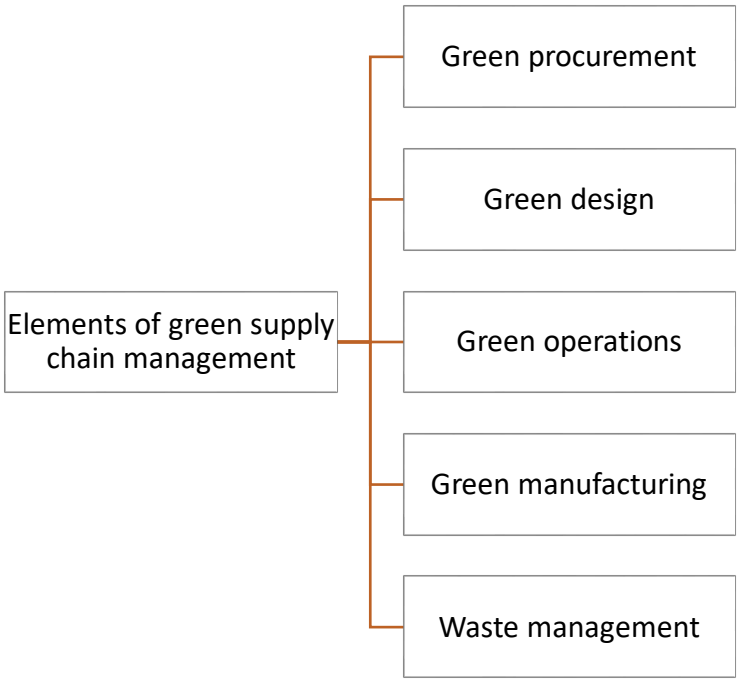

Figure 2. Elements of Green supply chain management (Cyrus et al. 2013, 51)

(Zsidisin and Hendrick 1998) defines green procurement as the acquisition of materials that benefit the reduction, reuse, and recycling processes. It considers environmental concerns in the purchasing decisions to search for raw materials that strongly adhere to environmental standards. Green design includes developing products that are carbon-neutral, sustainable, and environmentally friendly. The main point of green design is to optimize the material utilization and minimize the adverse environmental impacts throughout the entire design process (Yuan & Tang 2021). Green design relies on the 3R principles of reducing, reusing, and recycling. Evidence shows that with the use of green design and the consumable material design, Sony has reduced 40% of foam plastic, a harmful substance for the environment, in its TV set (Yuan & Tang 2021, 3). While green operations refer to activities at a broader level across an organization, waste management encompasses only the model of waste treatment, control, and transportation to prevent pollution at the source of products (Cyrus et al. 2013, 57). The driven motivation underlying the premise of green supply chain management is not only environmentally responsible but also high profits and a strong business image. Business often embraces green concepts to create competitive advantages as a corporate social responsibility company for environmentally conscious customers.

2.2 Green manufacturing practices

In the context of supply chain management, green manufacturing is not a novel concept. Rather it is a subject of scrutiny, with ongoing discourse about the impacts to the environment and the overall businesses. In fact, the concept of green manufacturing first arose in the 1990s with the core concerns about the environment. Initially, green manufacturing focused on a very specific area, with the main objective of reducing waste in the manufacturing process. However, with the evolution of sustainable supply chain management, green manufacturing expanded into resource minimization, pollution control, and energy use decrease.

As such, from 1990, there have been many definitions describing green manufacturing. (Cortellini 2009) found green manufacturing as a process concentrating on procedures minimization, environmentally friendly materials selection, and components recycling to retain an efficient mode of manufacturing. (Guomin & Botao 2020, 2) explained green manufacturing as a model that reduces the environmental impact by optimizing resources in the manufacturing session for the embodiment of sustainable development. (Chuang & Yang 2014) defined green manufacturing is the process of inputting raw materials for the output of finished products in a way that reduces waste and pollution emitted to the environment. (Ankur & Ankita 2022) concluded that green manufacturing is a novel paradigm that incorporates green strategies with the goal of reducing the depletion of natural resources and decreasing waste in landfills. Figure 3 gives a broad idea of the definition of green manufacturing.

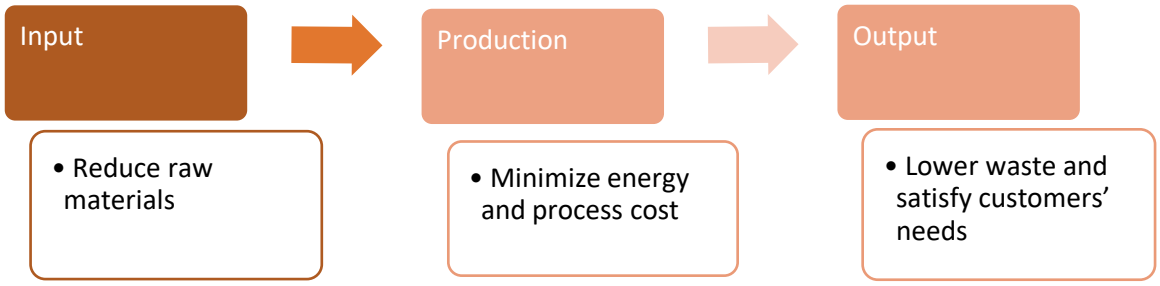

Figure 3. Definition of green manufacturing (Ira et al. 2019, 2)

Whereas a lot of authors have addressed the ideas of green manufacturing, there is one common pattern that emerges. In fact, green manufacturing is a method requiring raw material reduction at the input stage while minimizing energy and manufacturing costs in the production stage for the output of lowering waste and satisfying customers' needs. Green manufacturing is often mistaken

for green operations. However, green operations cover activities at a broader level across an organization from production, and procurement to transportation, waste control, and the overall operational aspects. Green manufacturing, in contrast, is concerned with a narrower scope of the manufacturing process from raw material extraction to the end of the product lifecycle. While the main target of green manufacturing practices is to create and design an environmentally- friendly production line, green operation attempts to reduce environmental impacts across the operational departments. Therefore, the concepts of green operation and green manufacturing are not the same yet interrelated (Cyrus et al. 2013, 57).

In the realm of the sustainable supply chain, green manufacturing is mainly described in the five features: water and energy efficiency, raw material usage, waste control and minimization, pollution prevention, and lifecycle management. It has been shown that companies with the mindset of incorporating green manufacturing have a tendency to enhance brand images. Almost 40% of 1560 companies in the survey of BCG and MIT in 2009 admitted that green manufacturing appears as an effective tool in brand-building strategies for environmentally conscious customers (Ankur & Ankita 2022, 34). Another driving force towards green manufacturing is cost savings and energy efficiency. By reducing energy consumption during the production process, green manufacturing benefits companies directly by lowering energy bills.

2.3 Waste management

Waste refers to materials or byproducts that are no longer in use and are disposed of after a process of manufacturing or using (Ameer 2021, 4). There are several types of waste including solid waste, liquid waste, biodegradable and non-biodegradable waste, hazardous and non-hazardous waste, industrial waste, and municipal solid waste (MSW). As the thesis mainly concentrates on the green manufacturing practices of a case company, the focus of this thesis is industrial waste. Industrial waste is waste that is produced during the industrial process such as a manufacturing process. Waste management is the process of handling waste by collecting, transporting, processing, recycling, and disposing to minimize the environmental impacts. It is mainly about how to turn waste into recyclable materials and valuable input for the sake of the manufacturing process.

Waste management follows the principles of Beat Environmental Management Practice (BEMP). BEMP is a set of measures and guidelines for the company to reduce the adverse effects on the environment through an environmental management system (Ameer 2021, 6). BEMP allows companies to establish waste management priorities and a waste management hierarchy, which ranks the waste management strategies under five categories prevention, reuse, recovery, recycling, and disposal. Recently, BEMP has attempted to move companies towards the concept of zero waste by reducing the waste for disposal to none. Companies are now implementing waste management

through waste treatment and recycling projects, aligned with the company's green and sustainable development goals.

Waste management brings several benefits to the companies and the environment. Companies get the overall information about current waste and waste management systems during the production process. With the conversion of waste into raw materials and valuable input, companies reduce manufacturing costs and save resources for future development. The main core of waste management is to handle waste in a sense that reduces the impacts on the environment. Therefore, waste management protects the ecosystems and reduces greenhouse gases and pollution emitted into the air and water. In contrast, poor waste management caused several troubles for the companies. Some companies even face legal investigation and penalties due to illegal discharge causing serious pollution. In 2016, Formosa Ha Tinh, a steel company built by Taiwanese Formosa in Vietnam, illegally discharged toxic waste beyond the permitted threshold into the coastal areas of Ha Tinh Province causing the death of 80 tonnes of fish in the central provinces from Ha Tinh to Thua Thien Hue, Vietnam (Po 2022, 303). The Formosa incident not only destroyed the marine ecosystem around the Ha Tinh Sea area but also indirectly caused water and soil pollution around the illegal discharge area. The company later faced legal measures from the Vietnamese government and had to pay compensation of more than 500 million USD. Formosa's case is a real example of the consequences of a poor waste treatment system to the balance of marine life, the environment, and the company. Moreover, poor waste management can lead to an unsafe working environment for employees and workers, which seriously destroyed the core People pillar to a sustainable future. With improper waste treatment systems and protection, waste management workers have a high tendency to be exposed to hazardous substances during the collecting, transporting, processing, recycling, and disposing of waste. These substances can cause severe illnesses such as cancer, respiratory illnesses, and skin diseases to workers and employees (Duan et al. 2008). Therefore, it is vital that companies implement a proper waste management system during the manufacturing process.

However, with the development of company scale and increased production capacity, waste accumulates, leading to a huge pressure and requiring an improvement in the ability to handle waste treatment of the company to protect the environment in the most optimal way. Moreover, implementing a complete waste management system requires huge investment and can be costly for the company in the short term. Due to these forecasting difficulties, a proper waste treatment system is not an easy task for companies. Rather, it requires compliance with green manufacturing practices and the ability to handle large amounts of waste from the manufacturing process.

2.4 Energy efficiency manufacturing and renewable energy

Energy efficiency manufacturing is the use of energy in an effective and cost-saving way to reduce energy waste and its impact on the environment while maintaining productivity during manufacturing sessions (United Nations Industrial Development Organization s.a). Currently, companies are mainly gaining energy efficiency through the incorporation of sustainable and renewable energy in the manufacturing process. The main green and renewable energy are hydropower, solar energy, and wind energy, which are utilized to reduce the environmental effects. From 1985 to 2020, there has been a dramatic increase in the use of hydropower, solar, wind energy, and other green, renewable energy.

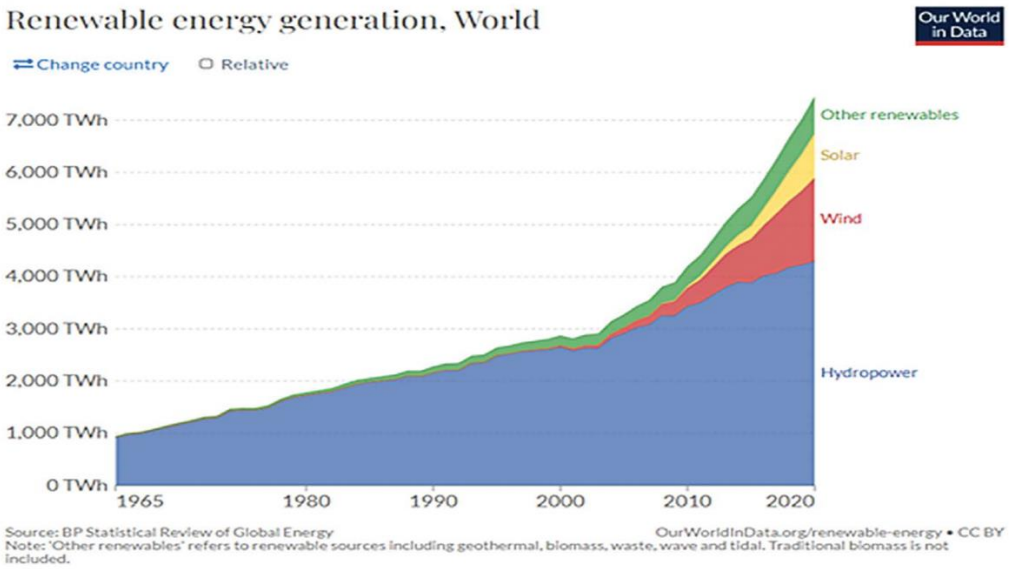

Figure 4. The usage of renewable energy from 1965 to 2020 (Tarana et al. 2023, 3)

As shown in Figure 4, from 1965, the usage of hydropower has increased fourfold from 1000 Twh to 4000 TWh. Similarly, the usage of wind energy has quintupled to nearly 6000 TWh. The utilization of solar energy has also witnessed a significant increase by 6 times. Besides hydropower, wind and solar energy, other renewable energy has also grown significantly. Similarly, (Ankur & Ankita 2022, 35) admitted that hydro and nuclear power are the main sources of sustainable energy in manufacturing. In contrast, due to coal's impacts on the environment, there has been a significant decrease in the utilization of coal for electricity generation in the manufacturing process. Therefore, it can be clearly seen that the usage of renewable energy such as solar energy, hydro, wind, and nuclear power is a trend and is prioritized by companies and countries in production to

minimize costs and increase energy efficiency. In other words, renewable energy is gradually substituting fossil fuels in the production industry.

In fact, energy efficiency and renewable energy brings several benefits to the company and the environment. For the company, energy efficiency allows companies to gain competitive advantages. This is because energy efficiency benefits companies with both energy costs and production costs. By reducing costs, companies can produce and distribute products at a competitive price. Moreover, some companies rely on green and renewable energy to reduce energy consumption. This is a major key of several organizations' green marketing strategy. Green marketing highlights companies as an efficient business and responsible corporations towards the environment and environmental-friendly customers. For the environment, the implementation of green and renewable energy significantly reduced the greenhouse gas emissions produced during the manufacturing process while enhancing air quality (Mahendra et al. 2024). Energy efficiency manufacturing also reduces the impacts of industrial activities on climate change.

2.5 Water efficiency

Similar to energy efficiency, water efficiency refers to the consumption of water in a more efficient and cost-saving method. In fact, there is a water management hierarchy system to control and manage the water efficiency and water consumption system as shown in Fig. 4. Accordingly, the most popular method for efficient water use is to eliminate excess water consumption through education (Invest Northern Ireland 2018, 6). Next, the 3R method: Reduce, Reuse, Recycle allows companies to increase water efficiency through reducing water consumption, and reusing and recycling water for consecutive production activities. Finally, the disposal method disposes of water in an ethical, legal and environmentally responsible way to minimize water pollution. It is the least favored option as water is disposed of without being reused and recycled.

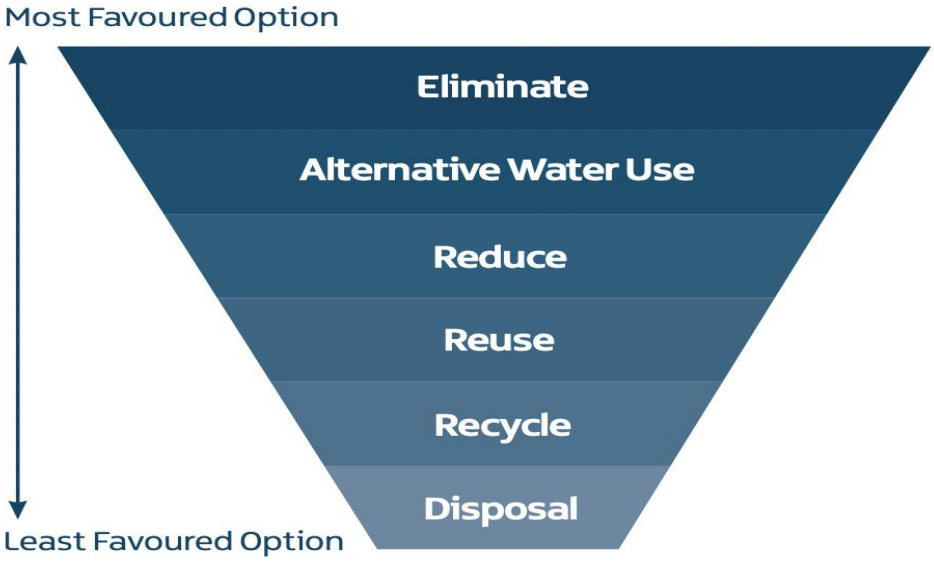

Figure 5. Water management hierarchy system (Invest Northen Ireland 2018, 6)

By nature, water efficiency moves its focus from water disposal to the reduction of water use by recycling and reusing excessive water during the whole manufacturing process. Therefore, water efficiency prevents the overexploitation of natural water resources, assisting the process of resource conservation while preserving ecosystems and protecting the surrounding environment (Invest Northern Ireland 2018, 5). In addition, increasing water efficiency involves decreasing water usage, thus, a significant production cost reduction tied to water consumption. Reducing production costs facilitates a decrease in the price of end products and establishes a win-win situation where not only firms and corporations directly yield pricing advantages, but customers also acquire products at a lower cost. Simultaneously, firms and corporations actively engage in green manufacturing practices and demonstrate commitment to green supply chain management while moving towards corporate social responsibility.

2.6 Closed- loop manufacturing

A closed-loop manufacturing system is a system that promotes the recycling of materials and post-use products in the manufacturing process to reduce production costs and environmental effects. In other words, closed-loop manufacturing utilizes the materials of end-of-life products as the new input to manufacture the continuing products (Juraschek et al. 2017). The core of the closed-loop manufacturing process is the integration of used materials into the new manufacturing process. In contrast to the traditional open-loop manufacturing, where the end-use products are disposed into landfills, the closed-loop manufacturing emphasizes on closing material cycle by remanufacturing and recycling materials and end-use products.

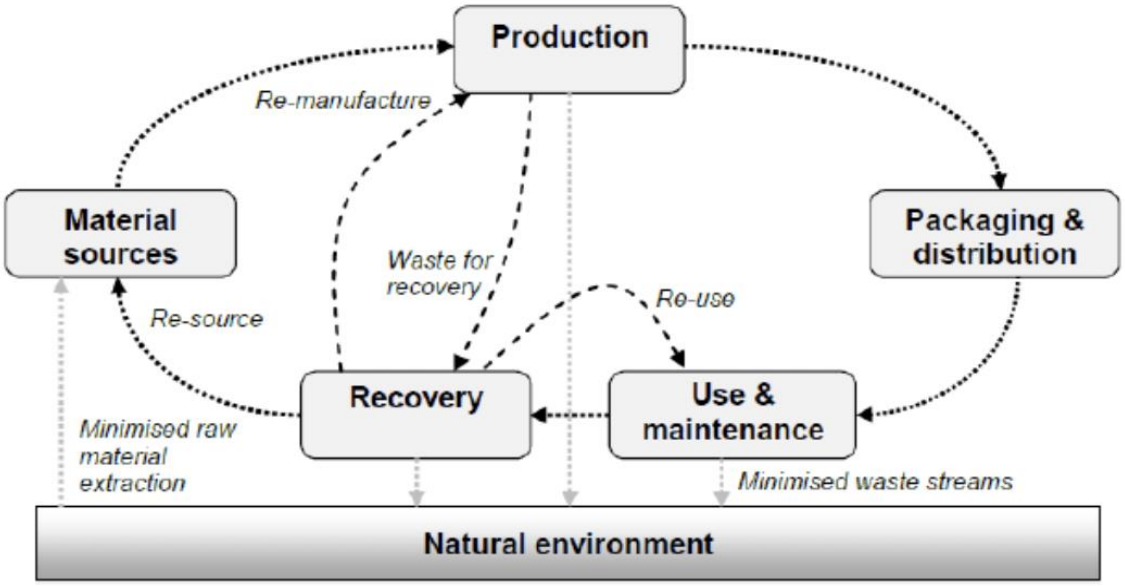

Figure 6. Closed-loop manufacturing system (Ashrafi 2014, 56)

As shown in Figure 6, the closed-loop production system starts from material sources where used materials are collected to prepare for the production stage. Once used materials are ready, they are sent to remanufacture. Waste from the production stage is recovered for recycling into new material sources. After going through the reproduction process, the used materials turn into new products and send to customers. After being used, the products are collected and sorted for recovery and re-sourcing into material sources. The whole process is a closed loop that allows the regeneration of end-use products and waste into new materials necessary for the production process. The entire process highlights the reintegration of materials into the production process (Ashrafi 2014, 56). Therefore, the principles of the closed-loop manufacturing process mainly lie in the efficiency of resources, the reduction of energy use and material reuse and recycling. Closed-loop manufacturing is in close connection with manufacturing where it promotes the recycling of materials to minimize resources and energy consumption. Therefore, it reduces the environmental impacts and production costs of the whole manufacturing process. Reducing costs allows companies to supply products at lower costs and gain financial benefits.

2.7 Green manufacturing and business performance

Business performance is not a new idea. Business performance, in general, has been studied by many researchers. It is commonly interpreted that business performance is the ability of a company to achieve its objectives and satisfy the interests of the shareholders (Kinga 2015). Two aspects to measure business performance include financial performance and non-financial perfor-

mance (Bhenu & Bintoro 2023, 41). While market outcomes such as sales and market growth express non-financial performance, profit outcomes as return on investment (ROI), and return on sales (ROS) represent financial performance (Suzana & Harvey 2014, 41).

The impact of green manufacturing on brand images is clear, however, the effects of green manufacturing on company performance and competitive advantages are a controversial topic. There are still skeptical opinions about the relationship between green manufacturing and business performance. In fact, (Wu & Pagewell 2011) considered that investment in green manufacturing initially requires a capital-intensive focus which potentially leads to high manufacturing costs and reduced earned profits in the short run. Similarly, (Hameed et al. 2015, 47) suggested that although there is a relationship between green manufacturing and firm performance, the relationship is not significant. However, the above opinions are limited in the scope of the research. Specifically, Wu's study focuses on the short term while the scope of Hameed's research was in Malaysia. In fact, there are many other evidence and abilities that have proven the positive relationship between green manufacturing and business performance. (Ebenezer et al. 2020) acknowledged the link between green manufacturing and business performance, claiming that green manufacturing practices are a significant factor to improve the overall performance and competitive advantages. (Roy & Khastagir 2016) supported the view by explaining that green manufacturing assists firms in enhancing business performance while earning higher profits and market share. (Przychodzen & Wojciech 2015) shared the same idea, concluding that better financial performance is generally achieved by eco-innovative business.

Investing in green manufacturing allows companies to enjoy a higher financial performance, a higher customer loyalty and a better profit in the long run. Studies confirming the connection between green manufacturing and company performance are supported by shareholder, administrative, and institutional dimensions. Moreover, as the impacts of green manufacturing on brand image and firm reputation are clear, (Jacob et al. 2016) asserted that companies with strong firm reputations are more favored in the eyes of investors and shareholders. Acquiring superior investments allows companies to expand to new business markets and invest in advanced and green technology to reduce operational costs and improve process optimization. As a consequence, a company increases the value of profits and financial outcomes. It is, therefore, resonated that green manufacturing indirectly advances corporate performance by enhancing firm reputation. In line with the assertation, (Ebenezer et al. 2020) found that a strong firm reputation serves as a mediating tool between green manufacturing practices and business performance.

Although there are skeptical opinions revolving around the idea of the impacts of green manufacturing on corporate performance, contradictory opinions are mostly limited to the short term when

the initial investment in the implementation of green manufacturing technology is huge. In the long run, green manufacturing practices prove to be efficient in gaining investments and improving business performance while earning high profits and market share.

2.8 Green manufacturing and environmental effects

The nature of green manufacturing is to minimize the harmful impact of a company on the environment. Therefore, it is clear that green manufacturing affects the overall environment and environmental performance of a company. Environmental performance is a model to measure the impacts of the company's activities and environmental management system to the overall environment (Elisabeth 2016, 275). It is obtained by reducing greenhouse gas emission, minizing pollution, reprocessing waste and decreasing the use of harmful raw materials to reduce the overall effects of company's activities to the environment (Ebenezer et al. 2020). Recently, several frameworks have been proposed to assess and certify a company's environmental performance. The two main organizations issuing frameworks include International Organization for Standardization (ISO) and Eco-Management and Audit Scheme (EMAS). ISO publishes consistent international standards to not only certify the safety and reliability of products but also secure that businesses implement sustainable practices during the operational process. EMAS is a voluntary tool assisting firms to manage and control their own environmental performance based on six key factors including material efficiency, energy efficiency, waste, emission, water, and biodiversity (Elisabeth 2016, 277). The aim of environmental performance framework is to gain information about internal environmental management of a company while providing stakeholders data about environmental activities of the company.

Many researchers have studied the impact of green supply chain and green manufacturing on the environment and environmental performance of a company. (Dzikriansyah et al.2023) stated that green manufacturing and green supply chain management positively affect the environmental performance of Indonesian small and medium enterprises. (Abdalwali Lutfi et al. 2024) conducted research about the relationship between the adoption of environmental management system and environmental performance amongst Jordanian companies. (Abdalwali Lutfi et al. 2024) suggested that green technologies and green manufacturing significantly transform the manufacturing of a companies, moving it towards green aspects. Therefore, the adoption of environmental management system including green manufacturing boost the overall environmental performance of Jordanian companies by leading companies to advantageous implications, a better control of organization and conscious decision- making. (Geng et al. 2021) shared the same idea, stating that significant differences in environmental performance was detected between SME companies that implement eco-innovation and green manufacturing and companies who do not adopt sustainable prac-

tices. (Geng et al. 2021) added that there was a significant link between the adoption of eco-innovation and positive environmental effects in Chinese small and medium enterprises. Therefore, most of the emphasis on the study of the impact of green manufacturing practices and the environmental effects is the positive connection between the two concepts.

3. Research Methods

The thesis takes the qualitative method as the main form of research methods. The qualitative methods take the form of desktop research through the analyzation of the current sustainability reports and academic journals as well as industry publications to identify the adoption of the current practices of green manufacturing of the case company Vinamilk in IQ1. The qualitative methods also allow data to be collected and analyzed through a survey related to the green manufacturing practices and its impacts on the environment and business performance in the selected case company. Therefore, the qualitative methods also deal with IQ2 and IQ3.

3.1 Qualitative research

According to (Oranga & Matere 2023), the qualitative method is a method that focuses on analyzing and describing a phenomenon from a non-numeric data aspect. (Oranga & Matere, 2023) highlighted that “qualitative methods are especially effective in obtaining information about behavior, opinions and contexts”. (Moser & Korsrjens 2018) shared the same ideas, asserting that “qualitative research explores the insights into real-world problems without having to quantify data”. Therefore, the qualitative research of this thesis mainly applies to address the theoretical background related to the current green manufacturing practices of Vinamilk.

3.2 Data collection methods

There are two main methods of data collection for this thesis: desktop research and the questionnaire survey.

The main information concerning the desktop research includes existing data about the green manufacturing practices of the case company Vinamilk, data about relevant manufacturing standards or certificates and data on sustainability. These data are mainly collected from Vinamilk’s sustainability reports, annual reports and academic journals and articles about the environmental impacts and business performance. The other sources are the industry publications about standards and regulations guidelines such as ISO142001.

The data is collected through a survey about the impacts of green manufacturing practices on the environment and the business performance. The survey gathers data from 41 respondents to understand their perception of the adoption and impacts of Vinamilk’s green manufacturing practices.

3.3 Population and participants

The idea participants for the questionnaires are individuals who are interested in the dairy industry and familiar with sustainable and manufacturing practices. The purpose is to choose the participants that are suitable for the aim of the research, mainly targeting those who are indirectly and directly related to the dairy industry and have an interest in green manufacturing practices.

In fact, because the company is based in Vietnam, the main respondents are from Vietnam and in Finland that have already been familiar with the company and its products. The author also targeted customers who follow the company's social media and its sustainability updates to become the respondents. In the questionnaire, the author also utilized a preliminary question related to company's manufacturing practices to filter participants.

The answers for the questionnaires are collected from respondents through multiple social media channels such as Facebook, Instagram and LinkedIn and through the authors' own connection in 5 days of distribution. There are a total of 41 chosen respondents. There has been no ethical issue until now.

3.4 Research design

The research for this thesis is qualitative research. Under is the visual representation of the research design:

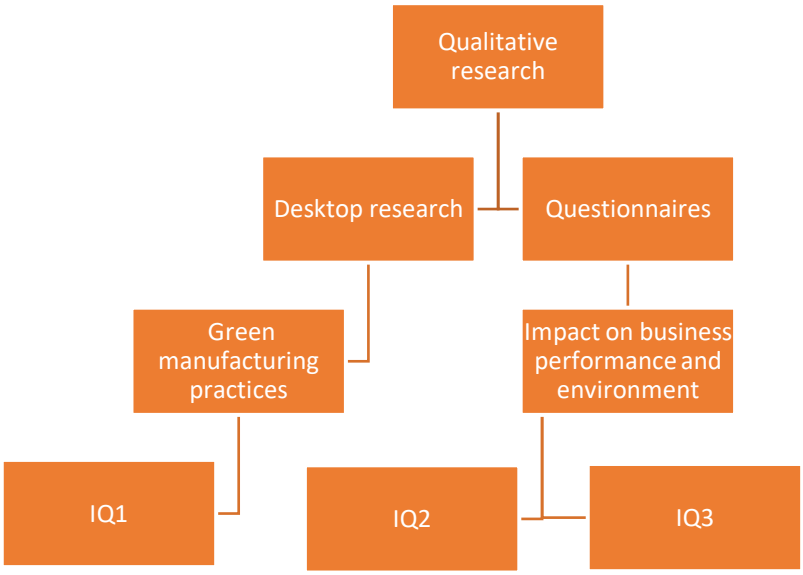

Figure 7. Research design in relation with the case company

3.5 Data validity and reliability

There are risks involved in my data collection procedures including the risks associated with data collection as the main source is from the questionnaires. The questionnaire is subjective opinions. Therefore, the risks are related to bias and subjectivity, which can affect data interpretation and

analysis. To increase data validity and reliability, the thesis double-checked the data validity and reliability by cross-checking with companies' sustainability reports. Moreover, the thesis also examines the correlation and p-value under Pearson correlation.

To ensure the validity and reliability in qualitative research to minimize the risk, the data collection methods are also consistent, and the questions released through Webropol tool are also aligned with the concepts of the thesis.

4. Data and results

In this chapter, the research analyzes the current green manufacturing practices of the company through the desktop research of the company reports, websites, and online databases. The chapter also involves all survey questions and answers to answer the impacts of these green manufacturing practices on the environment and business performance.

4.1 The current green manufacturing practices of the case company, Vinamilk

Vinamilk pays close attention to its sustainable and green practices in supply chain management in general and manufacturing specifically. Recently, to align with the company's sustainable goals, Vinamilk actively adopts green manufacturing practices such as waste management and closed-loop manufacturing, energy efficiency manufacturing and renewable energy usage, water efficiency and sourcing sustainable materials.

4.1.1 Waste management and closed-loop manufacturing

Vinamilk implements waste management in a strict method, which the company states in its sustainability report to comply with ISO142001:2015 standard. ISO142001:2015 standard emphasizes environmental management systems (EMS) and certifies that Vinamilk manages environmental responsibilities systematically and sustainably. Vinamilk is committed to compliance with environmental regulations with no environmental incidents or legal violations (Vinamilk 2023, 80). Accordingly, Vinamilk collects and sorts of waste at its source with a modern and semi-automatic waste treatment system. Cow manure, which is a by-product of the dairy production process, is automatically collected through a scraper system according to the size of the barn before being transported to the sorting and processing areas. Moreover, Vinamilk also reuses and recycles solid waste and liquid waste in a way that allows solid waste to turn into organic fertilizers for the tree through the Japanese composting technique and liquid waste to become renewable energy for the manufacturing activities on the farm through Biogas stages (Vinamilk 2020, 197). The act of reusing waste into resources is also a part of a closed-loop manufacturing process as the closed-loop manufacturing process, by nature, is the integration of used materials into the new manufacturing process. Specifically, through the composting model, solid waste and manure become organic fertilizers to improve soil structure and reduce climate change created by waste decomposition and chemical fertilizers. In addition, through the Biogas system, liquid waste becomes heating water utilized for the process of sterilizing milk, cleansing equipment and drying grass during the manufacturing process (Vinamilk 2023, 81). According to (Vinamilk 2023), since 2023, all Vinamilk farms have applied a Biogas system to convert cow waste into resources. In 2023, Vinamilk reused, recycled and recovered a total of 7,959,466 kg of waste.

Moreover, since 2020, 30,096 kg of waste sludge has been utilized to improve tree planting tree and 24,548 kg of tea grounds have been used as an organic fertilizer for trees each year. Not only repurpose cow manure, Vinamilk also recycled and regenerated tires from the cashew supply for the grass compost cabinets. In fact, (Vinamilk 2020, 193) reported that Vinamilk recycled 44,140 kg tires waste in 2020.

4.1.2 Energy efficiency manufacturing and renewable energy

The current energy management of Vinamilk is aligned and certificated under ISO 50001:2018. ISO 50001:2018 puts the core on energy management systems and acts as a framework for Vinamilk to enhance energy efficiency through the reduction of energy consumption and the increase in the use of renewable energy. The certification demonstrates Vinamilk's commitment to decreasing the impact of energy footprints and improving operation and production sustainability.

In fact, in an effort to move towards energy efficiency manufacturing, in 2023, Vinamilk employed renewable energy to replace fossil energy in the production process (Vinamilk 2023, 28). The average solar energy usage on Vinamilk farm has exceeded to nearly 87% since 2023. As shown in Fig. 8, (Vinamilk 2023, 106) suggested that the consumption of solar electricity increased by nearly 735 % from 2,637,718 kWh in 2021 to 22,021,983 kWh in 2023. Recently, since 2023, Vinamilk has also availed of biomass electricity consumption with 10 out of 13 factories resorting to biomass energy. Biomass electricity is also a source of renewable energy, originating from organic materials such as cow manure. With the use of biomass energy, Vinamilk signifies its effort to convert by-product waste into energy and resources. In 2023, (Vinamilk 2023, 106) asserted to consume 27,313,706 kW of biomass electricity. The increase in renewable usage allows a significant decrease in the consumption of EVN electricity, a type of grid electricity that involves a mix of fossil fuels. In fact, in the three consecutive years from 2020 to 2023, Vinamilk has successfully cut down on 11,547,432 kWh EVN electricity usage in the production process. In 2023, renewable energy including both solar and biomass electricity totaled 20% of the electricity usage.

	Unit	2021	2022	2023	Corresponding GRI standards
ENERGY					
ELECTRIC					
EVN electricity consumption	kWh	205,731,848	187,298,535	194,184,416	302-1
Solar electricity consumption	kWh	2,637,718	15,471,029	22,021,983	302-1
Biomass electricity consumption	kWh	N/A	N/A	27,313,706	302-1
Total	**kWh**	**208,369,566**	**202,769,565**	**243,520,105**	**302-1**
Total	**MJ**	**750,130,436**	**729,970,433**	**876,830,180**	**302-1**
Percentage Solar	%	1.3%	7.6%	9%	
Percentage Solar & Biomass Electricity	%	1.3%	7.6%	20%	

Figure 8. Vinamilk's usage of electricity energy from 2021 to 2023 (Vinamilk 2023, 106)

Fossil fuel electricity from coal and gas is highly related to significant side effects on the environment such as pollution, greenhouse gas emissions and climate change. Therefore, with the shift from fossil fuel to renewable energy, Vinamilk has significantly decreased the amount of greenhouse gas emissions by 3 tons since 2022 (Vinamilk 2023, 107).

Moreover, Vinamilk also resorted to LED lights instead of the existing halogen lamps and fluorescent lamps in all its factories in 2020 (Vinamilk 2020, 191). (Uydur 2022) stated that tube-shaped LED lights save 30 to 45% energy use compared to tube-shaped fluorescent lamps. Therefore, (Vinamilk 2020, 191) reported that with LED lights, Vinamilk not only saved more than 2,758 billion in 2020 on energy consumption but also reduced the amount of C02 emitted into the air during the process of manufacturing. In addition, Vinamilk continues to allocate and improve energy use in an efficient way through the incorporation of capacity building, technology and equipment operation solutions. Vinamilk invests in consulting organizations for the research and development of energy management systems while reducing electricity consumption during peak hours and gradually applying and implementing new forms of energy and renewable energy in production (Vinamilk 2020, 189).

4.1.3 Water usage efficiency

Vinamilk is committed to water efficiency and responsible mining related to water usage. Vinamilk is currently implementing several programs to save water consumption while optimizing water resources through the 3R methods: Reduce, Reuse and recycle. (Vinamilk 2022, 68) reported recycling and reusing 4,99% water in the production process. In 2023, 85% of wastewater was recycled for the purpose of farming activities. In an attempt to promote water efficiency, Vinamilk recycles water for steaming yogurt yam. Instead of discharging after steaming yogurt yam, Vinamilk stores hot water after the first yogurt jam steaming process in an additional intermediate tank and recirculates for the next steaming yogurt jam. Through the reuse process of hot water, Vinamilk reduces water consumption by 4,573m^3 and achieves 300 million VND savings annually. In the process of producing milk, Vinamilk also recycles and reuses wastewater by renovating the process design to store water in a semi-finished tank to cook the reconstituted milk.

Vinamilk also adopts a backwash water recovery system, allowing the collection, treatment and recovery of backwash water into clean water for reuse in the manufacturing steps. Moreover, Vinamilk successfully conducts research on the reduction of the amount of water used for homogenizer cooling by 66%, a key component in milk processing machinery. As a result, the backwash water recovery system recovers and recycles 48,180m^3 of water per year while the water saving for cooling the homogenizer reduces 22,464m^3 of water annually. In addition, instead of discharging water used for cooling the cooler on box filling machines as previously, Vinamilk utilizes tanks and heat

exchangers to restore and recover water for the cooling system, which further provokes the retention of 9,945m3 of water annually. Vinamilk factories also repurposes existing tanks and utilized rainwater through pipe collection for cleaning tank trucks transporting raw fresh milk that facilitates the preservation of 750m3 of water annually.

Not only applying the 3R principles of reducing, reusing and recycling, Vinamilk also follows the water management hierarchy system through ethical, legal and environmentally responsible disposal methods which significantly minimize water pollution. All Vinamik factories apply advanced and anaerobic, anoxic and aerobic biological wastewater treatment technologies to align with the requirements for waste treatment regulated in National Technical Regulation No. 40/2011/BTNMT to discharge into water sources utilized for domestic water production (Vinamilk 2023, 87). The technologies include stages of monitoring pH balance, combining biological treatment with sediment and disinfecting waste water before discharging into water sources. However, the storms and weather changes in the tropical country where Vinamilk is based can pose a risk of heavy rains and overflow of biological reservoirs. To avoid spillage of biological reservoirs causing water pollution, Vinamilk also prepares a backup plan and periodic drills to respond to chemical spills. In another effort to follow the legal discharge and environmental protection, Vinamilk strictly manages the chemical dosage usage in cultivation and livestock farming to not pollute the water both on the surface and underground.

Finally, Vinamilk provides adequate training for employees and operation teams to raise environmental awareness and monitor the treatment efficiency of the wastewater treatment system.

4.1.4 Sourcing sustainable materials

Vinamilk is also committed to sourcing sustainable materials in an attempt to move towards a broader aspect of green manufacturing concepts. In fact, Vinamilk acquires its materials in an ethical yet eco-friendly method through the key aspects of sustainable farming and organic materials.

Vinamilk obtained its materials from a modern dairy farm network that employs sustainable farming for the best condition and development of dairy cows. The farms where the materials are sourced follow the circular economy model with the usage of solar energy for energy efficiency and the reduction of chemical fertilizers for the protection of the environment (Vinamilk 2020, 148). Moreover, Vinamilk's farming system aligns with the international environmental certificate. In 2006, Vinamilk's Tuyen Quang Dairy farm obtained the environmental management system certificate under ISO 14001 standard. In 2014, Vinamilk's Nghe An Diary farm qualified for the Global G.A.P standard for sustainability and food safety. In 2016, Da Lat Dairy Farm received recognition from Control Union to meet European organic standards for sustainable farming and organic manufacturing

practices. In the same year, Vinamilk implemented a solar energy system in its farm network (Vinamilk 2023, 5). In 2021, Vinamilk introduced the eco-friendly and green farming model in Thanh Hoa, Tay Ninh and Quang Ngai Province with a solar energy system and no chemical fertilizers. Vinamilk also implements Biogass technology to treat and convert cow manure waste into organic fertilizer for grassland and dry grass to feed cows (Vinamilk 2022, 28). Through the efforts of Vinamilk in designing in accordance with international environmental standards and increase in the usage of renewable energy and a decrease in chemical fertilizers and pesticides, Vinamilk certifies its sourcing practices to promote energy and water efficiency while reducing the negative impacts of the whole manufacturing process on the environment.

In addition to sourcing materials from its own farming system, Vinamilk also imports materials from the United States. However, the materials to produce Vinamilk nut milk products imported from the United States are 100% non-GMO. In other words, Vinamilk only sourced organic materials that are free from genetically modified organisms (GMO). Non-GMO materials also highlight the farming practices that focus on crop rotation and biodiversity, which reduce pollution and greenhouse gas emissions. The practice reflects Vinamilk's attempt to reduce the effects of chemical inputs and increase the application of biodiversity to positively affect environmental surroundings (Vinamilk 2020, 146).

4.2 Questionnaire results about Vinamilk' green manufacturing and its effects on environment and company perspectives

In this sub-chapter, the research analyzes the survey questions related to green manufacturing practices of Vinamilk and its effects on the environment and financial performance of the company. Therefore, the sub-chapter mainly deals with the IQ1 and IQ2. The results for each question will be justified and illustrated.

4.2.1 Demographics

The survey starts the first four questions with demographics to get basic background and information about the participants.

Q1: What is your age?

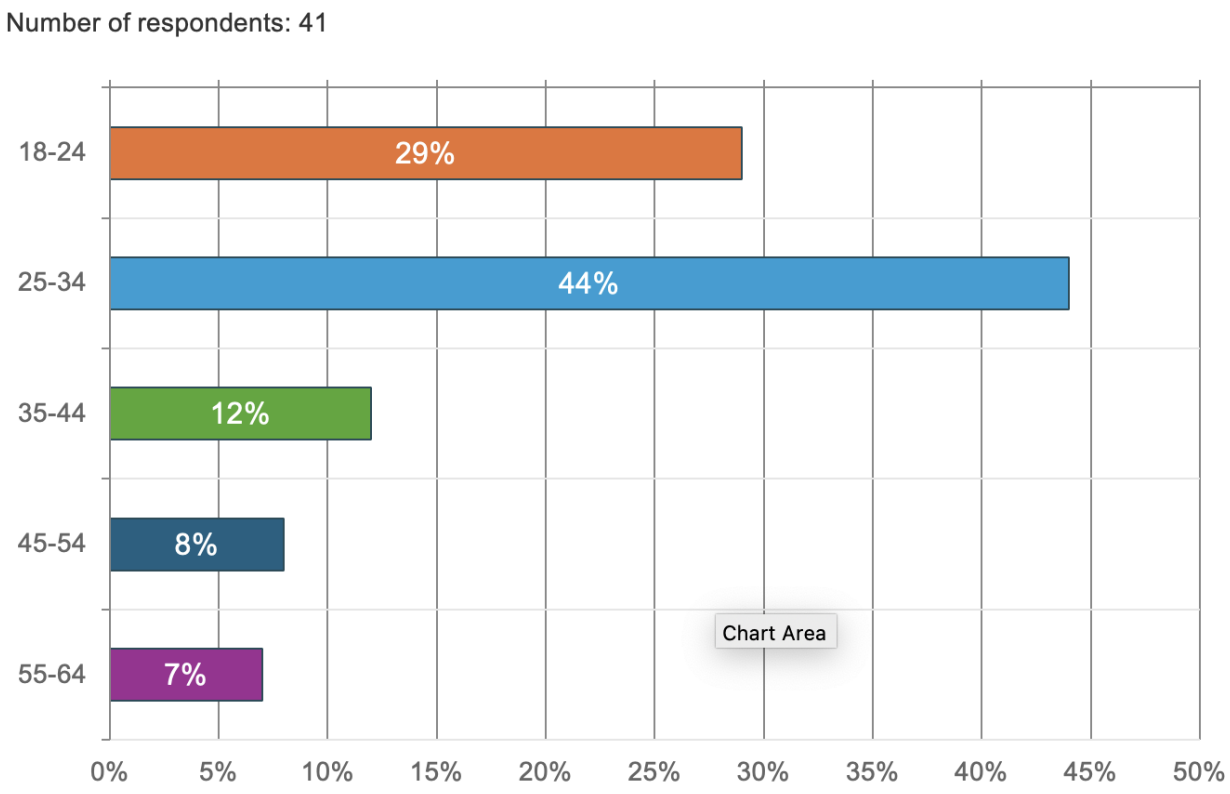

Figure 9. Question 1, Age group of respondents.

Figure 9 demonstrates the age of the respondents as significantly broad from 18 to 64 years old. The main respondents are in the age group of 25 to 34, with nearly 44% of respondents. The second biggest group age participating is from 18 to 24 with 29,3%. 12,2% of respondents are between 35 to 44. 7,3% are from 45 to 54 and in the age of 55 to 64. The majority in the age of 25 to 34 clearly reveals that participants in this age have an interest in environmental impact and are especially concerned about green manufacturing initiatives.

Q2: What is your gender?

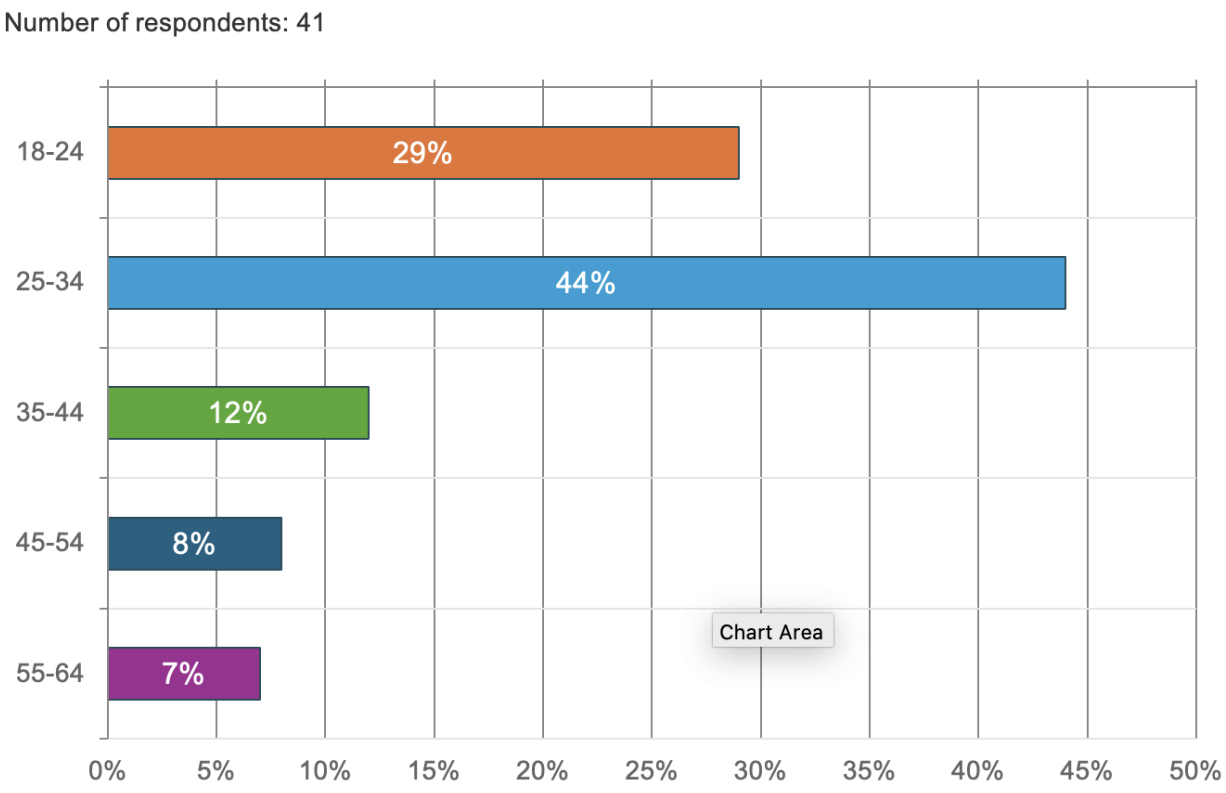

Figure 10. Question 2, the gender of respondents.

Figure 10 shows the gender of respondents in the survey. Only 1 person (2,4%) is from others. The ratio of male and female is nearly similar with 56,1% female and 41,5% male, which suggests a shared value of sustainability and are generally and equally susceptible to green manufacturing practices. It also discloses that when it comes to green manufacturing, the concern is not limited to gender values. Rather, it appeals to both male and female in a broad support base, reflecting the emergence relevance of sustainability and green manufacturing amongst consumers.

Q3: What is your occupation?

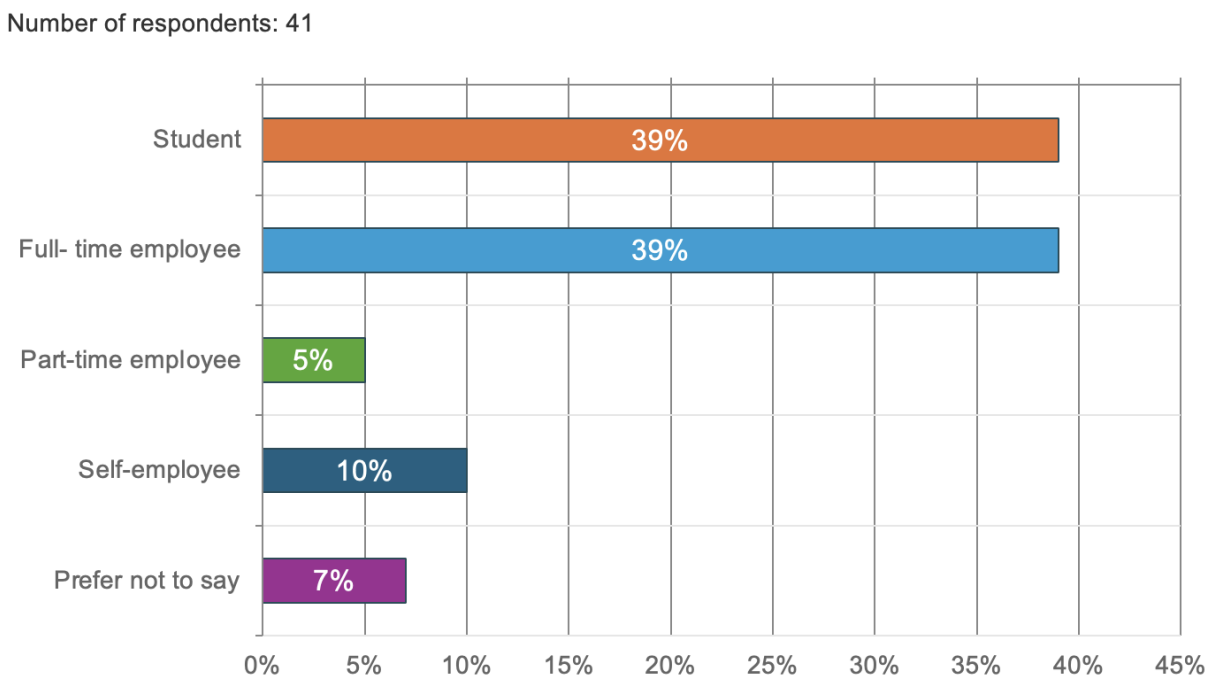

Figure 11. Question 3, the occupation of respondents.

Figure 11 shows the job of the total 41 participants. It is clear that the majority of participants in the survey are students and full-time employees, with the same percentage of 39%. 10% of the participants are self-employee and 7% prefer not to say. Only 5% of participants are part-time employees.

Q4: Have you heard of Vinamilk's products?

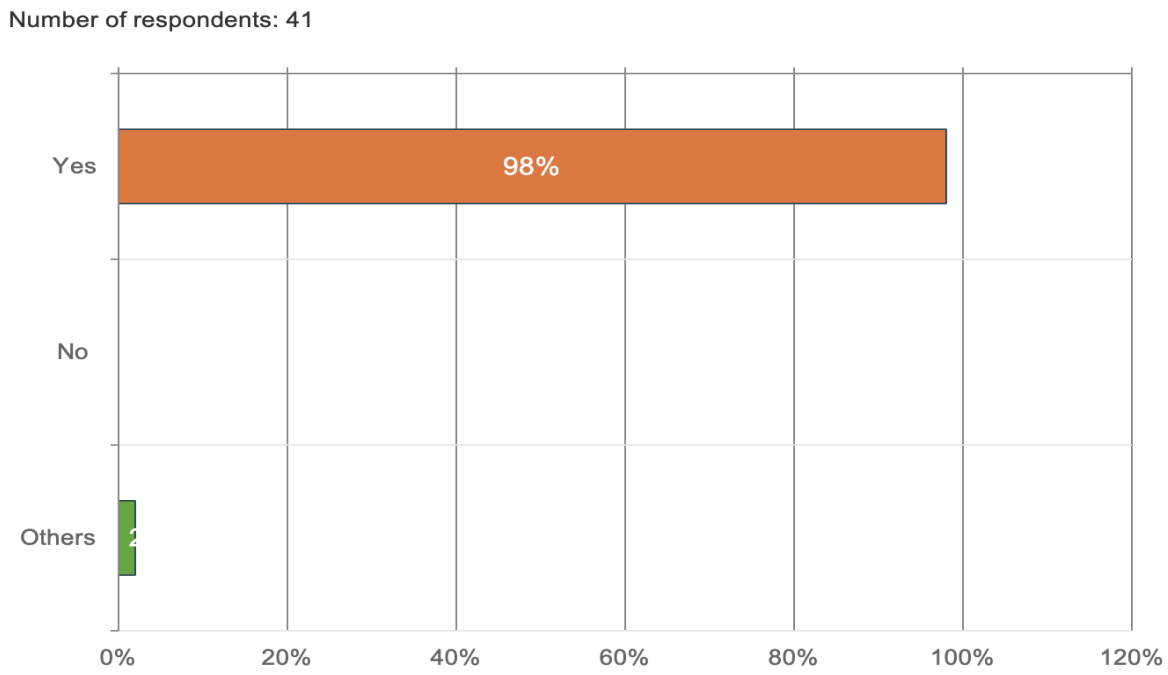

Figure 12. Question 4, the comprehension about Vinamilk's products of respondents.

Figure 12 presents the familiarity of participants with the case company. Out of 41 participants, there are 40 respondents have heard and known about the brand. Therefore, nearly all respondents possess prior knowledge about the case company. Only 1 participant stated others with the explanation of hearing but not detailly. Moreover, there is not a single participant who does not know about Vinamilk. This indicates a strong brand awareness of Vinamilk and its products to the respondents. The figure also ensures the answers are based on related and existing awareness about the case company and its practices.

4.2.2. The adoption of Vinamilk's green manufacturing practices

Questions 5, 6 presents the respondents' knowledge about the current green manufacturing practices that Vinamilk has adopted.

Q5: Do you think Vinamilk is implementing green manufacturing practices?

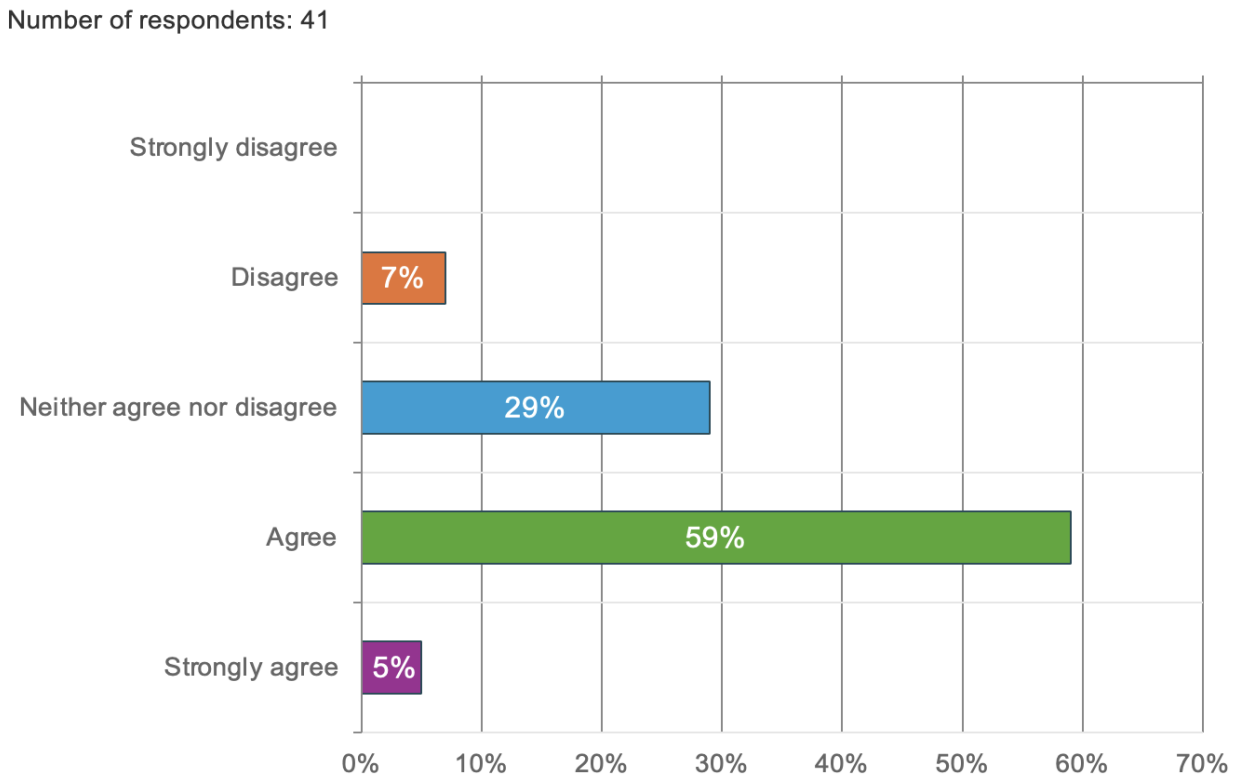

Figure 13. Question 5, response regarding Vinamilk's adoption of green manufacturing practices.

In Figure 13, respondents show agreement with the statement that Vinamilk is implementing green manufacturing practices. It includes five different categories from strongly disagree to strongly agree. When being asked, only 3 participants disagree with the statement. None strongly disagrees. A little over a quarter neither agree nor disagree. The majority nearly 60% of the participants agree with the fact that Vinamilk is implementing green practices in the manufacturing process. Nearly 5% strongly agree. The statement directly confirms the adoption of green manufacturing practices in the case company, Vinamilk. Nearly 60% of the participants find the statement agreeable and 5% find it strongly agreeable, indicating a general and pretty positive understanding of Vinamilk's efforts in the sustainable manufacturing field. The majority of respondents acknowledge and value Vinamilk's adoption of green manufacturing practices. Meanwhile, still nearly 30% of participants express neutral opinions, suggesting a potential gap in awareness and information about Vinamilk' initiatives towards green manufacturing. Since there are only 3 participants who disagree with the statement, the issue points out that this small group may be potentially skeptical or may not obtain sufficient knowledge about the efforts of the case company in the analyzed area.

Q6: Which of the following green practices do you think Vinamilk has adopted?

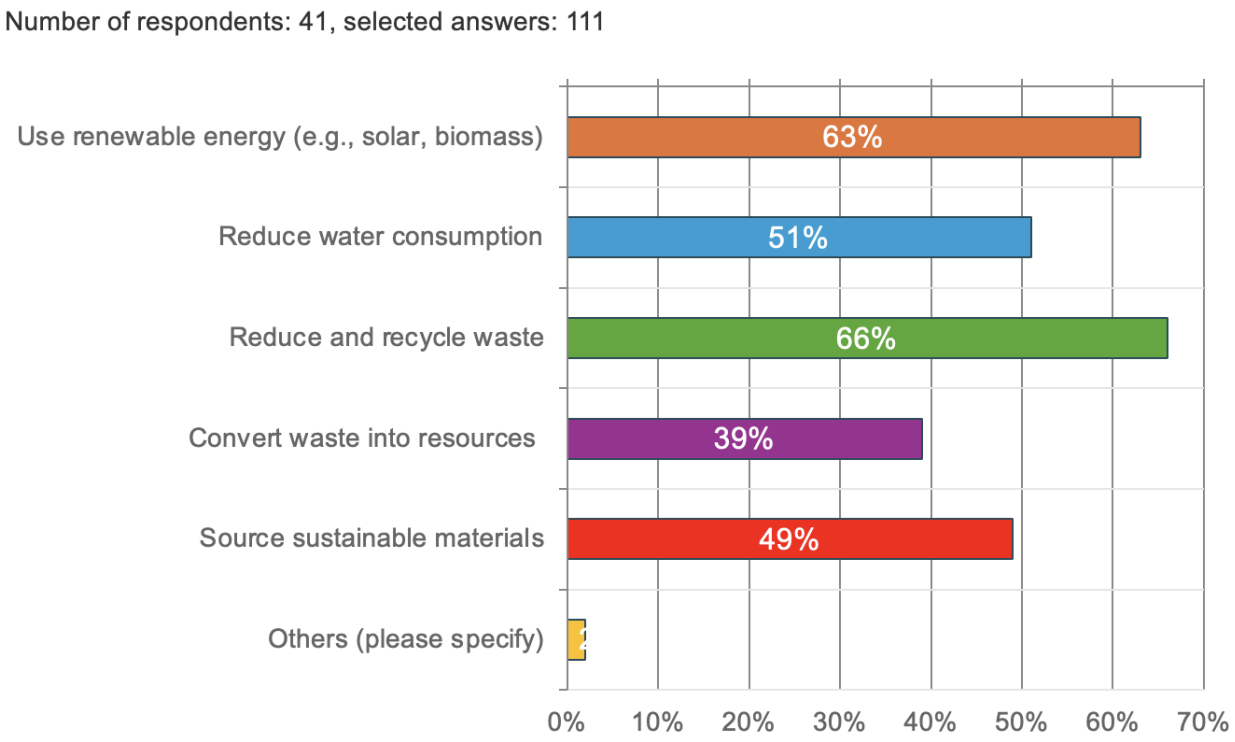

Figure 14. Question 6, The comprehension about Vinamilk's current green manufacturing practices.

To investigate respondents' understanding of Vinamilk's green manufacturing practices, question 6 asked specifically about the green measures that Vinamilk has adopted in the manufacturing process. 63% of respondents chose renewable energy usage. The second most common practice is waste reduction and recycling. Slightly more than 50% of respondents find reducing water consumption to be involved in green manufacturing practices. Another 49% of respondents perceive that Vinamilk has sourced sustainable materials with the remaining divided among converting waste into resources and others. In fact, nearly 40% of respondents agreed to convert waste into resources as green manufacturing. Meanwhile, only 2% chose others without further explanation.

The most favored green manufacturing practice is renewable energy use, indicating a shared recognition and awareness of customers about Vinamilk's efforts to resort to solar and biomass energy. Moreover, it may be because the method of renewable energy use has been promoted by several corporations and has grown into a global trend. It also indicates that respondents are comparatively aware of sustainable manufacturing practices, making green manufacturing an important factor in attracting environmentally conscious customers and gaining financially competitive advantages.

4.2.3. The impact of Vinamilk's green manufacturing practices

Questions 7,8,9 and 10 demonstrates the impact of Vinamilk's green manufacturing practices to the environment and financial performance of the case company under the respondents' respectives.

Q7: What benefits do you think Vinamilk gains from adopting green manufacturing practices?

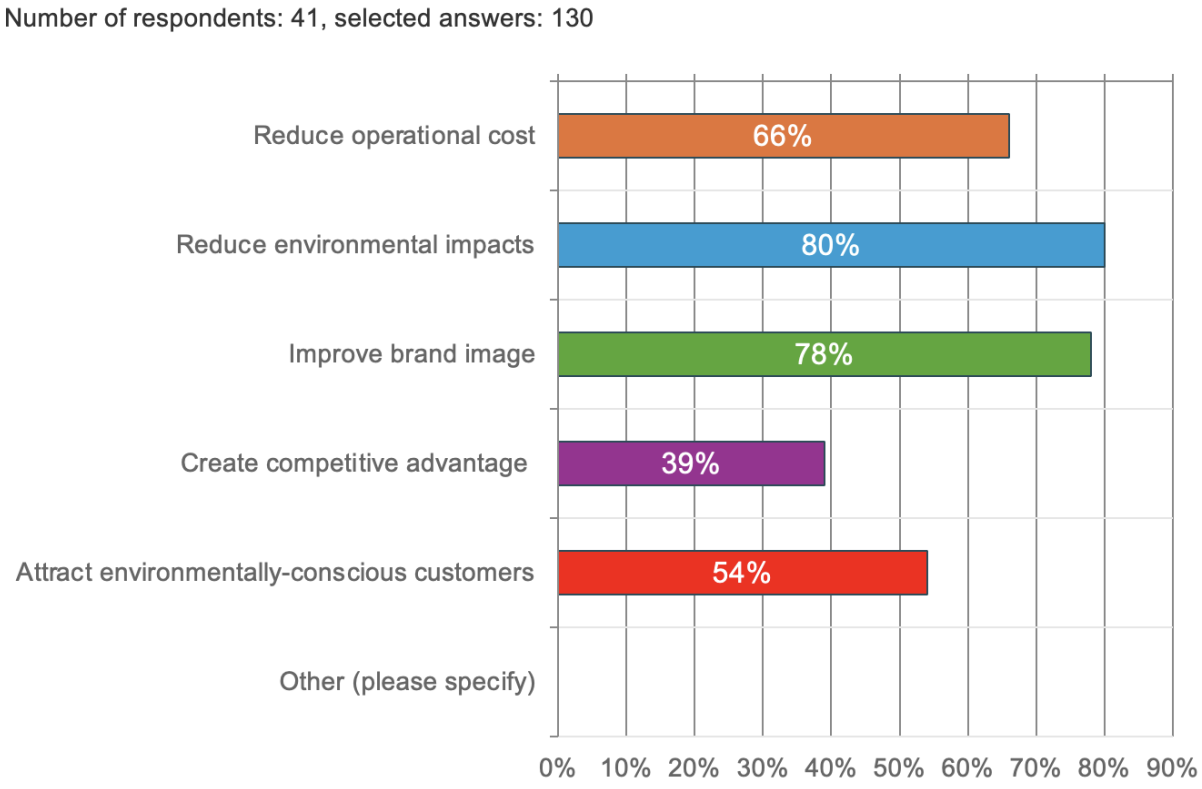

Figure 15. Question 7, comprehension about benefits of Vinamilk's green manufacturing practices.

Figure 15 presents the advantages that Vinamilk gains from adopting green manufacturing practices. Respondents can check all the answers that applied. The results show that most of the respondents (80%) believe in the positive impact of green manufacturing practices on the environment. A slightly lower percentage (78% of the respondents) consider green manufacturing as an effective tool to improve brand image. 66% of respondents find operational cost reduction as one of the core benefits of green manufacturing practices. More than 50% of the respondents agree that through green manufacturing practices, Vinamilk attracts environmentally conscious customers while the smallest portion (37%) believe green manufacturing practices create competitive advantages. Therefore, respondents mainly associate Vinamilk's green manufacturing with environmental benefits, brand recognition and cost efficiency, indicating the positive benefits related to the environment and the operational cost of the company.

Q8: Vinamilk's green manufacturing practices reduce negative environmental impacts

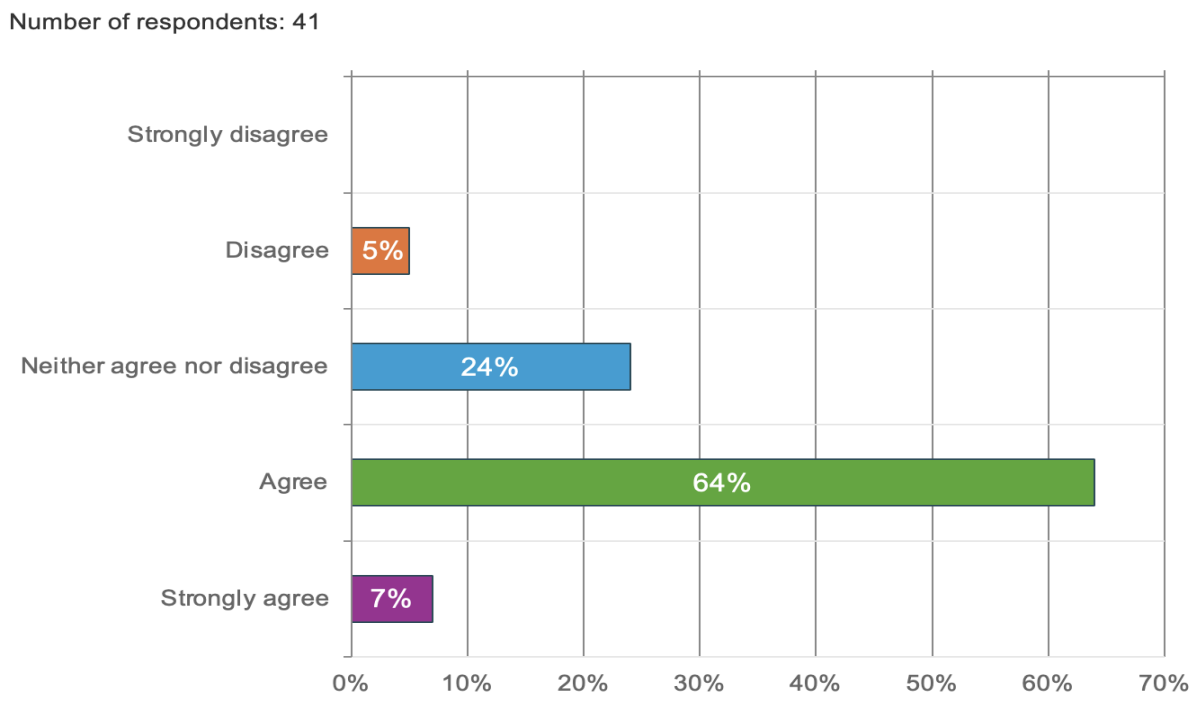

Figure 16. Question 8, Response regarding the reduction of negative environmental impacts of practices.

Question 8 asks the opinions of the respondents about the impact of the green manufacturing practices of Vinamilk on the environment. The respondents express their viewpoints from strongly disagree to strongly agree. The result shows no disagreement about the positive impact of green and sustainable practices on the environment. A small percentage of 5% expressed disagreement and skepticism about the effects. The number may originate from the 3 participants who disagree with the statement that Vinamilk is implementing green manufacturing practices in question 5. 24% of respondents selected ambivalent views of neither agree nor disagree. These respondents might imply a potential gap in awareness and information about the effectiveness of Vinamilk's green practices on the environment. In contrast, the majority of respondents (up to 64%) believe that Vinamilk's green manufacturing practices reduce negative environmental impacts, demonstrating a high level of belief and confidence in the impact of green manufacturing practices in addressing negative environmental issues. These respondents combined with 7% of respondents who strongly agree have a tendency to highly perceive and appreciate the efforts and initiatives of Vinamilk towards the path to a sustainable environment. They believe that through the practical actions of renewable energy use, water consumption reduction, closed-loop manufacturing, and sustainable materials sourcing, Vinamilk has sustainably contributed to reducing environmental footprint and carbon dioxide, which is extensively harmful to the environment.

Q9: On a scale of 1 to 5, how effective Vinamilk's green manufacturing practices are in reducing environmental harm?

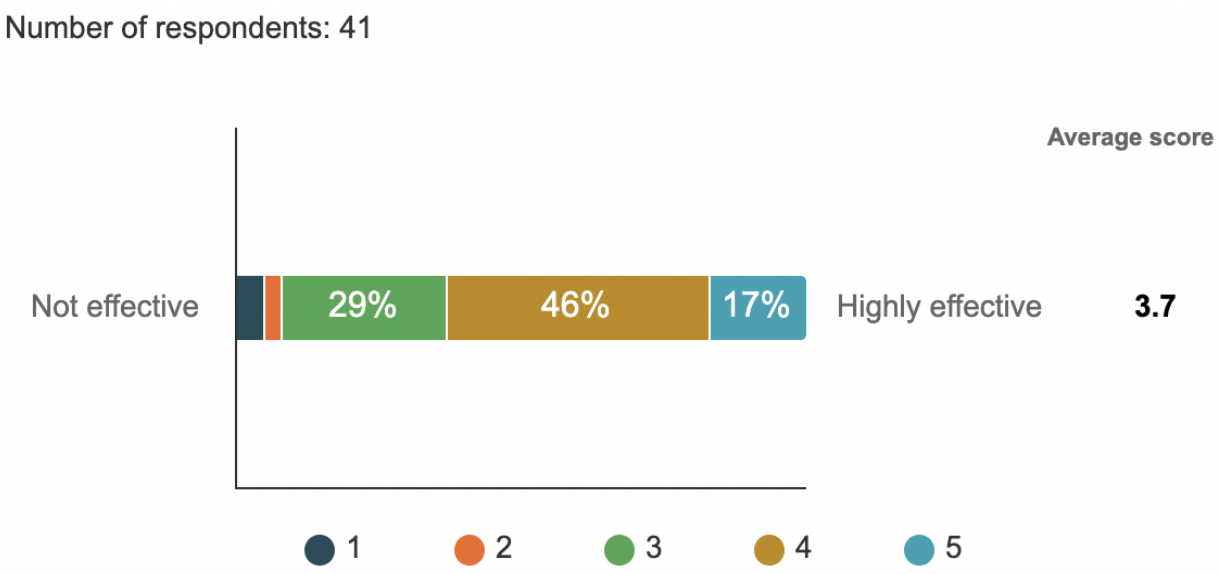

Figure 17. Question 9, the effectiveness of Vinamilk's practices in reducing environmental harm.

Figure 17 demonstrates the opinions about the impacts of Vinamilk' green manufacturing practices on the environment, figure 19 goes deeper into details to measure the effectiveness of Vinamilk's green manufacturing practices in reducing environmental harm. The highest b´numer of respondents 46,3% recognizes Vinamilk's green practices as 4, implying a positive attitude towards the practices. Another 17% considers Vinamilk's efforts as highly effective in reducing environmental harm, highlighting a strong belief and approval of green practices. 29% of the respondents perceive the efforts and the practices of Vinamilk but expect a more significant improvement when they consider the practices as effective. Only 3% of the respondents give 2 in relation to slightly effective and only 2 respondents (5%) reject the effectiveness of these practices, concealing a potential concern of corporate responsibility.

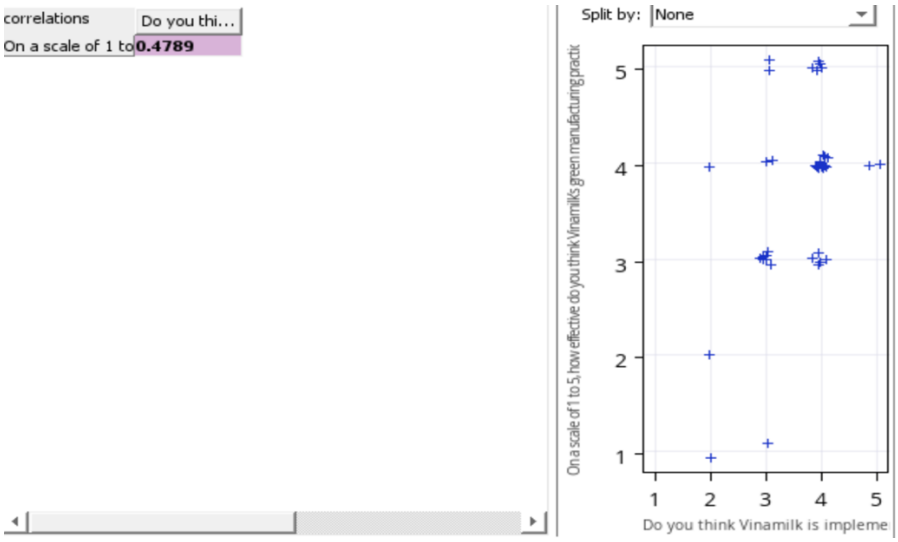

Figure 18. The relationship between comprehension of Vinamilk's green manufacturing practices and assessment of the effectiveness of these practices.

To validate the result, question 9 was also placed under correlation analysis to investigate the relationship between respondents' comprehension of Vinamilk's adoption of green manufacturing practices and their assessment of the effectiveness of these practices in reducing environmental harm. In Fig.18, a correlation of 0.4789 is found, indicating there is a positive relationship between the comprehension of Vinamilk's adoption of green manufacturing practices and the assessment of the effectiveness of these practices in reducing environmental harm. The more respondents acknowledge the implementation of Vinamilk's sustainable practices, the more effective they consider Vinamilk's green manufacturing practices to reduce environmental harm. Moreover, $p = 0.002$ ($p < 0.05$) allows the result to be statistically significant where no null hypothesis should be included. In other words, Fig.7 with a statistically significant p of 0.002 proves that the correlation of 0.4789 is valid, genuine and not due to random chances.

In essence, Vinamilk has applied green manufacturing practices, which minimizes the negative impact of manufacturing activities on the environment. The fact that 2 respondents reject the effectiveness of these practices potentially stems from a lack of information or insufficient comprehension about Vinamilk's adoption of these practices.

Q10: Vinamilk's green manufacturing practices cut costs and improve company financial performance? (sales, customers' loyalty, profits,..)

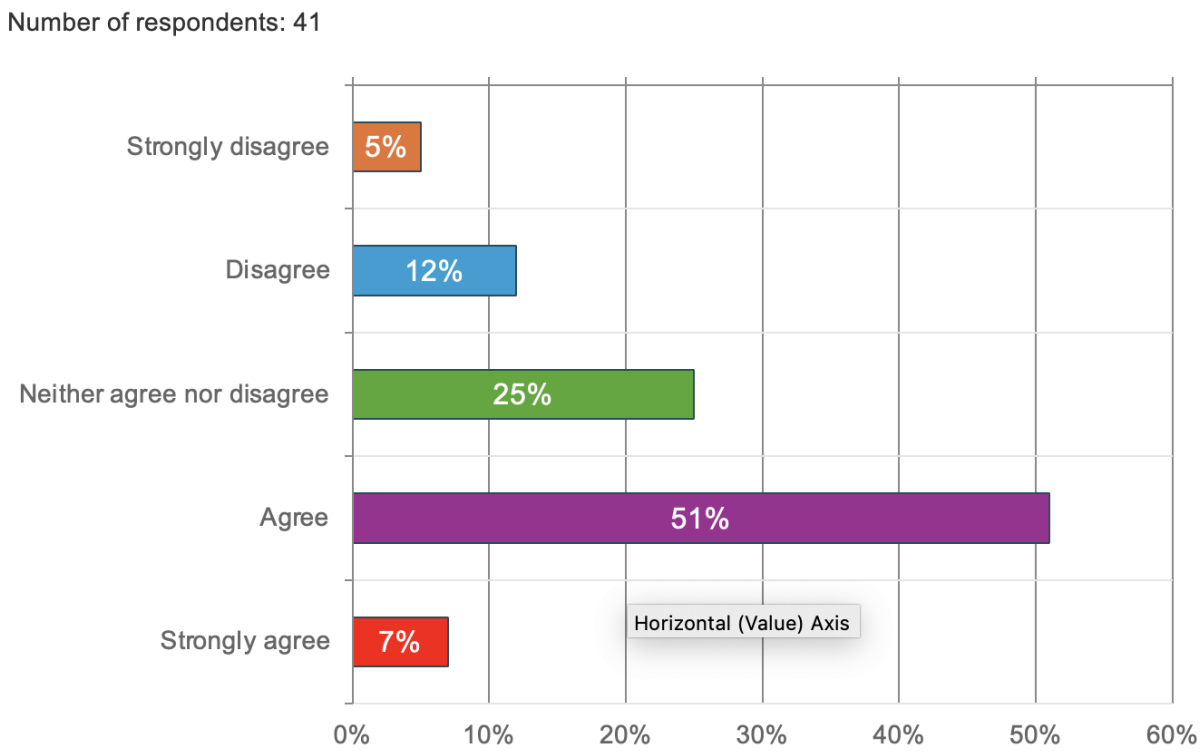

Figure 19. Question 10, comprehension about the impact of practices to business performance.

Figure 19 demonstrates the respondents' viewpoints from strongly disagree to strongly agree. However, while Figure 16 considers the environmental perspectives, Figure 19 delves into the impact of green manufacturing on business performance through cost reduction and financial performance increase. Figure 19 still shows the positive result with 51% agree and 7% strongly agree with the operational cost cut-down, increase in customers' loyalty and enhancement in sale volume between environmentally- conscious customers. 25% of respondents stay neutral as they might acknowledge the benefits but lack of comprehension the evidence to fully support the statement. A small number of 12% percentage of respondents find the impacts on financial performance insignificant and questionable. Only 5% totally disagree with the statements, demonstrating a small skepticism yet highlighting the demand for Vinamilk to communicate the message about its green manufacturing impacts to customers in a more clear and specific manner.

5. Discussion

This chapter summarizes the main point and key findings of the data and empirical study to explain Vinamilk's adoption of green manufacturing practices and the benefits of these practices to the environment and company perspectives.

Accordingly, Vinamilk is implementing green manufacturing practices in an attempt to move towards a sustainable future by initiating several programs to align with environmental protection and company growth. Vinamilk highly promotes the transparency of these practices through the publication of sustainable reports over the years. In fact, there are five main practices that Vinamilk concentrates on involving renewable energy use, waste management, closed-loop manufacturing, water usage efficiency and sustainable materials sourcing. The practices that are highly recognized and popular amongst customers are renewable energy use and waste management 3R (reduce, reuse and recycle).

With the application of these practices, Vinamilk has gradually substituted fossil fuels with wind energy and biomass in the production industry. Additionally, the act of converting waste into organic input combined with the waste management system reduces waste amount discharged into the environment and climate change created from waste decomposition. In addition, Vinamilk is committed to water efficiency through the 3R model of reducing, reusing and recycling, which further provokes the retention of water annually. Vinamilk also acquires materials from a sustainable farming network with the circular economy model and solar energy usage with the reduction of chemical fertilizers for the protection of the environment.

The green manufacturing practices of Vinamilk have proven their potential and positive effects on the environment and the company's performance. With the analysis of Vinamilk's annual sustainability reports and the demonstration of questionnaire results, Vinamilk has emphasized the impact of green manufacturing in relation to emission reduction, resource efficiency and waste recycling.

In fact, green manufacturing is not merely about positive environmental impacts. Rather, it contributes to company performance and competitiveness. Since the implementation of green manufacturing, Vinamilk has signified operational costs while cutting down on electricity, water, and materials expenses and attracting environmentally conscious customers. The green practices and the low operational expenses create a position where Vinamilk gains competitive advantages in the diary markets in several ways, including low selling price, high sales volume and great financial profits.

It has been mentioned in the empirical research that the environment has grown significantly into a serious and worldwide issue within the context of globalization and industrialization, leaving several

interrelated issues behind. The emergence of environmental issues requires a new method of manufacturing and production to emerge. Moving manufacturing practices towards sustainable and green methods is an effective way to enhance brand recognition and value amongst customers and positively impacts the environment and company competitiveness and performance. Generating manufacturing practices such as renewable energy use, waste management, closed-loop manufacturing, water usage efficiency and sustainable materials sourcing potential assists in maximizing the green operational strategy activities.

6. Recommendations

6.1 Recommendations

The analysis of data and questionnaire report has shown the relationship between the comprehension of sustainable manufacturing of the company and the assessment of the effectiveness of these practices in reducing environmental harm. Therefore, the research recommends Vinamilk and the companies in the dairy industry to increase consumers' awareness about green manufacturing practices and sustainability branding. The company should reflect on how green manufacturing practices and its green initiatives are promoted amongst consumers to enhance brand awareness and brand recognition. By highlighting the positive impacts on the environment, the company appeals to environmentally conscious consumers. The company can also provide educational content about green manufacturing not only to the public but also to employees to further reinforce internal sustainable practices within the operations.

Moreover, while Vinamilk has made strides in different aspects of the production process including water efficiency, renewable energy sources, and closed-loop manufacturing, there is still room for further improvements. Company should be committed to continuous enhancement in the green manufacturing practices to promote an agile yet resilient production process. It is vital for the company to further invest in research about the application and integration of sustainable strategies throughout all operations. This involves optimizing current processes, engaging technological advances, regularly reviewing the performances of sustainable programs, and making changes in case of necessity.

6.2 Self-learning

I have been working on my thesis for 2 months. It is not a long time. However, there were also some challenges at the beginning of the thesis as it was difficult for me to allocate what to investigate and what topics I should focus on. Luckily, with the help of my supervisor, I have finally narrowed down the list of topics and focused on this main thesis topic.

This topic thesis combined with the desktop research about green supply chain practices with green manufacturing and its impacts on the environment and the company perspectives has given me insights about the current manufacturing practices and the operating principles of these practices and the effects of them on the company and the environment.

Besides the knowledge and foundation of the topic, during this time, I have also honed several skills including data collection and analysis skills, critical thinking and time management. My data analysis has significantly improved with a focus on distributing and collecting questionnaires and interpreting data results while identifying comprehension and awareness related to sustainable

manufacturing. Moreover, during my writing time, I also work as a part-time worker. My task was to not only excel at my job but also highly concentrate on the thesis to perform the paper on time. Therefore, I obtained time management skills by managing the various phases of the thesis, mapping out the schedule and making use of tools like Gantt chart and Google Calendar to avoid overlapping deadlines. In addition, to increase the validity and reliability of the thesis, I have selected reliable sources of information, which completed my critical thinking abilities. These skills are not only useful for my current academic path but also an effective tool to prepare me for my future professional challenges in the field of supply chain management.

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