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**DRIVERS OF GREEN INNOVATION MANAGEMENT  
ADOPTION IN SMES:  
EVIDENCE FROM POLAND AND THAILAND**

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## TABLE OF CONTENTS

|                                                                                                                    |    |
|--------------------------------------------------------------------------------------------------------------------|----|
| TABLE OF CONTENTS.....                                                                                             | 1  |
| INTRODUCTION .....                                                                                                 | 4  |
| CHAPTER 1. PRINCIPLES OF GREEN INNOVATION MANAGEMENT IN SMEs.....                                                  | 13 |
| 1.1. Differences in Definitions of SMEs in Poland and Thailand .....                                               | 13 |
| 1.2 Terminology and Understanding of Green Innovation.....                                                         | 16 |
| 1.3 Strategies of Green Innovation Management in SMEs .....                                                        | 24 |
| 1.4 Benefits of Green Innovation Management for SMEs .....                                                         | 27 |
| 1.5 Green Innovation and Sustainability.....                                                                       | 33 |
| 1.6 Strategies for Encouraging Green Innovation Management in SMEs.....                                            | 36 |
| CHAPTER 2. GREEN RESEARCH POLICIES AND THEORIES FOR SMEs.....                                                      | 45 |
| 2.1. Green Innovation Management Policies for SMEs in Poland and Thailand .....                                    | 45 |
| 2.2. Green Innovation in SMEs in Selected Countries .....                                                          | 49 |
| 2.3 Natural Resources and Triple Bottom Line Framework for Successful Integration of Green Innovation in SMEs..... | 57 |
| 2.4. Development of Study Variables and Hypotheses .....                                                           | 64 |
| 2.5. Structuring Variables and Hypotheses Within Conceptual Models .....                                           | 77 |
| CHAPTER 3. RESEARCH METHODOLOGY FOR INVESTIGATING GREEN INNOVATION DRIVERS IN SMEs .....                           | 80 |
| 3.1. Research Design .....                                                                                         | 80 |
| 3.2. Study Population and Sample Size .....                                                                        | 81 |
| 3.3. Study Variables and Constructs.....                                                                           | 83 |

|                                                                                                                               |     |
|-------------------------------------------------------------------------------------------------------------------------------|-----|
| 3.4. Data Collection Techniques and Instruments .....                                                                         | 84  |
| 3.5. Reliability, Validity and Model Fitness Evaluation.....                                                                  | 91  |
| 3.6. Data Analysis .....                                                                                                      | 94  |
| 3.7. Ethical Considerations .....                                                                                             | 95  |
| CHAPTER 4. EMPIRICAL ANALYSIS AND KEY INSIGHTS INTO GREEN<br>INNOVATION DRIVERS IN SMES IN POLAND AND THAILAND.....           | 96  |
| 4.1. Review of Research Questions .....                                                                                       | 96  |
| 4.2. Results of Green Innovation Management for SMEs Respondents in Poland<br>.....                                           | 97  |
| 4.3. Results of Green Innovation Management for SMEs Respondents<br>in Thailand .....                                         | 125 |
| 4.4. Multi-Group SEM Analysis for Polish and Thai SMEs Respondents....                                                        | 152 |
| CHAPTER 5. DISCUSSIONS AND RECOMMENDATIONS FOR SMES<br>ADOPTION OF GREEN INNOVATION MANAGEMENT IN POLAND AND<br>THAILAND..... | 155 |
| 5.1. Discussions of the Findings .....                                                                                        | 155 |
| 5.2. Mediating Effect of Green Economic Resources in Polish and Thai SMEs<br>Respondents .....                                | 160 |
| 5.3. Moderating Role of Green Standards Compliance of SMEs Respondents in<br>Poland and Thailand .....                        | 161 |
| 5.4. Study Results Comparison for SMEs Respondents in Poland and Thailand<br>.....                                            | 162 |
| 5.5. Study Results Implications .....                                                                                         | 164 |
| CONCLUSION.....                                                                                                               | 167 |
| REFERENCES .....                                                                                                              | 172 |
| LIST OF TABLES.....                                                                                                           | 196 |

|                                                                                                |     |
|------------------------------------------------------------------------------------------------|-----|
| LIST OF FIGURES .....                                                                          | 198 |
| APPENDICES .....                                                                               | 200 |
| Appendix A - Questionnaire .....                                                               | 200 |
| Appendix B: IOC – Reliability and Validity .....                                               | 207 |
| Appendix C: Confirmatory Factor Analysis (CFA) Results for Poland SMEs<br>Respondents .....    | 215 |
| Appendix D: Structural Equation Modelling (SEM) Results for Poland SMEs<br>Respondents .....   | 217 |
| Appendix E: Confirmatory Factor Analysis (CFA) Results for Thailand SMEs<br>Respondents .....  | 219 |
| Appendix F: Structural Equation Modelling (SEM) Results for Thailand SMEs<br>Respondents ..... | 221 |
| SUMMARY IN POLISH.....                                                                         | 224 |
| SUMMARY IN ENGLISH .....                                                                       | 226 |

## INTRODUCTION

In the rapidly evolving business environment, responding to the "green innovation" agenda has arisen as a critical issue and opportunity for businesses, regardless of their size or industry. The concept cannot be ignored, bearing the increased emphasis on the production of goods and services that meet the health standards and environmental responsibility to society (Weng and Lin, 2011). Among Small and Medium Enterprises (SMEs), green innovation management is a key focus to capitalize on green innovation opportunities and remain competitive in the market (Polas et al., 2023a). SMEs are considering integrating green innovation practices into their operations, product development, and service delivery to create green ranking and value for their customers, employees and stakeholders.

According to Cuerva, Triguero-Cano and Córcoles (2014), green innovation practices and their management in the enterprise context are becoming increasingly relevant for the business operations of SMEs. Among the drivers are shifting regulatory requirements, consumer-sensitive demands for eco-friendly products and services, and the possibility of operations cost savings (Bilan et al., 2020). Green innovation management might also suggest legitimacy and improved brand reputation, boost competitiveness, and emphasize environmental responsibility. Considering these facts, most of the SMEs have started an active engagement that extends beyond their internal operations to improve their 'green profile' throughout the lifecycle of their products and services, from procuring raw materials through production to customer use. The effective management of these green innovation practices is crucial for business success (Cheng and Shiu, 2012; Kurowska-Pysz, 2021).

As suggested by Azam et al., (2023) an effective integration of green innovation concept in the management practices of SMEs is an interesting adventure. As well, it also has significant challenge that requires keen evaluation (Azam et al., 2023). There are various challenges that face SMEs in their journey to green practices. Due to a lack of resources and expertise, SMEs face key challenges in adopting and implementing green innovation management compared to other established and bigger firms. Additionally, they are also considered to lag in technology adoption

and assimilation. This is because their business operational and practices lack of exposure, goodwill, and technical capabilities. Additionally, Duque-Grisales et al. (2020) suggested that green compliance standards are critical aspects that SMEs struggle to achieve. However, the critical aspect is that the integration of these standards into the SMEs' operation without affecting their bottom line is critical. Pakhomova, Khoroshavin and Malyshkov (2017) further indicated that SMEs have limited market exposure and usually encounter obstacles concerning regulatory compliance.

However, there is a different observation from Ebrahimi and Mirbargkar (2017). Their study argues that that these challenges should not be considered barriers but opportunities where SMEs could demonstrate their agility and creativity in the demanding business environment. They have the advantage of quick adaptability to volatile market conditions and changing customers' tastes and preferences, which could give them an edge in the green economy.

Green innovation management in SMEs is also a demanding adventure, considering that in addition to developing new products, services, or technologies, it entails the transformation of the complete business processes to cultivate and foster a green culture throughout the organization (Huang et al., 2022; Riana et al., 2020; Wróblewski et al., 2018). Green culture requires significant investment from all concerned stakeholders, including employees and leadership engagement, and external partners like sector associates, customers, and suppliers. Establishing such a coherent network may challenge the SMEs (Kolasińska-Morawska et al., 2022). However, Rodrigues and Franco (2023) support the idea that SMEs could be better positioned to accelerate their journey towards adopting green innovation management through such an integrated like-minded network.

### **Problem of the Study**

Green innovation is currently seen as a business strategy to gain a competitive advantage because it helps access new markets or develop new goods, services, and applications ethically through practices that observe increasing environmental and health issues and concerns (Yurdakul and Kazan, 2020). This kind of innovation is significant because it enables businesses to compete in the market utilizing eco-

friendly and effective technologies and makes it easier to adapt to new healthy consumption trends. Green innovation has evolved into a critical business aspect due to increasing demand to adhere to environmental standards and satisfy customer health and environmental preferences in recent years. As a result, the concept of green innovation in business management has attracted great interest in business and academia. An increasing body of literature is geared toward deeply understanding green innovation practices in business (Bani-Melhem et al., 2022).

However, SMEs are often overlooked in the discussion about green innovation. Despite the fact that SMEs account for around 80% of all businesses in Poland and Thailand nations, their significant contribution to the economy and employment, many SMEs are not yet fully aware of their potential opportunities for green innovation (Wang and Yang, 2021).

The literature has not adequately addressed the adoption of green innovation by SMEs and its incorporation and implementation within their business practices. Most of the research has been conducted in the domain of big corporations, large enterprises, and public or government institutions. Additionally, Carrillo-Hermosilla, del Río González and Könnölä (2009) indicated that as compared to larger business corporations, SMEs may face various challenges while adopting and implementing green innovation practices in the management. These challenges act as barriers to SMEs' efforts to adopt green innovation. These challenges include lack of adequate knowledge in the management regarding green innovation, lack of knowledge regarding new possibilities within the management framework, the cost of developing green products and services, insufficient competencies in the research and development (R&D) department, among others (Carrillo-Hermosilla et al., 2009).

In addition, SMEs have been considered extremely resistant to technological advancement compared to other large enterprises. SMEs have begun adopting green innovation management practices primarily due to stakeholder pressure. Another barrier they face is their limited ability to adopt these technologies in terms of technological advancement and managerial knowledge required to adopt green innovation. Further, SMEs lack the internal motivation driving them towards

adopting green innovation. This implies the personal values observed by the owners and management of the SMEs, as well as their ethical principles. To a greater extent, SMEs lack personal beliefs, awareness, and commitment to social and environmental demands (Ashton et al., 2017). Further, Poland and Thailand have varying cultural practices and backgrounds, which significantly influence their management practices regarding green innovation. Due to cultural differences, the two countries differ in innovation perspectives, practices, and efforts. Considering the challenges and barriers SMEs face and the lack of literature on green innovation management, this study investigated the drivers green innovation management adoption in SMEs. It was a case study conducted in Poland and Thailand. The research problem was addressed by engaging it with the management discipline and practices in SMEs.

### **Research Gaps**

It was evident from the critical review of literature conducted for this study that the concept of green innovation management has not been adequately explored in Poland and Thailand. The specific research on the concept of ‘green innovation management’ in the SMEs is scarce. Related studies have researched on aspects such as green innovation adoption in SMEs, particularly the drivers influencing the adoption (Indrawati et al., 2023; Jun et al., 2021; Thomas et al., 2022). An example is the study by Jun et al. (2021) who carried out a research to investigate the determinants of green innovation adoption in SMEs.

On the other hand, Thomas et al. (2022) investigated stakeholders' influence on SMEs' green innovation adoption. It was found that these studies have researched and developed the implications of the adoption of green innovation from the perspective of environmental conservation and management. They have therefore highlighted the application of green innovation technology to reduce the negative environmental impact of SMEs (Cuerva et al., 2014; Khan et al., 2023; Weng and Lin, 2011). A study by Weng and Lin (2011) evaluated the adoption of green innovation from the perspective of its contribution to technological, organizational, and environmental responsibility.

Additionally, few studies have investigated the aspect of green innovation among SMEs in Thailand (Tariq et al., 2019; Muangmee et al., 2021), while others have been carried out under the case of Poland (Wysocki, 2021). However, the literature review did not find a study comparing SMEs' green innovation management practices in the environments of Polish and Thai businesses. While some research exists on green innovation in general, the management context-specific insights are limited, hindering the development of targeted strategies and initiatives. Considering these deficiencies in existing literature, this study was geared towards filling these research gaps.

### **Research Questions**

Green innovation management is a critical aspect to SMEs, in their effort to adjust to the global shift towards green technology, their market competitiveness, and long-term success and growth. By embracing green innovation principles and integrating them into their core business management strategies and practices, SMEs stand in a position to produce green goods and services, address the consumers' environmental concerns and impacts, enhance brand reputation, boost competitiveness, as well as drive innovation and growth by developing a culture of creativity and problem-solving. To achieve this green innovation initiative requires the right mindset, resources, and support. In this regard, this research is geared towards answering the following research questions:

- **RQ1:** What is the comparative status of SMEs' green innovation management practices in Poland and Thailand business environments?
- **RQ2:** What are the drivers of SMEs' adoption of green innovation management in Poland and Thailand?
- **RQ3:** What is the influence of green standards compliance on the drivers of SMEs' adoption of green innovation management?
- **RQ4:** What are the actionable policy recommendations to enhance SMEs' adoption of green management in their business operations and strategies?

## **Research Objectives**

This study was guided by the main objective, which was to find out the drivers that influences the green innovation management in SMEs, under a case of Poland and Thailand. This main objective is addressed through the following specific objectives:

**RO1:** To compare SMEs' green innovation management practices in Poland and Thailand business environments.

**RO2:** To determine the drivers that influence SMEs' adoption of green innovation management in Poland and Thailand.

**RO3:** To determine the influence of green standards compliance on the drivers of influencing SMEs' adoption of green innovation management.

**RO4:** To develop actionable policy recommendations to enhance SMEs' adoption of green innovation management in their business operations and strategies.

## **Hypotheses Proposal**

The following hypotheses below were proposed for this research:

**H1:** Green regulations significantly influence SMEs' adoption of green innovation management.

**H2:** Green technical capabilities significantly influence SMEs' adoption of green innovation management.

**H3:** Green economic resources significantly influence SMEs' adoption of green innovation management.

**H4:** Green economic resources mediate the relationship between green regulations and adopting green innovation management in SMEs.

**H5:** Green human resources management significantly influences SMEs' adoption of green innovation management.

**H6:** Green standards compliance significantly influences SMEs' adoption of green innovation management.

**H7:** Green standards compliance moderates the influence of green regulations, green technical capabilities, green economic resources, and green human resources on the adoption of green innovation management in SMEs.

The study lays its values in several aspects. First, the dissertation comprehensively explores green innovation management within SMEs in Poland and Thailand. These are two distinct economies with varied management practices, definitions of SMEs and green innovation policies. The study provides cross-cultural insights by comparing SMEs' green innovation management practices in Poland and Thailand. These insights were useful in understanding the influence of economic, social, regulatory, and environmental policies in the adoption of green innovation practices and incorporation into management practices.

Secondly, this study adds value to the concept of green innovation by incorporating the aspect of management. The study explored green innovation management practices and their incorporation into the business lifecycle. Many SMEs face various management problems with regard to innovation, the adoption of new technologies, and their incorporation into the management practices. This research explored these management context-specific issues.

Thirdly, the findings of the study identified the drivers of the adoption of green innovation management in SMEs. The findings were essential for guiding business leaders and the management of SMEs, as well as policymakers, in developing effective strategies that could be implemented by SMEs when adopting green innovation practices and incorporating them at the management level.

The study is expected to introduce a new conceptual model for the study of 'green innovation management in SMEs' that provides new insights into this subject and could be adopted for future research. It also provides empirical results and findings regarding the drivers of green innovation management in SMEs, including multi-group analysis and comparison of the results between Poland and Thailand. Further, the study also contributes to the existing literature on the adoption of green

innovation management in SMEs and propose new areas and gaps that could be explored by future researchers.

The organizational layout of this study covers five chapters: The first chapter presents an in-depth exploration of the complexities associated with the management of green innovation, with a particular focus on its implementation in the contexts of Poland and Thailand. This study explores the underlying factors driving the increasing focus on green practices and developing strategies for managing green innovation. A review of relevant literature on the subject demonstrates an extensive knowledge of green innovation, wherein there are no significant disparities in its definition despite variations in terminology among different sources.

The second chapter of this study presents a comprehensive review of the policies and theories adopted in the study. A major emphasis is put on the Natural Resource-Based View (NRBV) and the Triple-Bottom-Line (TBL) framework. The chapter provides an overview of the fundamental principles of the Natural Resource-Based View (NRBV), highlighting the significance of how SMEs can effectively utilize organizational resources consistent with objectives related to green initiatives. The review of literature therefore presents an important basis on which these theories develop the bases of exploring the green innovation management concept under the SMEs case. In development of this study literature, the two concepts of the Resource-Based View (RBV) and Triple Bottom Line (TBL) frameworks have been considered to effectively assist SMEs focusing on Poland and Thailand in incorporating green practices into their innovation initiatives.

In the third chapter, the researcher elaborates the fundamental components and techniques adopted in carrying out the analysis. The robustness of the research methodology is emphasized, where the ability of the methods adopted to deliver objective results is discussed. The chapter also discusses the process adopted in the data collection and the development of instruments used in the data collection process. As well, the measuring scales utilized for assessing the catalysts for implementing green innovation management practices are explained. These scales play a crucial role in converting abstract notions into measurable variables,

facilitating the methodical examination of data. The data analysis process and techniques adopted is also discussed in this chapter, which include the Confirmatory Factor Analysis (CFA), Structural Equation Modelling (SEM), and multi-group SEM analysis.

In chapter four, the data analysis and results presentation were done. The chapter starts by presenting the descriptive statistics analysis perspective on the fundamental trends and patterns observed in the research findings. The descriptive statistics presents the analysis of the demographic characteristics of respondents. A series of tests are conducted to establish the reliability and validity of the measurement instruments employed and ensure that the results obtained are consistent and a reliable representation of the phenomena under investigation. the tests of the hypothesis – the relationship between the study variables is conducted using SEM analysis. A comparison of the two cases – Poland and Thailand are conducted using a multi-group analysis technique. The findings of this chapter serve as a guidance of the other chapter towards results discussions, conclusions and implications of the study.

In the concluding fifth chapter, the study discussed the findings of the study, based on the set hypothesis, and to address the study objectives. The chapter also discusses the implications of these findings, both managerial and theoretical. Recommendations of the study and limitations, as well as recommendations of the future study is also discussed.

## **CHAPTER 1. PRINCIPLES OF GREEN INNOVATION**

### **MANAGEMENT IN SMEs**

#### **1.1. Differences in Definitions of SMEs in Poland and Thailand**

The term SMEs stands for "Small and Medium Enterprises," although no single generally accepted definition exists. Different definitions of SMEs are possible, differing in different regions and organizations. For example, the European Commission uses three quantitative criteria to define SMEs: number of employees, annual turnover, and annual balance sheet, while the World Bank uses employee count, total assets in dollars, and annual sales in dollars.

Definitions can be divided into three ways provided by international institutions, national laws, and industry using quantitative and qualitative approaches (Berisha and Pula, 2015). Since these criteria make it possible to discriminate between the obvious types of SMEs among small and medium-sized businesses, the quantitative approach is frequently employed to define SMEs.

SMEs play a critical role in the national economies of emerging countries. Based on the countries' views towards entrepreneurial intentions, Poland and Thailand indicate similar aspects of SME business creation (Tripopsakul, 2018). SMEs constitute most business enterprises in Thailand, with approximately 99.5% in 2022 (Arunmas, 2024; Tantivangphaisal, 2024). The increased growth in SMEs in Thailand is attributed to the revision of the definition of SMEs by the country's Trade Competition Commission in 2022 to protect businesses from unfair credit terms. In Poland, the SME sector accounts for 99.8% of all economic enterprises. Due to the need for financial support, including loans, subsidies, and grants, SMEs in Poland are defined based on the number of employees and the annual turnover (Siuta-Tokarska et al., 2023). Accordingly, the European Commission defines an SME as an organization with fewer than 250 employees, a net revenue of less than 50 million euros, and/or a total balance sheet of less than 43 million euros (Buculescu, 2013).

### ***SMEs Definitions in Poland***

The definition of SMEs in Poland is based on that of the European Union (EU) since it is a member of the EU. The European Commission No 2003/361/EC defines the small and medium enterprises companies' recommendations. The definition of SMEs according to the EU is found in Annex 1 of European Commission Regulation (EC) No 800/2008 (Alessandrini et al., 2019). According to the article 1, an SME implies an entity engaged in an economic activity, irrespective of its legal form. These include different aspects such as self-employed people, businesses involved in varying business activities, partnerships, or business associations that are regularly engaged in economic activity (Pellešová and Sýkorová, 2014). According to Article 2, the SMEs' thresholds and requirements are summarized in Table 1.1.

Table 1.1: EU SMEs Definitions

|                                 |                                    |                           |
|---------------------------------|------------------------------------|---------------------------|
| <b>Micro-Sized Enterprises</b>  | Annual Revenue (Million EUR)       | Less than or equal to 2   |
|                                 | Annual Balance Sheet (Million EUR) | Less than or equal to 2   |
|                                 | Employees                          | Less than 10              |
| <b>Small-Sized Enterprises</b>  | Annual Revenue (Million EUR)       | Not greater than 10       |
|                                 | Annual Balance Sheet (Million EUR) | Not greater than 10       |
|                                 | Employees                          | Less than 50              |
| <b>Medium-Sized Enterprises</b> | Annual Revenue (Million EUR)       | Not greater than 50       |
|                                 | Annual Balance Sheet (Million EUR) | Not greater than 43       |
|                                 | Employees                          | Less than or equal to 250 |

Source: Data adapted from Alessandrini et al. (2019)

The business that are considered as small, and medium firms are the enterprises that employ less than 250 people. Another characteristic is that their annual turnover does not exceed EUR 50 million. As well, the annual balance sheet should not exceed EUR 43 million as illustrated by Alessandrini et al., (2019). For the case of small and medium enterprises (SMEs) a small company is the one which has employed less than 50 people. Further, the total annual balance or turnover does not exceed EUR 10 million (Alessandrini et al., 2019). A micro-company for the case

of SMEs refers to the business that employs less than 10 people. As well, the annual balance sheet or turnover is not more than EUR 2 million (Alessandrini et al., 2019).

### ***SMEs Definitions in Thailand***

The SMEs definition follows the criterion set by Thailand Ministry of Industry. The classification is based on the number of employees and fixed capital that the company have. The capital consideration excludes land and properties (OECD, 2016). From the definition, a small sized enterprise is that one with less than 50 people and less than 25 people in production and wholesale sectors respectively. A medium sized enterprise is the one less than 200 people and less than 50 people in in production and wholesale sectors respectively. A medium-sized enterprise has a fixed capital of THB 51 million to THB 200 million in the production and service sectors and THB 26 million to THB 50 million (722,000 to 1,390,000 Euro) in the wholesale industry (see Table 1). The World Bank and the European Commission both use the number of employees as a criterion to categorize SMEs, which has also been adopted in Thailand's definition of an SME. Thai SMEs are thus defined as companies with less than 200 employees and fixed assets, excluding lands and properties, worth no more than THB 200 million (55,559,000 Euro). Table 1.2 summarizes the definitions of SMEs regarding the threshold for the number of employees and capital.

Table 2.2: Small and Medium Enterprises Definitions

| <b>Small Enterprises</b> |                         |                                      | <b>Medium Enterprises</b> |                                      |
|--------------------------|-------------------------|--------------------------------------|---------------------------|--------------------------------------|
|                          | <b><i>Employees</i></b> | <b><i>Capital (million Baht)</i></b> | <b><i>Employees</i></b>   | <b><i>Capital (million Baht)</i></b> |
| Production               | Less or equal to 50     | Less or equal to 50                  | 51 – 200                  | 51 – 200                             |
| Services                 | Less or equal to 50     | Less or equal to 50                  | 51 – 200                  | 51 – 200                             |
| Wholesale                | Less or equal to 25     | Less or equal to 50                  | 26 - 50                   | 51 - 100                             |

Source: OECD (2016)

However, a new definition and classification of SMEs were announced by the government in 2019 to better represent the realities of the current economy. The new definition was effective in January 2020. Three areas have changed: enterprise category, categorization standards, and sector grouping. First, a new enterprise

category, “micro-sized enterprise,” was formed. Second, the yearly revenue criterion for classification was introduced to replace the previous criterion of total fixed assets, and the classification information for the number of employees was modified. Third, the requirements for the services industry and the trading sector (wholesale and retail) were integrated. The classification's specifics are displayed in the table 1.3.

Table 1.3: New Categorization of SMEs

| Size                            | Criterion                     | Manufacturing                                  | Service, Wholesale and Retail                 |
|---------------------------------|-------------------------------|------------------------------------------------|-----------------------------------------------|
| <b>Micro-Sized Enterprises</b>  | Annual revenue (Million Baht) | Less than or equal to 1.8                      | Less than or equal to 1.8                     |
|                                 | Employees                     | Less than or equal to 5                        | Less than or equal to 5                       |
| <b>Small-Sized Enterprises</b>  | Annual revenue (Million Baht) | Less than or equal to 100                      | Less than or equal to 50                      |
|                                 | Employees                     | Less than or equal to 50                       | Less than or equal to 30                      |
| <b>Medium-Sized Enterprises</b> | Annual revenue (Million Baht) | greater than 100 and less than or equal to 500 | Greater than 50 and less than or equal to 300 |
|                                 | Employees                     | greater than 50 and less than or equal to 200  | Greater than 30 and less than or equal to 100 |

Source: Korwatanasakul and Paweenawat (2020)

The new categorization of SMEs indicated that there are cases where the number of employees lies in one category while the annual revenue lies in another category. In such cases, the criterion met by the annual revenue will determine the actual category in which the enterprise falls (Korwatanasakul and Paweenawat, 2020).

## 1.2 Terminology and Understanding of Green Innovation

Implementing green innovation has emerged as a critical strategic instrument for achieving market competitiveness and business growth. Historically, the allocation of resources toward environmental endeavours was seen as superfluous. The concept of green innovation has become relevant to business due increased awareness and stringent environmental policies being adopted globally. As a result, there are increased adoption of techniques and procedures associated green practices within the business context, such as green innovation. Various researchers have presented a range of definitions in their attempts to conceptualize the notion

of green innovation. The existing body of literature on green innovation incorporates an array of expressions, among them environmental innovation, ecological innovation, eco-tech, and green tech. These phrases are often used alternately as they refer to an identical theme. Their definitions have transformed over the past years, shifting from a more generalized characterization to more specific depictions.

Walley and Whitehead (1994) defined green innovation from the context of *being green is a driver for ongoing innovation, new market opportunities, and wealth creation*. Their definition emphasizes that adopting environmentally friendly practices drives continuous innovation, creating new avenues for market expansion and generating wealth. According to their definition, being "green" contributes to environmental protection and acts as a driver for innovation-driven growth and the exploration of untapped market potentials. They continue that as consumers become increasingly environmentally conscious, there is a growing demand for green products and services.

Investment in the green innovation management practices gives the companies concerned a competitive edge, as compared to other businesses. This investment is being triggered by the increasing concern regarding the sustainability issue. Another concept is that through the implementation of the green innovation practices carries additional cost, it also has a great potential of generating profit for the business or company concerned.

Porter and van der Linde (1995) defined a green innovation as an instrument that guides business to be more responsible. It enhances the company's image and increasing its success. They indicated that green innovation initiatives improve the impression of a company as outlined by its stakeholders. This implies that it enables companies differentiate themselves from their competitors. For the business, it is viewed as more attractive to environmental conscious consumers. Furthermore, implementation of green innovation practise may result in greater operational efficiency, lower cost, and new market opportunities. So, these aspects are indeed important towards achieving success and profitability of the organisation. Porter

and van der Linde (1995) argues that companies should keep in mind that just because a green initiative is not immediately a boost to a businesses' image, or a sure success does not mean that green is not good for business. It's difficult for companies with short term focus to invest in some initiatives that will involve a large initial investment with long term results.

Chenet al. (2006) presented another green innovation definition. They considered green innovation as hardware or software innovation for green goods or processes and energy-saving, pollution-preventing, waste recycling, green product designs, or corporate ecological management systems. This concept covers hardware and software advances for green products and processes. It is the technology advocating for energy savings, pollution avoidance, trash recycling, green product designs, and corporate social responsibility. Additionally, the term emphasizes green innovation's complexity. It goes beyond designing green goods to incorporating environmental friendly technology and practises across corporate operations, making this crucial. Innovation promotes energy efficiency, pollution reduction, and corporate social responsibility, according to the definition. Green innovation also promotes corporate practices that promotes corporate social responsibility (Chen et al. (2006). The definition's pertinent principles make it relevant today, especially with the worldwide move toward and green business management and operational practices.

Oltra and Saint Jean (2009) presented another interesting definition of green innovation. They defined green innovation as innovations that includes processes, practises, systems and products that support environmental consciousness. In thie defining green innovation entails the development of new or modified processes, practises, systems, and products for improving the environment and supporting overall environmental improvements and conservation (Oltra and Saint Jean, 2009). This definition echoes the current global environmental scenario. There is a global effort to address the unprecedented environmental challenges. Therefore, the scope of green innovation spanning processes, practices, systems, and products offers numerous pathways for individuals, companies, and nations to contribute to a more green future.

In other words, it could be arguing that their definition aligns well with global green initiatives and goals, as well as the increasing consumer demand for eco-friendly products and practices. While the definition offers a broad perspective, it could further expand by acknowledging the socio-economic dimensions of green practices, given that environmental consciousness often intersects with social and economic well-being. Additionally, the definition might be further enriched by addressing potential challenges or barriers to achieving green innovation, providing a more holistic understanding.

Another definition of green innovation was presented by Aguilera-Caracuel and Ortiz-de-Mandojana (2013). They indicated that green innovation comprises of technological developments that can save energy, prevent pollution, or aid waste recycling and can also contain green product design and corporate green management practices. They indicated that green innovation impacts business customer perspective, through the commitment to social, financial and environmental outcomes. By mentioning “green product design” and “corporate green management practices,” the definition captures the entire lifecycle of products and services, from product development to post-sale and customer service phases. The definition is especially relevant for SMEs today, where there is a growing realization that environmental concerns and business growth are not mutually exclusive but can be complementary. Businesses are now looking at green innovation not just for compliance or CSR activities but as a genuine strategy to drive competitive advantage, open new markets, and enhance stakeholder relations.

Leal-Millán et al. (2017) established that green innovation represents a fundamental business strategy which creates substantial market possibilities to deliver products without environmental harm. The definition shows green innovation evolution from optional strategy to fundamental business requirement. Managers must implement green innovation as their primary strategy when they want to improve their market share position and business growth. The term "strategic requirement" indicates that organizations must consider green innovation investments as essential elements of their successful future operations. Organizations which integrate green business methods into their innovation systems will preserve their market competitiveness in the evolving international marketplace.

Companies that refuse to shift toward green practices will face both declining market presence and imminent decline as an industry leader. There is increasing evidence that products and services create market demand, particularly to the customers who are aware of the green movement. Environmental responsibility as echoed by green innovation has become a primary factor in customer choices for immediate products they need. Having green innovation represents a distinctive marketing proposition which enables companies to stand apart from their competitors. Environment protection remains a fundamental goal behind innovations which meet consumer requirements without environmental damage. Companies promote their green products by design low-emission systems as well as materials that last longer and easily recycle and use renewable components. Companies now need to develop innovative solutions because governments around the world have established advancing regulatory standards for environmental protection and green initiatives requirements.

According to Kraus et al. (2020), green innovation describes modern technology which saves energy regardless of fuel types while also lowering pollution, preserving water resources and reducing waste output. Green innovation is beyond atmospheric conditions. In response to the worldwide water scarcity crisis, innovations to preserve water have moved centre stage. But now there are multiple technological approaches that simultaneously cut down the amount of manufacturing water used as well as purify and recirculate the resources of those same water to get to maximum efficiency. Waste management is an important work domain as well. Plastic pollution and electronics waste disposal problems have achieved critical levels of urgency for the world's present needs for innovations. Initiatives stimulating green innovation through green solid based initiatives like naturally decomposing materials combined with advanced recycling techniques are part of supporting circular economy structure.

As shown in recent definitions of Kraus et al. (2020), green innovation defined with academic and industry support is a permanent solution. Such an approach using multiple layers to solve current environmental challenges is required. Through technology advancements, green innovation initiatives illustrate commitment to

helping to build a better environmental friendly future. Countries that share best practices together can more effectively implement their green innovation programs.

The development of processes with new technology serves environmentally meaningful purposes by improving resource efficiency while waste reduction and energy efficiency gain benefits along with material reuse and renewable resource utilization in addition to resource recovery improvement and pollution reduction and greenhouse gas emission decrease. Since 1997 the World Business Council for Sustainable Development introduced the term "green innovation." The WBCSD describes sustainable development as an advanced process adopting modern technologies which minimizes environmental impacts while strengthening general business outcomes. Changing environmental challenges inspire green innovators to create technological solutions which improve environmental conditions (Maltese et al., 2018). Individuals who take the role of innovative solution creators are primarily driven by their environmental dedication and search for sustainability enhancements.

Various researchers and scholars have explored and defined the meaning of green innovation. The first definition that is clearly noticeable in this research was offered by the Organization for Economic Co-operation and Development (OECD), which defined green innovation as: The creation or implementation of new, or significantly improved, products (goods and services), processes, marketing methods, organizational structures and institutional arrangements which with or without intent lead to environmental improvements compared to relevant alternatives (OECD, 2009). Another comprehensive definition was coined by Arundel and Kemp (2009), who considered that green innovation could be defined as: an entirely new concept of great importance to business and policy makers. It is about innovations with lower environmental impact than relevant alternatives. The innovations may be technological or non-technological (organizational, institutional, or marketing-based). Green innovations can be motivated by economic or environmental considerations. The former includes objectives to reduce resource, pollution control, or waste management costs or to sell into the world market for eco-products.

It is clear from these definitions that green innovation refers to different types of innovation considerations, which have a primary objective of reducing or rather minimizing the damage caused to the environment. Innovation is geared towards ensuring that natural resources are used most effectively (Chen, Lai and Wen, 2006). Within the framework of business practices, it is a practice that is incorporated as a means of improving the business or firm's competitiveness in economic as well as environmental performance. This could be achieved through practices such as reducing energy use, recycling waste materials, reducing pollution, and ensuring efficient resource allocation. The primary objective is to develop and offer green products and services. The United Nations Environmental Programme (UNEP) defines green innovation using a different synonym: "eco". Using this synonym, UNEP defines green innovation, or rather eco-innovation, as: *a new business approach which promotes sustainability throughout the entire life cycle of a product, while also boosting a company's performance and competitiveness* (United Nations Environment Programme (UNEP), 2017).

With regard to the business, UNEP indicates that green innovation involves going beyond the business operations, focusing on the associated business impacts, and making sure that the business is more sustainable. In this regard, UNEP pioneered another definition of green innovation as follows: *green innovation is a process to help you develop and diversify sustainable business models that reduce your social and environmental impacts, as well as the impacts along your value chain to make you more resilient and competitive* (UNEP, 2017).

UNEP considers the SMEs from their green innovation by indicating that it is important for the SMEs to help them access new markets, resulting in expansion and increased productivity. Adopting and practicing green innovation practices helps them attract new business investment from interested stakeholders and increase the profitability prospects throughout the business value chain. More importantly, UNEP notes that green innovation helps SMEs adopt and adhere to green regulations and standards, particularly those related to the environment (UNEP, 2017).

The increased growth in green innovation awareness from consumers has significantly affected how businesses produce their goods and services to reduce to meet the customers' green expectations and societal environmental impact consideration. Green innovation is thus critical in the overall business management practices to promote the production of goods and services and carry out business activities that adhere to green standards. This perspective was coined in the aspect of 'green innovation management'. The development and awareness of green innovation management in enterprises are influenced by various factors. For instance, there is competitive pressure and demand from customers for green products and services. Firms offering green products and declaring their green reports tend to attract more customers and appeal to future customers (Bigliardi and Bertolini, 2012).

Regulatory compliance is another leading factor contributing to the development and awareness of green innovation and management (Wysocki, 2021). Regulatory compliance involves coercive pressure from business regulatory bodies, including the government. According to (Rodrigues, 2023), regulatory compliance pressure plays a critical role in adopting green innovation practices among businesses, both large firms and SMEs. Similarly, governments often create conditions to motivate firms to adopt green innovation practices, consequently impacting management decision-making.

Regarding SMEs, adopting and incorporating green innovation practices in enterprise management is considered a step towards global environmental objectives and business competitive strategy. Consumers are increasingly conscious of environmental issues in their purchase decisions, thus favouring green products and services. SMEs that offer such products can capture this growing market segment (Korpysa, 2019; Rodrigues and Franco, 2023). Moreover, green innovation often leads to cost savings in the long run by reducing resource wastage and optimizing operations. Environmental awareness in the management of SMEs has also contributed to adopting green management. Understanding the business's impact on the environment often helps in environmental management in terms of production efficiencies and cost reductions. Green innovation and management stand to benefit through effective waste management and resource efficiency

(Satchapappichit et al., 2023). Additionally, implementing green management comes with various perceived benefits, including increased profits through increased competitive advantage.

Pressure from business competitors also contributes to the increased development and adoption of green innovation management. According to (Lutfi, 2023), businesses with fewer competitors are less likely to minimize their environmental impact than businesses with high competition. The need to maintain brand recognition and meet the increased competition pressure leads SMEs to adopt green innovation. For example, the increase in green consumers has led to many SMEs adopting green technology and management strategies to increase their competitive edge.

### **1.3 Strategies of Green Innovation Management in SMEs**

As stipulated by Dangelico and Pontrandolfo (2010), the concept of green innovation strategies is crucial to consider in evaluating how green technologies affect businesses at various points in their life cycles. It consists of many complex business processes, from sourcing raw materials to developing green products and offering services. For SMEs, considering green innovation entails improving new, more environmentally friendly materials and altering processes for generation methods (Brindley and Oxborrow, 2014). Green product innovation and green process innovation are the two major strategies of green innovation management (Chiou et al., 2011; Rammer and Rennings, 2009). According to the study conducted by Kurapatskie and Darnall (2012), businesses that innovate to create new green products create greater value than those that merely make small, incremental changes to current goods and procedures.

There considerably wide literature on green product innovation and green process innovation (Kong et al., 2014). According to Shapfi (2015), Green Product Innovation is a complex field that combines environmental materials, energy, and contamination (Küçükolu and Pinar, 2015). The impact on the SMEs depends on these combined properties at different stages of the product innovation life cycle. This covers the manufacturing process, product use, and product disposal. The development of green products consists of three key elements. Specifically, (i) the

organization must choose resources with a low potential for contamination, (ii) it must use the fewest number of materials possible to create its products, and (iii) it must be careful in making this determination (Guoyou et al., 2013). Green product innovation needs to be improved if enterprises want to reduce adverse environmental effects while enhancing their competitive advantage (Dangelico and Pontrandolfo, 2010; Dangelico and Vocalelli, 2017). As far as SMEs are concerned, green product innovation is essential to helping SMEs grow their profits and sustainability while keeping or expanding their prospects for competitiveness (Fahad et al., 2022).

On the other hand, green process innovation implies the adjustments made to the existing systems and work procedures to create new or enhanced green products to minimize harmful environmental effects (Meeus and Edquist, 2006). According to Xie et al. (2016), green process innovation entails enhancing current modes of manufacturing or introducing new ones to lessen their biological consequences. Nanath and Pillai (2017) indicated that green process innovation is characterized as the execution of process innovation that is identified with energy sparing, contamination prevention, waste recycling and reusing, or reduced harmfulness on people and the environment. Therefore, green innovation is an exceptional and extended innovation process that actively maintains a competitive position in the business and market framework while improving and conserving the environment (Fahad et al., 2022).

### ***Green Supply Chain Management***

Green supply chain management stands as one of the multiple ways SMEs implement green management strategies (Holt and Ghobadia, 2009). Within business environments the green innovation practices of SMEs require adding environmentally friendly procedures to their existing supply chain arrangements. Business is involved in six distinct procedures that begin with supplier selection and supply acquisition and advances through product design and manufacturing before reaching distribution and completing with inventory management. Green supply chains create added value through both product improvement and corporate

growth from start to finish regardless of minimizing operational deficiencies (Rostamzadeh et al., 2015).

When considering SMEs, the primary goal of green supply chain is to eliminate air pollution, waste pollution, and water pollution. The benefits of green operations extend to performance to waste reduction, and product recycling strategies and cost minimization. It also enhances asset utilization and public relations advantages and improved customer happiness and satisfaction. Primary development plans distinguish themselves due to the implementation of green supply chains. The straightforward model presented in Figure 1.1 depicts a green supply chain which shows the implementation strategies businesses use to minimize environmental impact and obtain performance benefits (Holt and Ghobadian, 2009; Jemai et al., 2020; Kallmuenzer et al., 2024).

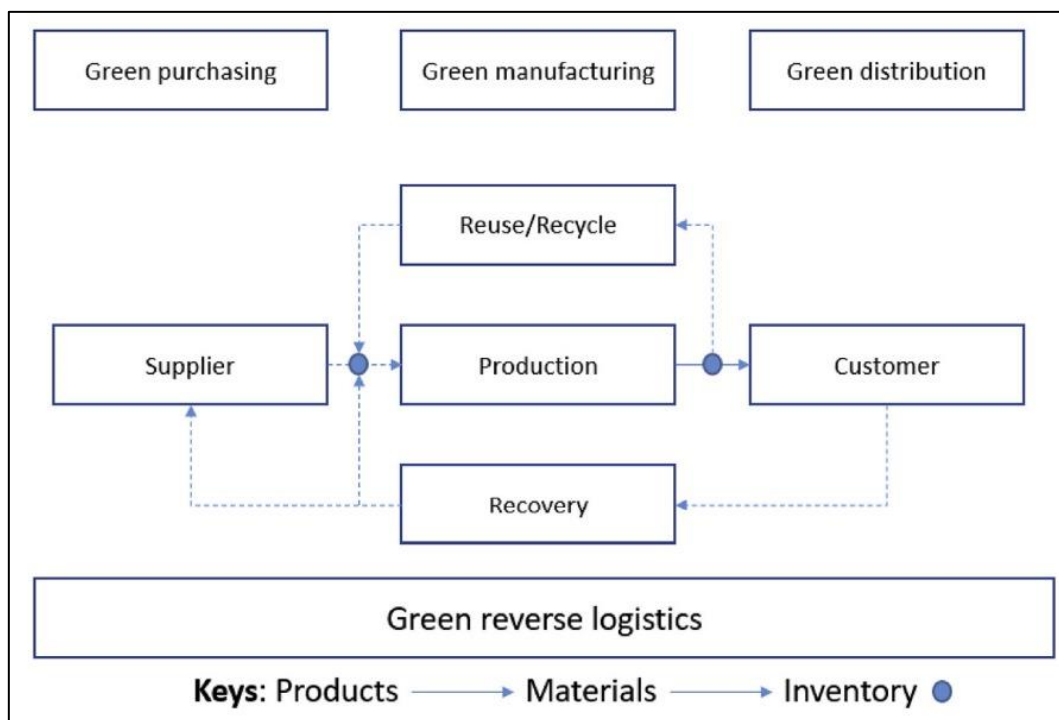


Figure 1.1: Green Supply Chain Management

Source: Jemai et al.(2020)

### ***Green Certification Programs***

Green certification programs represent an emerging measurement system that businesses actively adopt to determine their progress towards green practices and green operations. The verification process grants sponsorship to green activities of SMEs through which their brand reputation and public trust advances. Regulatory agencies and groups create green criteria for SMEs to fulfil through their developed or sponsored certification programs (Afum et al., 2023). SMEs earn recognition for their environmental dedication through their engagement with green certification programs. An independent verification confirms through certification that the SME follows green practices which allows customers and partners to trust the business genuinely practices green innovation management. All aspects of green innovation from energy efficiency to waste management to water conservation and carbon footprint reduction and responsible sourcing are typically covered in the criteria set by certification programs.

There various techniques used in the evaluation of the adherence to green innovation practices. For instance, the auditing practices for the SMEs compliance (Purwandani and Michaud, 2021; Rodríguez-Espíndola et al., 2022). This evaluation leads to the award of a certification or badge, which displays compliance to the green practices' requirements (Bruce et al., 2023; NatWest, 2021). The certification enhances the corporate image of the business. This certification, as illustrated by researchers (Afum et al., 2023; Purwandani and Michaud, 2021) is highly advantageous to the concerned business, particularly the SMEs. They attract business opportunities particularly the partners and customers (Ahmed et al., 2023; Wang et al., 2021). Regular assessment is however, required, to maintain a culture of continuous improvement.

#### **1.4 Benefits of Green Innovation Management for SMEs**

The adoption and implementation of the green innovation management practices within the business operations have various benefits. These benefits could be realized across various sectors, including the SMEs (Alraja et al., 2022, Söderholm, 2020 and Wang et al., 2021). The first benefit realised is the market competitiveness of the business using green practices in their products and services. For SMEs,

despite the financial limitation they face (Erdin and Ozkaya, 2020; Gherghina et al., 2020), green innovation practices and certification could win customer and businesses, especially to the clients who are environmentally conscious. Further, through environmentally conscious practices SMEs achieve cost reductions and efficiency enhancements and secure environmentally attuned customers while accessing emerging business opportunities (Afum et al., 2023; Rodrigues and Franco, 2023; Rustiarini et al., 2022).

The implementation of green innovation management enables SMEs to obtain substantial savings for their operations. The adoption of sustainable operational practices including energy-saving innovations together with waste reduction systems delivers lasting cost reductions. SMEs achieve both water utilization efficiency and energy management goals and carbon emission reduction through optimized resources handling and clean technology implementation. Through environmental preservation strategies businesses receive direct financial savings since these measures cut overhead costs according to research by Wang and Liu 2022 and Ekins and Zenghelis 2021. Using green innovation management practices allows small and medium enterprises to gain competitive advantages within the current business marketplace. Businesses together with their customers increasingly look for products and services that consider environmental responsibility (Riaz et al., 2023; Rustiarini et al., 2022).

The active participation of the SMEs in the green innovation practices demonstrates a green bright future in the business dealings (Baeshen et al., 2021; Alraja et al., 2022). Considering that the SMEs comprises the largest proportion of operational business, their initiatives in the process of green innovation management is critical. As illustrated by Rodrigues and Franco (2023) SMEs can boost their competitiveness by adding green innovation practices to their traditional business methods while conforming to worldwide environmental concerns about green products. Standout placement in the market coupled with enhanced market competitiveness and new customer acquisition are enabled when SMEs implement this approach.

Application of environmental innovation management enables small and medium enterprises to meet industry obstacles while achieving better market competitiveness and building a sustainable future (Fahad et al., 2022; Rodrigues and Franco, 2023). Any jurisdiction operates through the majority of its business activities through SMEs which form the backbone of global economic operations. Smaller businesses frequently overcome adoption of green practices through resource limitations and capital access barriers and logistical hurdles (Erdin and Ozkaya, 2020). Through green innovation practices SMEs can leverage their present obstacles into competitive benefits. Conditional adoption of sustainability practices enables small and medium-sized enterprises (SMEs) to minimize operational expenses and develop effectiveness while drawing sustainable consumers together with unlocking new environmental markets (Afum et al., 2023). The benefits associated with green innovation management in SMEs are discussed in the following section:

SMEs benefit from boosted brand reputation when they use green innovation management because customers actively seek green products, or rather environmentally responsible products in their purchase decisions. SMEs that integrate green innovation practices throughout their entire supply chain achieve two benefits: their green brand projection drives competitiveness and attracts environmentally sensitive consumers (Kim and Lee, 2023; Larranaga and Valor, 2022). The business models of SMEs that implement green innovation reveal environmental conscious strategies and forward-looking mindset (Farida and Setiawan, 2022; Rua and Santos, 2022). Such position brings advantageous differentiation for businesses which enables them to stand out from market competition.

Customers choose environmentally responsible businesses as their preference because they recognize both the value of green practices and the importance of climate protection and environmental preservation (Leckie et al., 2021; Risitano et al., 2023). Market openness and better client relationship development enabled through green innovation allow SMEs to attract new business and support continuity with their established customer base. Green innovation adoption simultaneously enhances trust and product authenticity while holding businesses

responsible for developing desirable products (Wang et al., 2022; Meidute-Kavaliauskiene et al., 2021). Green innovation practices help SMEs maintain environmental authenticity by fostering trust while increasing their credibility (Meidute-Kavaliauskiene et al., 2021; Baeshen et al., 2021). Small and Medium Enterprises can establish permanent strategic market positions by using superior brand reputation which results from better brand image.

Green innovation management techniques lead businesses to decrease operational expenses which save money while creating less waste and minimizing carbon emissions (Maasoumi, Heshmati and Lee, 2020). Through improved efficiency of resources companies cut their energy costs and enhance employee health while simultaneously minimizing waste and carbon emissions. Businesses within UK spent £1 billion on replacing fossil fuel usage with renewable sources including wind power and solar panels according to research by KPMG. These modern production methods prove better than conventional energy generation systems. According to Wei, Ang and Jancenelle (2018), The benefits for businesses are huge: Through these improvements' businesses can achieve higher profits together with diminished environmental impact. Green innovation enhances business competitiveness within competitive marketplaces because customers increasingly value green initiatives on financial and environmental and social levels for their purchasing decisions. The implementation of waste reduction together with recycling efforts and material reusing practices reduces resource consumption and minimizes procurement expenses.

By implementing proper inventory management techniques, SMEs can avoid overstocking or waste, reducing unnecessary expenses (Amaral et al., 2019; Ikpe and Shamsuddoha, 2024). green innovation management can also help SMEs streamline their supply chain processes, further saving costs (Dharmayanti et al., 2023). Its relevance is also observed in compliance with regulatory standards by businesses. With the increased concerns regarding human health, environmental protection, and the movement towards green living, many regulations and standards are being proposed, adopted, and implemented around green practices. It is evident that going green is an inevitable business endeavour. This has led to the establishment of standards such as green certifications, which evaluate the effort of

a business towards green innovation. As such, SMEs that have made efforts, or rather already adopted green innovation management, gain a significant advantage by staying ahead of the curve (Fan et al, 2021; Rizos et al., 2016).

By proactively adopting green practices and technology, SMEs can effectively adhere to environmental requirements, avoiding the risk of incurring penalties, sanctions, and expenses associated with last-minute adjustments. Governments and regulatory bodies worldwide are implementing regulations and policies to reduce the environmental impact of businesses (Dechezleprêtre and Sato, 2017; Drago and Gatto, 2022). These regulations cover emissions reduction, waste management, energy efficiency, pollution control, and green sourcing. SMEs that are proactive in adopting green innovation management practices are better positioned to meet these regulatory requirements, allowing them to avoid penalties or legal consequences that may arise from non-compliance (Meidute-Kavaliauskiene et al., 2021; Tyler et al., 2024; Wang et al., 2021).

Green innovation management helps SMEs find new business prospects through its ability to reach client populations who want green active products or services (Rustiarini et al., 2022; Rodrigues and Franco, 2023). Green issues worldwide drive an expanding market for green products which presents a market opportunity for smaller enterprises to seize. Through green product incorporation SMEs can create markets for environmentally led consumer bases while serving their specific eco-friendly demands. Customers actively scout products which both fulfil their personal green principles and help them lower their environmental effect (Brata et al., 2022; Giacalone and Jaeger, 2023; Hasan et al., 2023). The growing market segment of environmentally conscious consumers who value health combined with ethical sourcing brings expansion opportunities to SMEs which implement green innovation management practices including organic farming methods and green packaging and fair-trade practices.

SMEs that implement green innovation management techniques can reach business-to-business (B2B) markets because these sectors want partners with green capabilities (Alraja et al., 2022; Thomas et al., 2022). Large organizations have established green practices goals with demands for suppliers who share these

values. Commitment to green practices and green innovative approaches enables SMEs to secure their position as primary suppliers or business partners who meet B2B customers with environmental integrity (Govindan et al., 2021; Mensah, 2019). Governing bodies and regulatory organizations motivate green product adoption through organized policies as well as requirements and green procurement procedures (Guo et al., 2020; Shadrina et al., 2022). Green innovation adoption by SMEs ensures competitive benefits because they fulfil environmental requirements which connects them to opportunities for public procurement and government contracts that emphasize environmentally friendly solutions. Through their engagement in green innovation management SMEs develop opportunities to partner with dedicated environmental advocacy groups and non-profit organizations or sustainability-focused networks (Baeshen et al., 2021; Rustiarini et al., 2022). Through strategic partnerships SMEs can build new market access points and increase their client base alongside establishing an environmentally conscious business reputation. SMEs will need to display effective communication along with proven environmental advantages of their green inventions when they target emerging consumer segments or new markets. Deliberately searching for green innovations generates new business possibilities which advance the success of SMEs over time in response to mounting customer environmental consciousness.

There has been evidence of government support to green initiatives. SMEs that are active in green initiatives management practices in their operations could benefit from government support. The support ranges from grants and tax breaks and subsidies along with other types of monetary assistance to promote green technological adoption for businesses (Agrawal et al., 2023; Rodrigues and Franco, 2023; Rustiarini et al., 2022; Wang et al., 2022). There has been evidence of efforts of government support green initiatives as a means to address environmental problems (Mensah, 2019; Ogunkan, 2022). Additionally, the adoption of environmentally friendly business approaches and renewable source utilization by SMEs is supported through tax incentives delivered by governments (Qadir et al., 2021; Wang et al., 2022). Lowering technological and practical investments for green initiatives creates financial advantages which lead SMEs to focus more on green solutions.

Popular incentives in the form of financial benefits exist because organizations and governments support SME businesses using renewable clean energy devices including wind turbines and solar panels (Bartlett & Trifilova, 2010). Renewable energy system installation costs are reduced through government-sponsored subsidies which enhance financial feasibility for SME businesses. SMEs generate clean power to lower dependence on conventional energy while slashing utility expenses while driving green initiatives (Chanchangi et al., 2023; Qadir et al., 2021). Above government programs eco-friendly encouragements serve as additional support for green innovation management. Industry associations together with non-profits and organizations grant financial contributions to SMEs through programs for organizations expressing sustainability initiatives. Green fund programs tailored for specific industrial sectors as well as innovative idea prizes exist as financial motivation opportunities for green projects (Imran et al., 2019; Moursellas et al., 2023). SMEs earn supplementary resources as well as financial backing through their participation in these funding programs for implementing green innovation management systems. Essential financial incentives provide businesses with immediate financial benefits while securing their ongoing ability to succeed financially. The adoption of incentives by SMEs enables them to use them as tools for efficient green economy transition while securing corresponding financial benefits.

### **1.5 Green Innovation and Sustainability**

Green innovation and sustainability work together address environmental problems as well as create enduring global welfare. Although their objectives overlap, they operate on different dimensions from each other. The basis of green innovation is formed through the development and implementation of new or enhanced products with improved processes which ensure environmental sustainability. The production of innovative solutions which decrease environmental degradation and preserve resources while lowering pollution levels receives primary focus. Green innovation connects to the discovery of technological advancements together with sustainable business models and operational practices which help construct a sustainable future (Javanmardi et al., 2023; Kuhlman and Farrington, 2010).

The concept of sustainability extends beyond single dimensions because it includes three fundamental aspects of social stability, environmental responsibility and economic sustainability. The movement aims to meet current demands while conserving future needs (Kuhlman and Farrington, 2010; Mensah, 2019). Environmental protection, social fairness, and economic growth must be balanced to achieve sustainability. Green innovation advances sustainability by addressing environmental issues and reducing ecological footprints. The 1987 Brundtland Report introduced the concept of economic, environmental, and social sustainability. Balance between these basic societal building blocks promotes long-term prosperity and wellness (Basiago, 1999; Mensah, 2019; Purvis et al., 2019). This system uses green technology to improve resource management, energy saving, and waste reduction while protecting the environment (Söderholm 2020, Zhang et al. 2022).

Sustainability guides modern civilization away from linear resource consumption patterns (Kirchherr et al., 2023; Velenturf and Purnell, 2021) toward an economic framework where materials are reduced, reused and recycled (Kirchherr et al., 2023). The sustainability framework extends its influence across every sector of human action along with individual conduct and local community habits and international regulatory standards. The core objective continues to serve across diverse areas such as sustainable farming and renewable energy with waste management to protect our planet's well-being for future populations (Chauhan et al., 2022; Debrah et al., 2021). Small and medium-sized enterprises have traditionally implemented market-oriented strategies to generate increased profits while achieving business success. The technique frequently dismisses environmental crises and habitat destruction while ignoring their negative results. The international world faces multiple social and ecological crises which intensify at an alarming speed.

According to Majid et al. (2023) and Sasmito et al. (2023) these problems will continue as long as unsustainable business operations remain active. As a tactical strategy sustainable innovation concentrates first on creating eco-friendly products alongside efficient services and manufacturing processes (Geissdoerfer et al., 2018). Sustainable innovation involves strategic implementation of sustainable

resource utilization together with energy optimization and waste minimization to deliver sustainable economic solutions which further environmental health (Haleem et al., 2023; Wang and Liu, 2022). Sustainable innovation demonstrates how entrepreneurs create new technologies with environmental benefits alongside financial improvements (Geissdoerfer et al., 2018).

In their research Chen and Ma (2021) redefine green investments as multiple economic activities which demand intricate management strategies. Southeast Asian countries along with China lead the extraordinary advancement of green energy business while being key drivers of its expansion (Oyedepo 2012; Zhang et al. 2010). Both research and literature demonstrate that organizations actively work towards maintaining economic success while minimizing their environmental footprint (Kirchherr et al., 2023; Wirba, 2023). The academic research on green innovation together with sustainability demonstrates that corporate interest in green technology stems from its ability to result in profitability (Stucki, 2019).

Companies determine their green technology investments through weighing the monetary savings from reduced emissions next to the expenses needed to establish those ventures (Shuwaikh et al., 2023). Ekins and Zenghelis (2021) reveal that the difference between expense and emission reduction benefits creates powerful incentives for enterprises to pursue environmentally friendly technologies. Stucki (2019) states corporations allocate funds to green technology products when gains surpass expenses. In a similar observation, Khalid et al. (2023) argue that companies are primarily motivated by the economic advantages associated with investments in environmental protection rather than the possible increase in the value of a company that prioritizes environmental sustainability.

SMEs' adoption of green investment can indicate their proactive commitment to fulfilling their social responsibilities. This can positively impact their external reputation, enhancing economic performance (Afum et al., 2023; Zhang et al., 2022). They are highly motivated to expand their investments in environmentally sustainable practices to mitigate the financial consequences of non-compliance with existing environmental legislation and regulations. Therefore, SMEs willingly participate in environmentally friendly investments (Flögel et al., 2023; Rodrigues

and Franco, 2023). The concept of "pay to be green" aims to improve a company's environmental reputation, but the actual implementation of green investment might differ significantly among enterprises. Not all SMEs possess the capability to execute an equally ambitious environmentally conscious plan (Khalid, 2023).

### **1.6 Strategies for Encouraging Green Innovation Management in SMEs**

Green innovation management within SMEs is essential in promoting green business practices and fostering long-term environmental stewardship, especially in reducing the productivity and competitiveness disparity between big corporations and SMEs across emerging nations such as Poland and Thailand (Baeshen et al., 2021; Rizos et al., 2016; Rodrigues and Franco, 2023; Srisathan et al., 2023). Albaz et al. (2020) indicated that the worldwide productivity gap equates to around US\$15 trillion in extra value or around 7% of international GDP. However, integrating these principles into SMEs requires a targeted strategy due to their unique operational challenges. Numerous SMEs actively integrate diverse green frameworks in global contexts to enhance their social and ecological functions (Burlea-Schiopoiu and Mihai, 2019; Permatasari and Gunawan, 2023). Concurrently, these businesses are exploring novel entrepreneurial avenues within sectors considered strategic to the business's survival. Such organizations' longevity and sustained success are intrinsically tied to their operational continuity. This often presents a situation where the pursuit of immediate financial objectives might conflict with long-term sustainability goals (Haessler, 2020; Ruggiero and Cupertino, 2018). The following are some strategies that can help encourage the adoption of green innovation management among SMEs in emerging economies such as Poland and Thailand; they are presented to highlight the strategy to adopt and the rationale behind the strategy proposed:

#### ***Awareness and Training Programs***

Awareness and training programs serve as vital instruments to advance green innovation management adoption throughout SME organizations by owners and staff members (Baeshen et al., 2021; Fahad et al., 2022). Such programs exist to teach people about green innovation management methods alongside their environmental advantages which further generate business sustainability beyond

short-term timeframes. The main purpose of these programs focuses on sharing examples of successful SMEs who applied green innovation management along with their achieved positive results (Fahad et al., 2022). The awareness of potential advantages and green innovation management methods is generally low in many SMEs thus their knowledge development should be a priority. The strategy sets out workshops alongside seminars and training workshops to both increase SME awareness and supply them with needed sustainable business implementation knowledge and methodology. During these events, stakeholders share information and provide concrete green innovation management techniques (Díaz-García, et al., 2015).

Green innovation management seminars should include essential principles and major operational procedures with their benefits. Group work and interactive sessions encourages SMEs representatives participation and hands-on learning. These efforts should include seminars by industry leaders and successful SMEs implementing green innovation management. Presentations, panel discussions, and Q&A sessions teach green innovation management ideas and their applications at the seminars.

Training programs should teach SME employees and business leaders how to apply green innovation management to their organization. Energy efficiency, waste management, sustainable supply chain management, and eco-friendly product design are key subjects in these seminars. Students learn better by seeing green innovation management ideas in action in inclusive course exercises and case studies. Green innovation management offers financial savings, waste management improvements, market potential, and brand visibility, which must be taught in training programs. Communicating the beneficial effects of green innovation management on small-to-medium enterprise financial performance is essential for their enduring success.

### ***Financial Incentives of Green Innovation Management***

The government together with other organizations employs this approach to drive SMEs toward adopting green innovation management. Small and medium-sized enterprises encounter substantial difficulty in implementing green innovation

management because green practices and new technologies require significant initial financial investments. SMEs struggle to afford these expenditures because small businesses operating with constrained financial capacities mostly encounter such significant entry barriers (Agrawal et al., 2023; Purwandani and Michaud, 2021). SMEs will face fewer hurdles when they adopt green innovation management through government-provided financial support. The combination of tax privileges together with financial grants and low-interest loans stands as the most proven driver for SMEs to establish green innovation systems. SMEs can lower their tax expenses for green tech investments through tax breaks according to research by Wang et al. (2022). SMEs free up funds through cost reduction then they should invest these savings into green innovation management programs.

Financial aid programs known as grants serve as substantial incentives which help SMEs achieve green innovation management goals. The government along with other agencies distribute non-repayable funds known as grants to support particular project-based initiatives. SMEs benefit from grants which provide funding for green practice adoption costs during the initial phase because they minimize the company's financial responsibility (Liang et al., 2022). Most grants follow strict eligibility terms and application deadlines which run parallel with the criteria SMEs need for qualification.

The attractive nature of low-interest loans makes them suitable for SMEs who need financing for their green innovation management activities. Low-interest loans specifically developed for small businesses present a financing option that costs less than typical commercial loans while being more accessible because of low-interest rate requirements. Through incentives SMEs acquire financial resources for green innovation management solutions while maintaining operational stability (Schäfer et al., 2023; Ullah et al., 2021). Parallel to current incentives, the government should develop supplementary benefits through accelerated depreciation schedules with environmental regulation exemptions and energy-efficient equipment reimbursements. Through these incentives organizations can cut their expenses while enhancing their competitive position and showing dedication to environmental conservation (Sovacool 2017; Wang and Chen 2023).

### ***Collaborative Platforms***

Collaborative platforms are important in creating essential conditions for quick implementation of green innovation management practices by SMEs. SMEs benefit from these platforms because they establish a communal space for unified collaboration and collective knowledge-sharing to promote green practice innovations (Aboelmaged and Hashem, 2019; Shahzad et al, 2022). Partnerships between firms result in accelerated benefits and streamlined adoption rates of green innovation management systems by the SME sector. Minimal collaborative platforms enable SMEs to obtain access to multiple shared resources. SMEs gain enhanced capabilities through collaborative resource sharing because they can merge their equipment and facilities and specialized expertise to address separate resource gaps while obtaining inaccessible assets. Shared resources help decrease obstacles that block the implementation of green innovation management by organizations which have limited access to financial resources or assets.

Partnerships through these digital tools enable stakeholders to exchange knowledge and create new innovative solutions. Members of the SME sector can mutually exchange their green innovation management adoption best practices together with learned experiences and pertinent observations. Through sharing knowledge with their peers SMEs gain enhanced insight into sustainable methods and technologies while generating fresh sustainable innovation concepts (Alraja et al., 2022; Tajpour et al., 2023). SMEs use collaborative platforms to start conversations through video chats and dedicated discussion spaces or online communities that help address common green innovation management problems. Platform collaboration creates a prime opportunity for joint sustainable product and process development (Chauhan et al., 2022; Hindi and Frenkel, 2022).

SMEs should form partnerships that enable them to create new environmentally friendly products while improving existing products to meet green criteria. SMEs maximize their chances for market success by joining efforts with other companies because this initiative lets them combine relevant expertise together with available resources and market understanding. Through joint participation SMEs distribute sustainable product development expenses and liabilities to each other which

generates both affordability and practicality for independent companies (Audretsch et al., 2023; Gherghina et al., 2020). Business opportunity networks combined with partnership creation form a crucial aspect of collaborative platforms. Through platform participation SME businesses gain access to potential business relations including suppliers and partners and customers focused on sustainability initiatives. Through such networks businesses can attain new markets alongside greater competitiveness to fuel their growth. Collaborative platforms create opportunities for business matching and networking occasions and sustainable offering promotion spaces which help SMEs develop vital strategic partnerships (Aulkemeier et al., 2019; Kathan et al., 2014).

Through their role as an advocate collective platform SMEs have the power to ask for favourable policies and incentives and protection under existing regulations (Aulkemeier et al., 2019; Klievink et al., 2015). Sustainable platforms that connect like-minded SMEs help these organizations generate stronger political traction to establish favourable policy frameworks supporting green innovation management implementation. Advocacy work among platform members results in positive outcomes including new supportive policies as well as financial rewards that foster sustainable practices for SMEs at a national level.

### ***Market Access and Green Supply Chains***

The market access and green supply chain management serve as fundamental strategies to enable SMEs' entry into new environmentally friendly market sectors. They act as basic strategies provide small and medium-sized enterprises (SMEs) entry into a growing segment of customers who endorse both adoption and execution of green innovation management practices. Companies that adopt these methods will become part of green supply networks while accessing marketplaces dedicated only to green product offerings (Rodrigues and Franco, 2023; Wei et al., 2023). Market access combined with green supply chains enables small and medium enterprises to extend their customer reach beyond existing market limitations. The growing significance of eco-friendly practices has created increased consumer interest in environmentally friendly products as well as environmentally friendly services. Emerging businesses that incorporate

themselves into green supply chains can market their products to environmentally conscious customers while widening their customer footprint (Han and Xu, 2021; Wei et al., 2023).

SMEs who join green supply chains gain access to green collaboration possibilities with other businesses that aim to achieve identical sustainability targets. The alliances produced from these partnerships allow participants to exchange knowledge while distributing resources that support joint sustainability efforts throughout supply chains. Through collaboration with other green oriented businesses SMEs establish better environmental outcomes because they work jointly to decrease ecological impacts while implementing sustainable frameworks (Chauhan et al., 2022; Jo and Kwon, 2022).

SMEs taking part in green supply chains create a beneficial effect on their corporate image which boosts their reputation. Through green supply chain participation SMEs can improve their business reliability which builds customer confidence and trust. Eco-minded investors and clients who deliberately choose firms that support green initiatives causes will be drawn to businesses that emphasize productions of green products and services (Jo and Kwon, 2022 and Dzikriansyah et al., 2023 and Yang et al., 2023). Market access for SMEs becomes simpler when dedicated marketplaces for green products and services are established and promoted. Marketplaces enable SMEs to display their green products to particular buyer groups through their dedicated platforms.

When SMEs take part in specialized marketplaces, they gain extra visibility alongside increased exposure to green-conscious customers (Gherghina et al., 2020). Business expansion combined with increased sales becomes possible for SMEs who serve the green sector. Green marketplaces function as networking platforms for SMEs to build collaboration networks (Rizos et al., 2016; Walker and Preuss, 2008) through their focus on sustainable products and services. The platforms unite businesses and industry experts with customers to build connections that lead to partnership development. SMEs use green platforms as tools to gain valuable knowledge from other businesses while receiving market trend data alongside potential sustainability-focused partnership possibilities.

### ***Flexible Regulatory Frameworks and Support***

The flexible regulatory framework and support helps facilitate the implementation of green innovation management within SMEs. The special regulatory frameworks prove essential because they account for the different problems which SMEs must overcome compared to larger companies (Alraja et al., 2022; Indrawati et al., 2023). Small Medium Enterprises (SMEs) function as the economic backbone of numerous economic systems while supporting technological innovation within their markets and creating workforce opportunities. Bureaucratic procedures alongside rigid regulatory environments often create challenges for SMEs because they reduce their speed to market. Due to this necessity governments together with regulatory bodies must develop policies which promote a suitable green innovation management framework for this sector (Arsawan et al., 2022, Gherghina et al., 2020 and Ndiaye et al., 2018).

Tax incentives emerge as a strong influential tool in this process. Tax reductions for SMEs who integrate green innovation management practices into their operations help them manage their finances better while offering them direct environmental benefits (Wang et al., 2022). The combination of incentives creates a green model which presents strategic business advantages while facilitating eco-friendly decision-making and coordinated systems. Green technologies experience lengthy review procedures which trap their effective implementation even though these inventions show great promise. Simplified expedited technology approval processes help SMEs implement green solutions quickly thus building an environment of fast adaptation and innovation (Baucus et al., 2008; Dreyer et al., 2017).

The gap between knowledge deficiencies can be filled when government provides R&D grants. Limited financial capacity often forces SMEs to struggle with heavy green research investments because they lack enough funding (Park and Shin, 2018; Testa et al., 2019). Through funding programs these businesses can compete to lead innovation in environmentally friendly technologies. Support functions as an essential element but organizations also need to find an appropriate equilibrium between helping and backing limited independence across different situations.

Strict regulations that constrain innovative thinking render themselves ineffective. The regulatory frameworks require flexibility to function effectively. Environmental conservation remains an essential constraint for Small and Medium Enterprises which receives innovation incentives within this framework (Donate et al., 2022; Kitching et al., 2023). The development of welcoming regulatory frameworks which permits flexibility stands as a key requirement to build a future that lets SMEs lead green innovation management. Profitable green operations of SMEs can be achieved through strategic policy development along with joint efforts between stakeholders.

### ***Track Progress and Share Results***

A system to track and monitor SMEs executing green innovation practices enables effective evaluation of green innovation management programs and supports identification of strengthening opportunities. When SMEs present their successful green initiatives and examples of best practices, they motivate other businesses to pursue green operations (Indrawati et al., 2023; Zheng et al., 2022). Strategies to monitor business development along with outcome sharing development enables the SME sector to evolve through teamwork and continuous enhancement (Chauhan et al., 2022). Permanent progress monitoring requires the implementation of defined sustainability targets alongside key performance indicators (KPIs) that SMEs must achieve. Small and medium businesses can establish quantitative sustainability targets covering aspects like energy efficiency alongside waste reduction, carbon emission management and water consumption.

Measurable assessment procedures with reporting mechanisms enable continuous evaluation of SME achievement levels with sustainability targets. Financial and environmental performance data can be managed by SMEs through self-reporting processes and external audits as well as membership in reporting formats like Global Reporting Initiative (GRI) and Sustainability Accounting Standards Board (SASB) (Afolabi et al., 2022; Bashir et al., 2023; Contini et al., 2023, Hristov and Chirico, 2019) the tracking of progress within green practising organizations must go hand in hand with sharing results to stakeholders. When SMEs share their best green practices together with their success stories, they inspire others to duplicate

their achievements through meaningful examples. Many communication channels like websites and social media along with newsletters and industry events (Boaz et al., 2018; Pandi-Perumal et al., 2015) allow sharing these results with stakeholders.

The demonstration of favourable outcomes from green innovation management strategies creates motivational power for other small businesses to engage in these practices and help extend green innovation management across industries. SMEs receive essential encouragement to track their progress and exchange results from government agencies and industry associations (Lutfi et al., 2023; Rustiarini et al., 2022; Wang et al., 2021). There are organizations that have established green reporting systems, that offers guidance on green performance measurements through events and discussion platforms for small businesses to display progress. Incentives given to outstanding SMEs who advance their green innovation management practices successfully stands to inspire other participants to develop more effective green innovation management systems.

## **CHAPTER 2. GREEN RESEARCH POLICIES AND THEORIES FOR SMEs**

### **2.1. Green Innovation Management Policies for SMEs in Poland and Thailand**

Green Innovation is a critical success factor for small and medium-sized enterprises (SMEs) looking to compete in the global marketplace. While all businesses must innovate to survive and grow, SMEs face unique challenges when it comes to green innovating (Shahin et al., 2024). They often lack the resources of larger firms, including capital, personnel, and technological infrastructure. Tjahjadi et al. (2020) assert that SMEs must adopt creative methods for promoting and managing innovation to overcome these obstacles and create a culture of innovation within their organizations.

One way to promote green innovation in SMEs is through incorporating green technologies into management practices a concept referred to as 'green innovation management'. According to Asadi et al. (2020), green technologies are those that minimize environmental impact while meeting human needs. They can include renewable energy sources, energy-efficient products and processes, waste reduction strategies, and pollution prevention measures. Green technologies can help SMEs save money on energy costs, reduce waste output, and improve their public image. SMEs have often been considered to lag behind when it comes to adopting green innovation practices in their management process. However, this is now changing as entrepreneurs within the sector are becoming increasingly aware of the benefits of green innovation management from reducing costs and improving competitiveness to mitigating climate change (Wang and Yang, 2021). Various policies and standards have been developed and proposed to foster green innovation management in the SMEs.

Researchers argue that in the 21st century, green innovation should be a key priority for SMEs. The introduction of green technologies has become integral to people's daily lives. People use them daily but do not really know what they are. As the world becomes more aware of the environment and its impact on our lives, there is an increased demand for environmentally friendly products. The market has also

seen several product safety, quality, and reliability regulations. Many companies have realized they can use green technology to make their products more environmentally friendly. Green technology uses natural resources rather than polluting chemicals or processes to make products (Fatima et al., 2024). It can be used for everyday items such as clothing, electronics, and even food ingredients.

For SMEs, green products have been designed and produced to use fewer resources, reduce pollution, conserve energy, and protect the environment while increasing efficiency. In terms of design, green products are usually more attractive than conventional products. They can be used for extended periods without wearing out or breaking down. This reduces waste and lowers costs for both consumers and businesses. There are many ways in which SMEs can adopt green processes and products into their business models. This will help them to cut down on costs as well as reduce their carbon footprint (Ademi et al., 2024). The first step is to identify what areas need improvement so that you can focus on them before moving onto other areas, such as reducing their waste output or improving efficiency within the factory or office space.

In the SME's management and production practices, green technology uses natural resources rather than polluting chemicals or processes to make products. It can be used for everyday items such as clothing, electronics, and even food ingredients. There are many ways in which green technology is implemented in small businesses to make their products eco-friendlier: Using renewable energy sources such as solar power or wind power instead of fossil fuels; using natural dyes instead of man-made dyes; using recycled materials instead of virgin materials; as well as using biodegradable packaging or packaging made from recycled materials (Bagga, 2024).

### ***Green Innovation Policies in Poland***

Poland is a member of the European Union and is therefore influenced by the green policies and standards that govern the union. However, this research highlights that Poland has developed its own national strategies and policies to promote green innovation practices. This section explores policies that are put in place to push the green innovation agenda in Poland and its intended outcomes (Sułkowski et al.,

2022). Considering the green innovation efforts, the European Union prioritizes using green innovation to promote businesses' economic and environmental performance. It carries out this through policies like Eco-Innovation Action Plan (EcoAP). Poland's total innovation indicator rose by 7.8% but remains below the EU average of 8.8%. Poland ranked 40th in the Global Innovation Index 2021, dropping 41st in 2023 (Dutta et al., 2023). The research and development intensity, measured as spending on research as a share of the GDP, increased in Poland from 1.21% to 1.32% between 2018 and 2019 (Brzyska, 2023).

The National Centre for Research Development (NCBR), an executive agency in Poland's Ministry of Education and Science, has played a key role in supporting research and development activities focusing on green innovation. A good example of the NCBR effort is the 'Green Innovation Hub', an initiative to accelerate the development, deployment, and adoption of green technologies (Szczygielski, 2019). The hub creates a platform that accelerates green innovation practices by connecting businesses, research institutions and investors. Another NCBR effort is through green innovation strategic research and development programs, which offer programs to promote green innovation (Wyszomirska, 2022). These programs target areas of green innovation, such as renewable energy, green production processes, energy efficiencies, and environmental remediation.

Another green policy that Poland observes is the Polish Green Investment Scheme (GIS), which aims to guarantee the 'greening' of the financial resources generated as a result of the sale of Assigned Amount of Units (AAUs). The major focus of the GIS is the climate and environmental protection. It has led to the development of an institution structure that ensures effective management of funds and resources aimed at climate protection (Iea, 2021). The scheme has implemented policies aimed at improving energy efficiencies, promoting renewable energy, and reducing the effect of greenhouse gases.

### ***Green Innovation Policies in Thailand***

Thailand is actively responding to the current wave of green innovation and embracing it as a cornerstone for its future development. Beyond the traditional economic model, the country actively promotes green innovation practices through technologies, policies and strategies. Among Thailand's most pronounced green policies include the Thailand 4.0 initiative and the Bio-Circular-Green (BCG) economy model.

The most pronounced green innovation initiative in Thailand is the Bio-Circular Green Economy Model (BCG model). It serves as a background of Thailand's green innovation strategy, a strategy adopted and implemented towards green innovative economy. The BCG model's main objective is enhancing efficiency in resource utilization through green technology and green innovation (Jaroenkietkajorn et al., 2024). The model has implemented three pillar policies. The green economy pillar promotes environmentally friendly practices through greener production, processes, eco-friendly waste management, and adoption of renewable energy (Edyvean et al., 2023). The circular economy pillar focuses on strategies for minimizing waste and resources in the complete aspect of the circular economy. This initiative advocates for green practices such as recycling, resource recovery, and re-manufacturing. The third initiative is the bioeconomy, a strategy focused on utilizing renewable biological resources in developing bio-products, biomaterials and biofuels.

Another green innovation effort by Thailand is becoming a member of the Partnership for Action for Green Economy (PAGE). Thailand joined PAGE in 2019 with the intention of implementing inclusive green innovation strategies. The major actions of green innovation are reducing carbon emissions, promoting energy efficiencies and energy resources, and transitioning to equality and diversity. In Thailand, PAGE incorporates a wide range of stakeholders, such as international organizations, government agencies, private sector and academicians.

Thailand's green innovation programs include advanced environmental management, renewable energy, green agriculture practices, clean transportation, and manufacturing. Research studies in green agriculture strive to cultivate environmentally friendly farming techniques, advocate for organic farming

methodologies, and mitigate the negative consequences of agricultural operations. In addition, Thailand's green innovation agenda places high importance on researching clean mobility technologies such as electric vehicles and alternative fuels (Paudel et al., 2023; Preedakorn et al., 2023; Winyuchakrit et al., 2017). Thailand has actively encouraged green innovation by partnering with international organizations, academic institutions, and the private sector. The government has implemented financial structure and incentives to support green innovation initiatives, specifically emphasizing advancing multidisciplinary research and exchanging knowledge.

## **2.2. Green Innovation in SMEs in Selected Countries**

### ***Investigation from Portugal***

According to Rodrigues and Franco (2023), climate change remains one of the most pressing global challenges, and businesses, especially SMEs, are pivotal players in the global emissions scenario. Their study illuminates how SMEs, which constitute a significant portion of global economic output, struggle with transitioning to green practices and the broader concept of green innovation. Their perspective is that green innovation can be broadly understood as integrating technologies, processes, and practices that markedly reduce environmental impact and further green development goals. It extends beyond compliance with environmental regulations, encapsulating proactive measures to minimize pollution, waste, and other environmental issues. The study primarily focuses in on SMEs located in a specific Portuguese inland region as case studies, offering a microcosmic view of the challenges and endeavours of these enterprises in their green innovation journey. This focus contributes richly to the extant literature on innovation, entrepreneurship, and management strategy and provides a nuanced understanding of the regional factors influencing green initiatives. The qualitative study included three SMEs representing the restaurant industry, the retail sector, and a company specializing in producing and commercializing wines with Denomination of Controlled Origin (DCO). The study adopted the definition of SMEs outlined in the Commission Recommendation 2003/361/EC, dated 6 May 2003.

The key findings from among the SMEs analysed showed a clear awareness and concern surrounding green innovation among the three SMEs. This is particularly since the COVID-19 pandemic with increased usage of packaging in the restaurant business. The pandemic resulted to customers preferring to take away their food as opposed to dining in the restaurant due to fear of contracting or spreading the virus. From the SMEs studied, only two were actively involved in recycling waste generated from their operation, and none fully met green practices expectations and requirements. This highlights the gap between intent and action in SMEs' green initiatives. One positive attribute from the investigation was an enterprise that had transitioned to providing green services, evident from its certified products without of artificial ingredients. The study uncovered some barriers to the adoption of green innovation management by SMEs in Portugal. Some of the barriers uncovered include access to resources like funding, skills and expertise, government taxes, lengthy and complex certification procedures, knowledge networks, and timely information emerged as significant issues affecting green innovation management adoption.

Staying competitive in a rapidly evolving business ecosystem requires SMEs to innovate constantly. However, the journey towards green innovation management is riddled with challenges, emphasizing the need for a supportive infrastructure. As seen in the literature (Aboelmaged and Hashem, 2019; Alraja et al., 2022; Shahzad et al., 2022; Tajpour et al., 2023), the importance of selecting the right partners and practices was also highlighted, stressing the role of strategic alliances and collaborations in successful green transitions. Rodrigues and Franco's study indicates that for a green transformation to be truly effective, it needs to permeate an organization's culture. SME managers play a pivotal role in this, needing to recognize the importance of green innovation management and instill this realization in their workforce. While SMEs hold significant potential to drive green innovation management and green practices, their journey is full of challenges. Research such as Rodrigues and Franco's 2023 study provides valuable insights and directions for future research, especially regarding comprehensive approaches to green innovation management and potential applications in different sectors and regions.

### ***SMEs Adopting Green Innovation Management in Indonesia***

The study conducted by Rustiarini et al. (2022) explores the green innovation management concept, which involves the integration of a firm's internal intellectual capabilities with green principles. At the core of this synthesis lies a response to growing public concerns regarding global environmental challenges. The authors emphasize that green innovation management presents a convincing resolution to these environmental issues. These technologies not only alleviate the negative environmental impacts of corporate operations but also enhance the financial resilience of businesses. The study was conducted on the woodcraft industry in Indonesia. The researcher investigated the antecedents and ramifications of implementing green innovation management within 336 SMEs. The manufacturing domain, despite causing significant environmental effects due to its raw material consumption and wasteful production processes, represents a salient part of Indonesia's SME landscape. The study used SMEs from different districts of Bali, Indonesia. The districts form a representative cohort, mirroring the broader manufacturing SME demographic. A critical aspect of the research was evaluating green innovation management's mediatory role between intellectual capital, green performance, and financial outcomes in SMEs. The findings reveal that intellectual capital positively contributed to increasing green innovation management among SMEs', and their financial performance. The green innovation management variable significantly mediated the influence of intellectual capital, green performance, and financial performance. Implementing green innovation management directed entrepreneurs to fulfil their social and environmental responsibilities and encouraged SMEs to achieve economic benefits. The findings can be summarized as follows:

1. The research posited that intellectual capital significantly bolsters green innovation management. This assertion stems from the belief that intellectual capital, primarily the knowledge and skills of employees, is pivotal for the effective integration and utilization of green technology. Given their substantial nexus with environmentally conscious stakeholders, SMEs feel compelled to spearhead green innovations. Such an approach aligns with their stakeholder expectations and the broader green

imperatives. However, this discovery contrasts with Liu et al. (2021), who believed intellectual capital did not significantly influence green innovation. SMEs with the appropriate intellectual capital will be able to adapt to green initiatives and development challenges. The finding did not support the previous research that intellectual capital did not impact green innovation performance.

2. Rustiarini et al. (2022) resonate with prior research by asserting that green innovation management is not merely an environmental gesture; it has tangible financial benefits. They offer an important insight into the relationship between green innovation management and financial viability for SMEs. Contrary to traditional views that perceive green initiatives and profitability as mutually exclusive, their research underscores the financial benefits of integrating green practices into business operations. For SMEs, green innovation management paves the way for environmental stewardship, enhances operational efficiencies, opens new revenue streams, and serves as a competitive differentiator in the market. Consequently, greening emerges as an ethical or compliance measure and a strategic tool that can drive substantial economic gains.
3. The study's scope is limited to conventional intellectual capital metrics, excluding the green dimension. They advocate that future inquiries should encompass green initiatives within intellectual capital markers, mainly when focusing on SMEs with green-centric intellectual capital. Such enterprises possess competencies intricately linked to environmental considerations.

The study by Rustiarini et al. (2022) serves as a reminder for SMEs worldwide. While green innovation management is crucial for an environmental issues, it is equally instrumental in SMEs' economic prosperity. Such a duality of purpose ensures that green innovation management remains at the forefront of SME strategies in the foreseeable future.

### ***Barriers Affecting Pakistan SMEs Adopting Green Innovation Management***

This case study seeks to distinguish the significant obstacles hindering SMEs' adoption of green practices in Pakistan. The authors utilized a framework to classify the major obstacles and solutions influencing green innovation management adoption. Shah Fahad led the research from the Leshan Normal University in 2022. Twenty-five barriers and fifteen solutions were recognized by reviewing extant literature and expert opinions (Fahad et al., 2022). A Fuzzy Analytical Hierarchal Process (AHP) was utilized to rank these barriers, and a Fuzzy Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) was employed to give appropriate ranks to strategies/solutions to overcome the identified obstacles. The study's findings revealed that legal barriers were the most critical obstacles to green innovation adoption in Pakistani SMEs out of six significant barriers.

Information barriers were the second critical green innovation adoption obstacles/barriers in SMEs, followed by technical, managerial, economic, and market barriers. Information barriers were the second critical green innovation adoption obstacles/barriers in SMEs, followed by technical, managerial, economic, and market barriers. These findings offer insights to SME stockholders to overcome and eradicate barriers to green innovation who intend to adopt green practices instead of conventional ones. Several strategies have been suggested to address the barriers listed earlier, and determining the relative importance of these measures is challenging.

The results showed that in Pakistan, adopting green innovation management within SMEs faces various challenges, and identifying practical solutions is fundamental for their successful integration into business practices. The study's findings emphasize the importance of targeted interventions to promote green innovation management. One influential finding emphasized government or establishment-driven subsidies to enable SMEs to develop green products. This approach was prioritized based on its closeness coefficient value, suggesting that direct financial support could be a linchpin in overcoming barriers to green innovation management. Contrarily, while collaborations with social and environmental groups are beneficial, they were identified as a lesser priority in the study. Such

collaborations, although valuable for building a green brand image and harnessing expertise, might not provide the immediate tangible support SMEs need to innovate and adopt green innovation management in their operations.

However, regardless of the prioritization, the central message from the study is evident: For a successful green transition, SMEs in Pakistan need to embrace these recommended solutions holistically. Prioritizing and implementing these measures fosters a green business environment and ensures SMEs remain competitive in an increasingly eco-conscious market. By understanding and acting on these factors, SMEs can better navigate the complexities of green innovation management adoption, contributing positively to their bottom line and the environment.

### ***Stakeholders Influence on Green Innovation Management Adoption by SMEs in Italy***

In the study "Adoption of Green Innovations by SMEs" Thomas et al. (2022 from the Italian Medicines Agency explored the dynamics influencing SMEs in adopting green innovation management methods. They highlighted the critical role of contractual and non-contractual stakeholders in shaping the direction of SMEs' green innovation management pursuits. The researchers observed that certain SMEs contend with weak associations with suppliers and customers, which can hamper their green innovation management operations. Based on this, they emphasized the potential role of public administrations in reshaping perceptions amongst local entrepreneurs. It is essential to understand that companies often showcase their green development actions to achieve legitimacy and consensus.

Such green practices emphasize integrating environmentally friendly techniques and processes into their operations. What makes this matter pressing is the influence of stakeholder sensitivity on companies' strategic directions, especially concerning environmental and social undertakings that they consider to affect the organization. The research sought to discuss how stakeholders' environmental and social sensitivities impact SMEs' decisions to support and participate in green innovation management initiatives in Italy. These SMEs green initiatives and efforts could further the United Nations' Sustainable Development Goals (SDGs), particularly goals 7, 8, and 9.

To obtain a broad perspective, the researchers conducted a survey targeting innovative SMEs registered with a specialized section of the Italian Chamber of Commerce. They utilized stratified sampling, with the region of the company's registration as the stratification variable. This approach yielded a sample of 225 SMEs, constituting approximately 22% of the innovative SME population. Interestingly, a segment of these SMEs operated within the service sector, predominantly concentrated in Northern Italy. The findings were revelatory. Contrary to expectations, not all stakeholders appeared to persuade the innovative SMEs in their green innovation management decisions. From the stakeholders identified as contractual by Thomas et al. (2022), only the workforce emerged as a significant influencer of SMEs' green innovation management choices. This unique outcome could be attributed to the small average dimensions of the surveyed SMEs, implying that they might be inadequately integrated into relational networks or supply chains. These SMEs might primarily cater to end-consumers or offer specialized supplies stemming from their innovative and high-tech nature. Concluding their investigation, the team posited that future research endeavors should contemplate the mediating effects of different stakeholder categories. They recommended an expansion of the survey scope to encapsulate a broader spectrum of SMEs, both in terms of category and geographical distribution. This would facilitate a better understanding of the issue and provide actionable insights to strengthen policies encouraging SMEs to embrace green innovation management processes.

### ***Implementation of Green Innovation Management in Bangladesh***

Polas et al. (2023b) undertook a study exploring the behaviours of rural entrepreneurs in Bangladesh toward Green innovation management, specifically in the context of green practices of SMEs operating within rural areas and cities. The research aimed to evaluate the effects of specific dimensions environmental concern, perceived ease of use, and general attitude on adopting green innovation management among this demographic. The study demonstrates that many environmental experts have recently spotlighted the growing inclination of rural entrepreneurs towards adopting solar energy technology, which stands out among many green energy options. The core intent of this study was twofold:

1. To determine the primary factors driving innovation among rural entrepreneurs in Bangladesh.
2. To clarify the relationships between these factors and assess the effectiveness of their associated strategies in implementing Green innovation management in their operations.

Bangladesh was singled out for this research due to its stature as an emerging economy in the South Asian region. Despite its economic momentum, the SME sector in Bangladesh lags in terms of environmental management and the adoption of green practices, especially when compared with developed nations. Such a backdrop lends a sense of urgency and relevance to the research. To carry out their study, the researchers collected data from a diverse sample comprising 288 rural Bangladeshi SME entrepreneurs. They adopted a positivist approach complemented by the hypothetic deductive observation method. The data analysis was executed leveraging advanced tools like Smart PLS 3.3.9 (SEM) and SPSS V 25.0.

The findings suggested that environmental concern and perceived ease of use serve as drivers, increasing the adoption of green practices and innovation. A key revelation was the mediating role of the intention to use green energy technology, particularly solar energy, in bridging environmental concerns and attitudes with the central theme of green innovation management adoption. However, this intention did not influence the relationship between the perceived ease of use and the adoption of green innovation management in rural Bangladesh. The study emphasizes the importance of constructing parameters that enhance eco-innovations to bolster green innovation management practices among rural entrepreneurs. This becomes even more salient given that the concept of green innovation management is still being defined in the Bangladeshi entrepreneurial landscape and is considered to be in its infancy.

By emphasizing the latent potential in rural green entrepreneurship and innovation, especially in the digital realm, Polas et al. (2023b) enriched the theoretical foundations of green innovation management research. The research also bridges an existing gap by mapping the relationship between environmental concerns, perceived ease of use, and attitudes toward green innovation management in

the Bangladeshi context. It may apply to a greater extent in the South Asian region paradigm. However, it also highlights the underexplored confluence of green energy technology and rural entrepreneurial green innovation adoption.

### **2.3 Natural Resources and Triple Bottom Line Framework for Successful Integration of Green Innovation in SMEs**

#### ***Theoretical Knowledge Review***

The theoretical background of this research is based on a critical evaluation and analysis of two theories that have been put forward in the past. The primary theories evaluated in this study includes the Natural Resource-Based View (NRBV) and the Triple Bottom-Line (TBL) framework. According to Afum et al. (2023), efficacy of green innovation management implementation is contingent on organizational capabilities developed from the organization's NRBV. Scholars have pointed out that based on NRBV, an organization's environmental capabilities, product stewardship, and capabilities contribute to its effectiveness. The NRBV framework suggests that organizations can acquire scarce, unique, and irreplaceable resources if they develop a shared vision of the future centred on emerging technologies, utilize new competencies, and implement agile competencies. On the other hand, TBL is a framework that considers the three equally important factors identified by World Commission on Environment and Development: the economy, environment, and society (WCED, 1987).

The notion supports green innovation, emphasizing development that satisfies current demands without sacrificing future generations' capabilities to do the same (Khan et al., 2021; Orellano et al., 2021; Purvis et al., 2019). Several research studies have evaluated its application and effectiveness in green innovation implementation capabilities. According to Aboelmaged and Hashem (2019) and Hart (1995), the NRBV theory supports the practice of green innovation by increasing firms' competitiveness and value creation. The NRBV theory has been discussed in length and critically analysed in this stud. The theory was found satisfactory in laying a sound background for developing an effective green innovation theoretical background. As a result, this study extended the NRBV to

develop and propose a theoretical model that could be used in the future to propel the concept of green innovation management, particularly among SMEs.

### ***Natural Resource-Based View (NRBV)***

The theoretical background of this research is based on a critical evaluation and analysis of the natural resource-based view (NRBV) theory. NRBV was introduced by Hart (1995) as a social theory that articulates reasons people think and behave. It explains the correlation between development and natural resources. It proposes that people's decisions and behaviours are mostly influenced by their perceptions of the availability of natural resources.

The NRBV theory describes how goods and services are produced, consumed, and exchanged in a society. It suggests that natural resources are important to economic growth because they are a necessary input in production. Natural resources are an essential input because they are used to produce goods or services that have high value relative to their costs (Gabler et al., 2022).

In this theory, human behavior is controlled by the perception of natural resources available in a particular area. People tend to behave in a way that they believe will benefit them financially or socially when they know there will be a high demand for natural resources. For example, if someone believes that there are many jobs available in an area with lots of natural resources, they will most likely choose to live there because they think it is more beneficial than other areas where there are few jobs available but no natural resources (Minbashrazgah and Shabani, 2018).

The NRBV theory argues that natural resources are key to human life. Natural resources include land, water, oil, gas, minerals and metals. They also include sunlight, wind power, and other renewable energy sources like geothermal heat. These resources are essential for humans because they provide us with food, shelter, and economic opportunity. According to the NRBV theory, it is impossible for the economy to grow without increasing consumption or decreasing production of natural resources. This can impact an individual's ability to function within society and the overall health of society at large (Yunus and Michalisin, 2016).

From the business perspective, the NRBV establishes a broad perspective in which businesses would adopt green innovation management practices based on their organizational capabilities (Aboelmaged and Hashem, 2019). The theory holds that a firm's environmental protection and conservation capabilities could be achieved considering its commitment to product and service stewardship (Lin and Wu, 2014). It is a business model that views natural resources as the core asset of a firm. The NRBV is based on the idea that resources are the most valuable asset of a firm and, thus, have an inherent value in terms of money. While this view may seem counterintuitive, it has gained popularity among practitioners advocating for green innovation practices within the business atmosphere (Gabler et al., 2022). The NRBV is a key concept that could lead to the development of a new Green Innovation Management Theory. This theory states that companies can increase their value by using their resources more efficiently, reducing waste and pollution, and becoming more environmentally responsible (Laskowska-Rutkowska, 2009).

The NRBV has contributed towards green innovation through the concept of innovation that focuses on using the resources in an ecosystem (Rahman et al., 2021). Some companies have used it to develop new products and services that are more environmentally friendly. The NRBV is also used to determine which innovations benefit a company's bottom line. This view encourages businesses to use natural resources more wisely and find ways to adopt green practices as a way to protect the environment.

Green innovation borrows from NRBV because it involves more than just technology development. It includes organizational changes affecting people and processes, through regulations and economic resources (Hart and Dowell, 2011). Muangmee et al. (2021) recommended integrating the green innovation concept in analysing strategic competency on SMEs performances. The constructs used to develop this study were developed from the NRBV Theory and TBL Theory. The theory elements were adopted and adjusted to develop the latent variables (drivers), while the sub-elements were adopted and adjusted to develop the observed variables (factors) of the study.

### ***The Triple Bottom Line (TBL) Framework***

The TBL framework is vital framework that advocates the maximization of people, planet and profit, with emphasis on environmental management (Appannan et al., 2022; Balu et al., 2023; Gyimah et al., 2023; Lamba et al., 2023; Mamedova et al., 2023; Yamaguchi et al., 2023). Stakeholders still need to be in accord with the concept and definitions of this contentious subject (Ahmed et al., 2023; Encisco-Alfaro and García-Sánchez, 2022; Kotzé and Adelman. 2022). WCED (1987) asserts that green development is "*development that meets the needs of the present without compromising the ability of future generations to meet their own needs.*" Considered the three pillars of green business performances, which are, economic, environmental, and social challenges are all a part of this definition, collectively called "triple bottom line", with implications for the current and generations to come (Curado and Mota, 2021; Elkington, 1998; Sarfraz et al., 2018). Economics, society, and the environment are all factors in TBL's CSR approach. These three components are mandatory for achieving long-term success. As a result of the importance of the three aspects of TBL, it was considered to lay a sound theoretical background for this study (Curado and Mota, 2021; Sarfraz et al., 2018).

The term "Triple Bottom Line" is commonly used in the business world to describe the practice of analysing the financial, environmental, and social implications of a company's operations. "Triple bottom line" was developed by John Elkington, the first to use it in his 1992 book of the same name. The initial idea behind the Triple Bottom Line was to guarantee that businesses were not only financially successful but also socially and environmentally responsible. Many major companies now use the strategy since it is adaptable to any field of business (Elkington, 1997). It is critical to understand that there are three levels at which a firm might examine its environmental effect:

- Economic/financial – What impact does it have on our bottom line?
- Environmental – How does this product affect our planet?
- Social/people – How does this product affect people's lives?

Various scholars have worked on developing a framework for assessing an organization's social value, environmental effect, and financial worth, arguing that all three are interconnected (Ahmad et al., 2023; Ali et al., 2023; Rodríguez-

Espíndola et al., 2022). The framework is used by businesses to determine how efficient their processes are. Since its introduction, many for-profit and not-for-profit organizations have taken up TBL. The triple bottom line may be used by any business, no matter how big or little. Businesses' "triple bottom line" include its fiscal success and socioenvironmental implications.

*Financial/economic bottom line:* The financial outcome may be stated as profit. How much a business can do for society and the planet is tied to its bottom line. A company that is losing money cannot aid society or the environment. It will have to reduce spending to make up the difference, which will leave less money expended on people and socioenvironmental aspects of Triple Bottom Line (Rodríguez-Espíndola, 2022). In addition, this factor assesses how much impact a company has on its sector or market niche through things like innovation, efficiency, and other competitive-enhancing tactics.

*Environment bottom line:* This factor takes into account the degree to which management is concerned with preserving natural features and organisms, such as animals and plants, as well as the surrounding environment. It determines how much of an influence a company's total energy use, water usage, and waste generation have on the surrounding environment. It analyses the locations of the company's operations, determines the extent of the impact those operations have on the surrounding environment, and determines how those effects might be mitigated (Ahmad et al., 2023).

*Social/People bottom line:* This section focuses on the company's personnel as well as its consumers. How content are the people who work for a certain business or organization? What kind of an environment do they provide there for workers? How pleased are the patrons of the establishment? These aspects decide whether the business or corporation in question has a healthy bottom line financially and whether or not it will still be in operation within the next five years or less (Ali et al., 2023).

The concept of TBL has been considered important to lay a foundation in the development of the green innovation management concept for this study. The

concept of green innovation management borrows from this framework through its emphasis on the consideration of business and products and services economic, social and environmental effects (Purvis et al., 2018). The framework has evolved as a key instrument for assessing how organizations' model performs on all three levels of management, which are social, economic, and environment. A business should consider it's the effects of its production activities and process, products and services from the economic, social and environmental dimensions. The environmental dimension bears the critical aspect of green innovation management. The adoption of green innovation management practices and their implementation incorporates the business concern to the social and environmental wellbeing (Yip et al., 2023).

The triple bottom line framework helps companies monitor their social, environmental and economic impacts. It provides a way for organizations to measure all three features of their operations to certify that they are producing products that are beneficial to society as well as profitable. The approach can be used by any company or organization looking to achieve long-term green innovation management goals (Purvis et al., 2018; Yip et al., 2023). It is not just about making money and generating profit for a business; it is about making sure they are doing good things for other people and the planet taking into consideration, organizational factors (Figure 2.1).

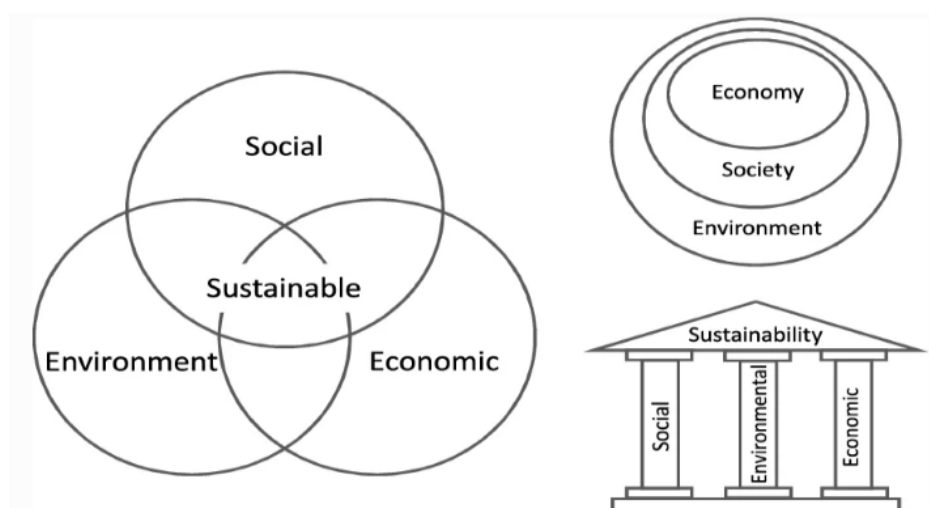


Figure 2.1: The TBL framework

Source: Purvis et al. (2018)

According to several studies, eco-business performance concept from the TBL is an extremely important factor in the achievement of business performance objectives by combining a variety of approaches, including corporate social responsibility, green innovation management, and absorption capacity (Fallah Shayan et al., 2022; Malvestiti et al., 2021; Mo et al., 2022). Nevertheless, impact of organizational factors such as Green Economic Resources, Green Human Resource, and Green Innovation Management on achieving green performance in SMEs through Green innovation management has yet to be studied. Furthermore, there is limited research on integrating green economic resources, managerial governance, and green innovation management, especially in SMEs in emergent economies (Javeed et al., 2023; Ali et al., 2023; Xue et al., 2019). While there is extensive literature on both frameworks, there appears to be few studies on the integration of NRBV and TBL frameworks by SMEs in promoting green practices. Bridging these frameworks is necessary to provide guidance on the relevance of theoretical concepts toward advancing green innovation practices. This study attempts to add to the knowledge of integrating NRBV and TBL frameworks in the SMEs' discourse in emergent societies. Further research could provide valuable insights for SMEs adopting green innovation management practices.

The NRBV and TBL theory helped develop the study of latent and observed variables. The six study latent variables were developed with reference to the NRBV and TBL theories and consultation with a literature review (Table 2.1).

Table 2.1: Development of Study Variables from NRBV and TBL models

| <b>TBL Elements</b> | <b>NRBV Elements</b>  | <b>Green Innovation Management Drivers</b>                                            |
|---------------------|-----------------------|---------------------------------------------------------------------------------------|
| Economic            | Key Resources         | Green Economic Resources                                                              |
| Environmental       | Strategic Capability  | Green Technical Capabilities<br>Green Regulations Management<br>Green Human Resources |
| Social              | Competitive Advantage | Green Standards Compliance<br>Adoption of Green Innovation Management                 |

Source: Adapted from Muangmee, et al.(2021), Gabler et al. (2022), Rahman et al. (2021), Yunus and Michalisin (2016), Minbashrazgah and Shabani (2018), and Aboelmaged and Hashem (2019)

The variables were developed as follows: strategic capability (NRBV) and environmental (TBL) elements led to the development of green technical capabilities and green regulations management. The economic (TBL) and key resources (NRBV) led to the development of the green economic resources.

The social (TBL) and competitive advantage (NRBV) led to the development of green human resources, green standards compliance (ISO 14001 compliance), and adoption of green innovation management. Hypotheses for these variables were developed by critically evaluating the previous researchers, as presented in the following section.

## **2.4. Development of Study Variables and Hypotheses**

### ***Green Regulations Management***

A critical review of previous studies related to the identified study variables was conducted. The analysis evaluated the relationship between the variables as depicted in the conceptual framework and the appropriate and applicable observed variables with related research questions. The analysis is presented in the following subsections.

Green regulation implies the policies, laws and standards put in place within a particular setting, organization, or jurisdiction aimed at guiding green practices (Du et al., 2021). These regulations aim to promote green innovation practices, protect the harmful effects of business practices on the environment and society, and ensure effective and efficient utilization of the available resources. Luo and Patuano (2023) state that green regulations encompass formal policies restricting pollution emissions and demonstrate a commitment to social responsibility and environmental protection. Different organizations formulate appropriate environmental regulations and recovery packages from global issues like the recent COVID-19 pandemic, such as tax requirements, green subsidies, and similar initiatives; long-term, green recovery plans can also help fund the enormous costs associated with the pandemic through cost-effective strategies and investments (Quan et al., 2021).

Wang et al. (2021) conducted a study on the green innovation practices and inherent effect on the environmental and organizational performance. The researchers assert that green regulations could include laws on emissions, waste management, resource conservation, energy efficiency, and the use of green materials. The objective of green regulations and the associated green regulation management practices is to reduce environmental impact and encourage businesses, including SMEs, to adopt greener practices and innovations. Previous studies have tried to explore the concept of green regulation and its relationship with other concepts, such as green innovation and the adoption of green innovation practices.

A study conducted by Zubeltzu-Jaka et al. (2018) investigated the determinants of green innovation through a meta-analytic study. Four factors were evaluated: the technology push, market pull, regulatory push-pull, and firm-specific factors. The study indicated that regulatory pressures significantly drive SMEs to implement green innovations. This is often due to the need to comply with environmental standards and avoid penalties, which can lead to competitive advantages by fostering innovation and improving green innovation and management credentials. The study also indicated that the firms that are more concerned about the creating collaboration networks are more inclined to adoption of green innovation policies are regulations. This echoes the concept of 'technology push' which drives the green innovation, as well as the 'regulatory push-pull' which demonstrates the government regulations which compels or incentivize the efforts towards green innovation management practices.

Horbach et al. (2012) carried out a study to investigate the factors that determine eco-innovations with reference to the type of environmental impact. The objective was to investigate whether different aspects of green innovation (eco-innovation) are driven by different factors. The study highlighted those green regulations, particularly those providing economic incentives or technical support, effectively promote environmental innovation among SMEs. These regulations encourage compliance and stimulate SMEs to go beyond mere compliance towards proactive environmental management and innovation. Additionally, the authors introduced the concept of regulatory push/pull, a concept which demonstrates the role of

environmental regulations in driving green innovation by compelling firms to adopt green innovation related to green innovation.

Another study by Huang and Lei (2021) studied how corporate green investment is affected by environmental regulations in a case study of China. The research indicated that there is a significant relationship between the environmental regulations related to green innovation and corporate green investment practices. This analysis shows that green regulations are crucial in fostering green innovation management among SMEs. They help by setting clear environmental standards and providing frameworks. From the literature analysis presented above, this study hypothesised a significant relationship between green regulations management and the adoption of green innovation management. With reference to the NRBV and TBL models, the literature led to the development of three observed variables, namely environmental uncertainty, government support, and regulatory pressure (Figure 2.2).

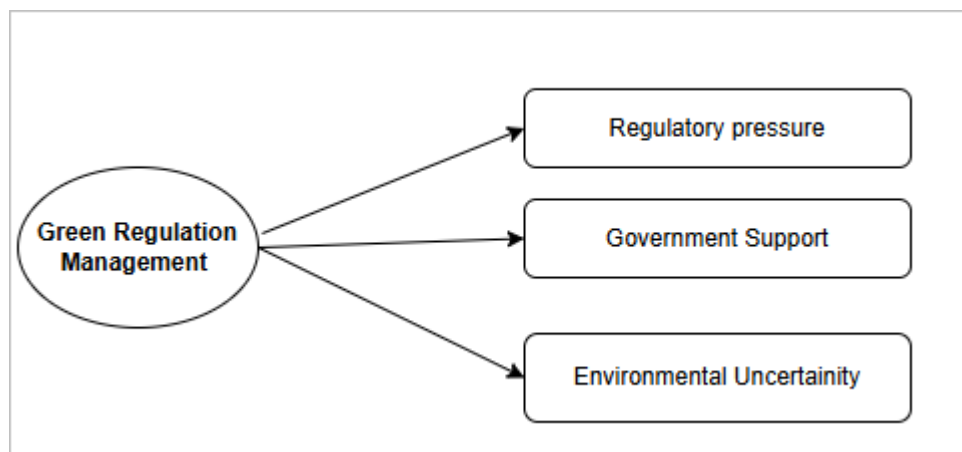


Figure 2.2: Green Regulation Management Observed Variables

Source: Author's elaboration

### *Green Technical Capabilities*

Green technical capabilities imply the aspects of technological knowledge, skills and resources that could be harnessed and applied by businesses and organizations in their effort to adopt and manage green innovation practices (Shen et al., 2018). According to Barbieri et al. (2023), these capabilities include designing eco-friendly products, improving energy efficiency, reducing waste, and complying

with environmental regulations. SMEs must innovate to reduce their environmental footprint and align with broader green practices and green management goals.

Another study was carried out by Bhatia (2021), on the role played by proactive environment strategy, technological capabilities, and organizational learning in green process innovation and operational performance. The study indicated that the technical capabilities of a business are critical to consider in the process of adopting new green technologies. Given that numerous green innovations are designed to complement, rather than replace, existing technologies in businesses, compatibility becomes a vital factor to consider during adoption (Bhatia, 2021). The likelihood of an organization adopting green innovations rises when these innovations are compatible with the tools and technologies already in use within the organization. Organizations can enhance the adoption rate of green innovations and successful integration by ensuring compatibility.

An additional study was by Shen et al. (2018) who focused on understanding the green technical capabilities and barriers to green buildings in developing countries. The study considered green technical capabilities to include resource efficiency and reduced operational cost. The results indicated that green technical capability is critical in boosting green innovation practices, in this case, green building.

A study by Barbieri et al (2023) evaluated the regional technology capabilities and the green opportunities in Europe. The study indicated green capabilities are critical aspects to consider, in the effort towards green innovation. However, different regions have varying green capabilities, due to the different geographical distribution of innovation. It is therefore important to map these capabilities in order to identify areas with potential green technology growth (Barbieri et al., 2023).

Another important study was carried out by Fahad, Alnori et al. (2022) to investigate the adoption of green innovation practices in the SMEs sector. The study focused on discovering the barriers and obstacles that affect the smooth adoption of green practices among SMEs. The study findings indicated that technological capabilities were among the factors that significantly influenced or determined the green innovation adoption process. They found that SMEs with higher levels of

technical expertise in environmentally friendly technologies were more likely to engage in green innovation practices.

Rao and Holt (2005) investigated the relationship between green supply chain management practices and organizational performance. The study evaluated whether green supply chain helps in competitiveness and economic performance in an organization and the determining factors. The researchers found that companies with advanced green technical capabilities were more successful in implementing green supply chain practices. These capabilities included waste reduction, resource efficiency, and pollution control technologies.

From this analysis, this study a hypothesis was developed that there is a significant relationship between green technical capabilities and adoption of green innovation management. The literature review with reference to the NRBV and TBL theories led to the development of three observed variables for green technical capabilities. These are Complexity of Technology, Compatibility of Technology, and Green Relative Advantage (Figure 2.3).

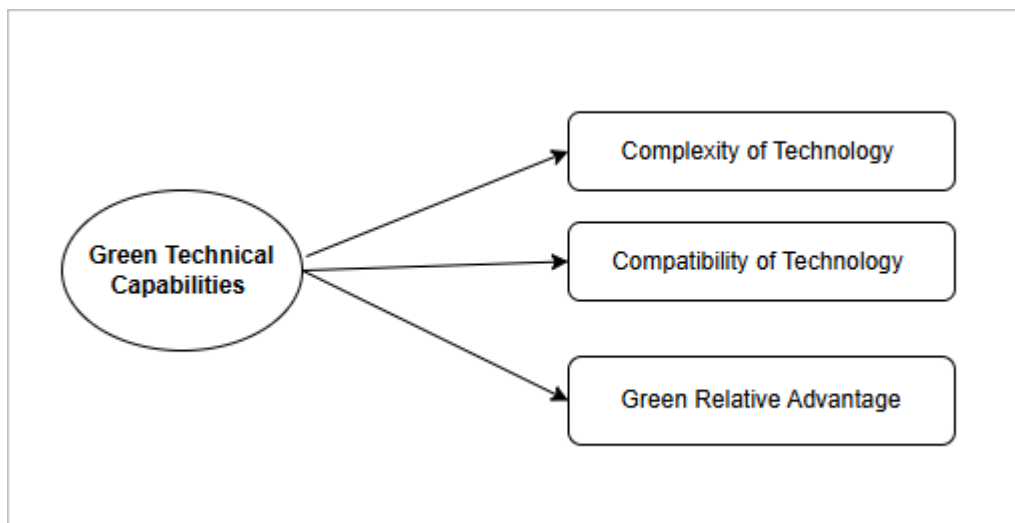


Figure 2.3: Green Technical Capabilities Observed Variables

Source: Author's elaboration

### *Green Economic Resources*

According to a study by Lee and He (2022) green economic resources imply financial instruments and economic support mechanisms designed specifically to

promote green innovation practices in business premises (Lee and He, 2022). They include financial, material, and technological assets that are essential and dedicated to green practices, such as green products and green services within an organization. These resources could be utilized to reduce environmental impact, conserve energy, minimize waste, and promote green practices within an organization. In the context of SMEs, green economic resources can include investments in renewable energy, eco-supply chain practices, eco-friendly product development, and technologies that enhance resource efficiency. According to Shah et al. (2021), green economic resources that could be harnessed to achieve green practices include access to skilled labour and expertise, natural resources, and profitability.

Research conducted by Doran and Ryan (2012) evaluated the regulation and firm perception, green innovation and firm performance. The purpose was to investigate the factors that influence green innovation (eco-innovation) and, more importantly, compare green innovating firms' economic and financial performance versus non-green innovating firms. The study findings indicated that businesses that had invested in green innovative practices in green environmental management systems and green certifications were better positioned to innovate in response to environmental challenges. The availability of green funds, a factor of green economic resources, was vital in adopting advanced technologies and green business models.

Ma et al. (2023) studied how green finance influences green innovation. Green finance was considered an aspect of green economic resources adopted in this study. The results indicated that green finance significantly promotes green innovation, which brings in the 'green compensation' effect. The research further indicated that the green finance effect is more pronounced in state-owned companies, demonstrating a higher social responsibility (Tiwari et al., 2024). From the findings of Ma et al. (2023), it is noted that the economic resources that supports green innovation practices is usually financial capital. This brings in the concept of green finance, an areas with potential of exploration by future researchers.

Another study was carried out by Liu and Chen (2022) to investigate the effect of digital finance on green innovation from the resource effect and innovation effect

perspective. The research considered digital finance as a new perspective within the green innovation domain. The study findings indicated that digital finance, a component of green economic resources, is a stimulant of green innovation in an enterprise (Jaroenkietkajorn et al., 2024). They further indicated that Digital finance plays a critical role in reducing the enterprises' financial constraints and stimulating green innovation process (Liu & Chen, 2022).

From this analysis, this study proposed a hypothesis that there is a significant relationship between green economic resources and adoption of green innovation management. The literature review with reference to the NRBV and TBL frameworks led to the development of four observed variables for green economic resources. These are Access to Funds/Loans, Availability of Skilled Labor and Expertise, Availability of Natural Resources, and Profitability (Figure 2.4).

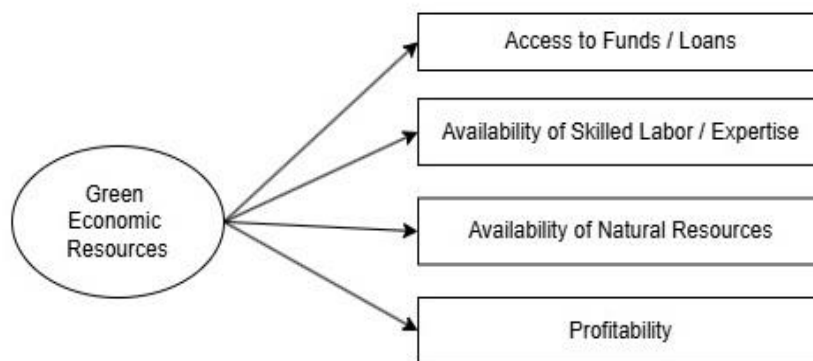


Figure 2.4: Green Economic Resources Observed Variables

Source: Author's elaboration

### *Green Human Resources Management*

The concept of green human resource management implies the strategic alignment of human resource management practices to an organization's green practices and goals. It is a practical process that involves attracting, developing and motivating employees to contribute towards green practices, green innovation, green products and services, and the overall green practices that ensure environmental conservation (Renwick et al., 2013).

Green human resources management entails various practical aspects integrating environmental management principles into human resource management practices. According to Ali et al. (2020), green human resource management promotes practices that reduce waste, efficiently use resources, and develop a culture of environmental responsibility among employees. It entails green recruitment and selection, which prioritizes employees' candidates with knowledge, experience and expertise regarding green innovation. Green productivity and cooperation focus on fostering organizational cooperation and working that encourages green initiatives. It also entails product/service quality and management support, which ensures that the organization's leadership understands and guides the employees toward green awareness and practices (Masri and Jaaron, 2017; Sathyamoorthi et al., 2023).

Various studies have examined the concept of green human resource management from various perspectives and in different sectors. This section evaluates these studies and tries to map their relationship with the adoption of green innovation management. A study conducted by Munawar et al. (2022) analysed the effects of green human resource management on green innovation, considering the aspects of green human capital, environmental knowledge, and managerial environmental concern. The study was conducted in the hotel sector, with respondents comprising management, such as entry-level, middle- and top-level management employees. The study results show that green human resource management contributes to green innovation of a firm. Additionally, other human resource aspects - green human capital and environmental knowledge – were also found to have a significant influence.

Another study by Sobaih et al. (2020) investigated how green human resource management influenced environmental performance, considering the role played by green innovation. The study was carried out in small lodging enterprises based on the resource-based view theory. The data was collected from the owner-manager of these enterprises. The results revealed that green human resource management significantly influences both green innovation and the environmental performance of small lodging enterprises. The results also revealed that the effect of green human resource management on environmental performance was amplified by green innovation practices.

A study carried out by Masri and Jaaron (2017) evaluated the green human resource practices in the manufacturing context of Palestine. The study was driven to determine the extent of practices of green human resources. It was found to be a critical factor that supports green environmental awareness and performance. The study indicated that among the green human resources practices include the green recruitment and green training, which were considered to have a significant influence in the effort to adopt and implement green innovation management practices.

Song et al. (2021) conducted a study investigating how green human resource management and managerial concern affected green innovation. The study was developed on the background of human capital theory and conducted empirically. The results revealed that green human resource management significantly affects green innovation. Additionally, this relationship was significantly mediated by green human capital, an aspect critical in human resource practices.

The above critical review led to developing a hypothesis that there is a significant relationship between green human resource management and green innovation management. As well, with reference to the NRBV and TBL frameworks, observed variables were developed, for green human resource management. These include productivity, cooperation, product/service quality, and management support (Figure 2.5).

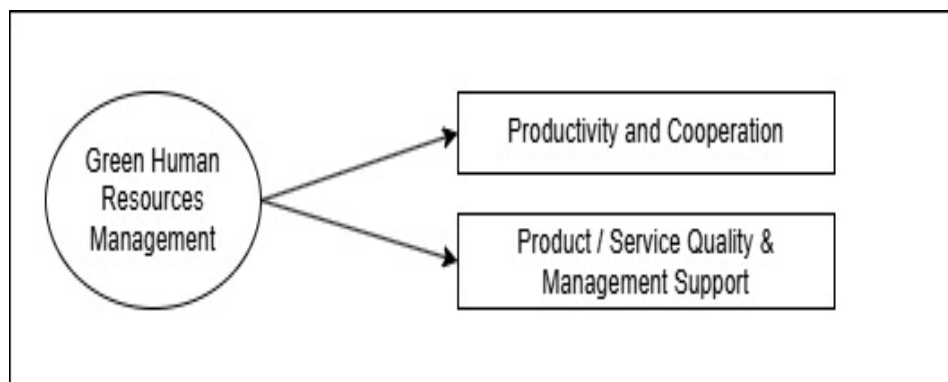


Figure 2.5: Green Human Resource Management Observed Variables

Source: Author's elaboration

### *Green Standards Compliance*

Green standard compliance implies the set guidelines and regulations designed and implemented for the organization to minimize their impact on the environment. These regulations. According to Toha et al. (2020), it could be based on international, national, or industry-specific guidelines. The green compliance standard considered for this study is ISO 14001. It is a widely recognized standard that has been adopted and applied in the Environmental Management System (EMS). This standard outlines a framework that should be used by firms in their effort to identify, manage, and continuously improve environmental performance (Potoski and Prakash, 2005). Compliance with the stipulated standards generally involves a firm adopting and implementing business practices that enhance resource efficiency, reduce emissions, and minimize waste. These practices contribute to environmental conservation and overall green practices.

Various studies have investigated green standard compliance (ISO 14001 compliance) and its application in various sectors. This study evaluated the application of this standard with regard to the aspects of green innovation. A study by Borsatto and Amui (2019) unfolded the relationship between environmental regulations and green innovation. The study investigated whether environmental regulations influenced the green innovation practices of companies in both developed and developing countries. The study used industrial companies as the study subjects, and the data was analysed using structural equation modelling. The results indicated that environmental regulations significantly and positively influence industrial firms' green innovation practices. However, the study pointed out that this relationship was inconsistent.

A study by Potoski and Prakash (2005) contributed a significant concept to the green innovation practices, the voluntary and participation in green regulatory compliance. The study evaluated the perspective of the green clubs and voluntary governance towards the ISO 14001 and business regulatory compliance. The study observed that the presence of voluntary non-governmental green programs boosts the morale towards participation in the green regulatory compliance among businesses. Another study by Toha et al. (2020), who considered the moderating

role of the ISO 14001 environmental management system, in evaluating the societal development towards green innovation. They observed that these green regulations and policies monitors the firms green ennovation models, both in production (product, process, and technology) as well as non-production (organisation and marketing) business practices (Toha et al., 2020).

Another study was conducted by Brogi and Menichini (2019), which investigated whether ISO 14001 environmental management system has s has any influence on green innovation performance. The study was carried out under a case study of the context of the European Union. The study focused on the ISO 14001 standards and their influence on green innovation performances. The study found that there was no significant correlation between green innovation performance and the number of companies that observe the ISO 14001 certifications. This implies no relationship exists between the number of companies that have developed innovations with environmental benefits and those with ISO 14001 certifications.

Hu et al. (2023) evaluated China's ISO 14001 certification as a voluntary environmental regulation and its relationship with green innovation and greenwashing. The empirical study was driven by the significant role played by voluntary environmental regulation in the promotion of green innovation practices. The study examined Chinese companies listed between the year 2018 to 2020. The findings indicated that ISO 14001 significantly influences both the quality and quantity of green innovation among Chinese enterprises. The study further suggested that ISO 14001 certification plays a critical role in leveraging the effect of the existing innovation activities.

The above critical review, with reference to the NRBV and TBL theories led to development of a study hypothesis that there is a significant relationship between green standards compliance (ISO 14001 compliance) and adoption of green innovation management. This led to the development of two observed variables: organizational procedures and performance evaluation (Figure 2.6).

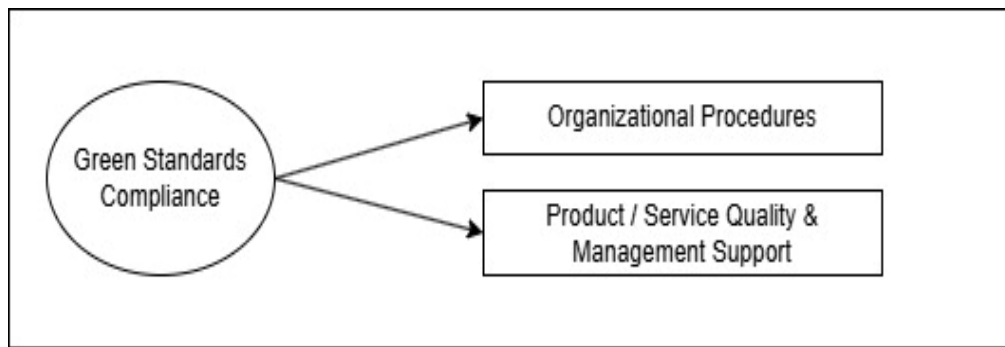


Figure 2.6: Green Standards Compliance Observed Variables

Source: Author's elaboration

### *Adoption of Green Innovation Management*

Green innovation management implies the strategic processes and practices that are used by a business or firm to develop or implement green products and services or production processes that are environmentally friendly (Jun et al., 2021). Another perspective was presented by Shahzad et al. (2022), who indicated that green innovation management and its adoption is not just developing green products but extends and encompasses the holistic approach of integrating green practices throughout the business cycle.

Jun et al. (2021) in their analysis of determining the effects of green innovation adoption in small and medium enterprises, they observed that green innovation management entails the overall business practices, from human resources management through marketing to the customer relations. They also emphasised the role of external partnership and cooperations, as well as government support to achieve the ultimate goal of green management and practices. Green innovation management focuses on achieving three key goals. First, it aims to develop environmentally friendly products and services to minimize environmental impact. Second, it strives to improve the efficiency of resource utilization. Third, it emphasizes integrating environmental concerns into business operations and strategies to achieve dual economic and environmental benefits.

This study evaluated various studies conducted on green innovation management, particularly on the factors determining its adoption within an organization. Yin et al. (2022) conducted a study investigating the digital green innovation management

for fabricated construction enterprises for green urban development. The study was driven by the desire to the development of a conceptual framework for digital green innovation management applicable to urban building 5.0. the study results indicated that green innovation management is a vital concept in promoting green urban development practices.

A study carried out by Nunes and Bennett (2008) used a case study to explore the concept of green innovation management. Based on the research, the researchers defined green innovation management as the process of identification, implementation, and monitoring of new ideas to improve companies' environmental performance while enhancing their competitiveness. They propose that it incorporates two aspects. First, the aspect of understanding the environmental demands such as environmental regulations and shortage of resources. Secondly, the customers' acceptance of green products and services is also important.

Luan et al. (2023) studied how the corporate green innovation strategy translates into green innovation performance. The study was driven by the realization of the role played by green innovation as a driving force toward green transformation in manufacturing enterprises. The study identifies various aspects of green innovation, green innovation strategy, green organizational identity, employee's green innovation behavior, and corporate green innovation performance (Bendkowski, 2004). The study adopted the natural resource-based view as the reference model. The study's findings indicated that green innovation strategy significantly influences green innovation performance and should be emphasized in the process of green practices in firms.

Another interesting study was carried out by Bai et al. (2024) on the impact of green innovation management on the brand image of the contemporary fashion industry. The intention was to discover whether integrating green innovation practices could result in other positive outcomes beyond the financial benefits. The results indicated that customers have a positive response to green products. There is also a positive relationship between high education and high income and the willingness of people to pay for green products and services. The study advocated the importance of improving and incorporating green practices into business processes. The critical

review of literature and reference to the NRBV and TBL theories led to the development of three observed variables for the latent variable ‘adoption of green innovation management, product/service innovation, process innovation, and administrative innovation (Figure 2.7).

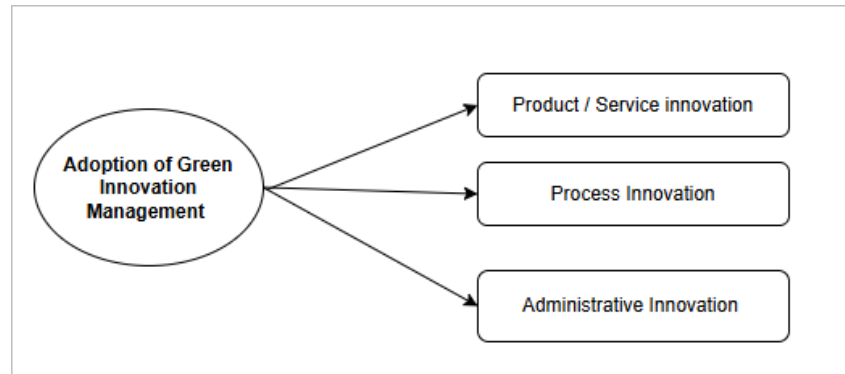


Figure 2.7: Adoption of Green Innovation Management Observed Variables

Source: Author's elaboration

## 2.5. Structuring Variables and Hypotheses Within Conceptual Models

To develop the study's hypotheses, the conceptual framework of the relationship of the study variables was developed as shown in Figure 2.8. The model comprised green regulation, green technical capabilities, green human resource management, and green economic resources as the independent latent variables. Green standards compliance is the moderating variable, while adoption of green innovation management was the dependent latent variable. Each of these has observed variables.

From the review of the literature and reference to the adopted theoretical framework, the following hypotheses were developed:

**H1:** Green regulations management significantly affect SMEs' adoption of green innovation management.

**H2:** Green technical capabilities significantly affect SMEs' adoption of green innovation management.

**H3:** Green economic resources significantly affect SMEs' adoption of green innovation management.

**H4:** Green economic resources mediate the relationship between green regulations and adopting green innovation management in SMEs.

**H5:** Green human resources management significantly affects SMEs' adoption of green innovation management.

**H6:** Green standards compliance significantly affects SMEs' adoption of green innovation management.

**H7:** Green standards compliance moderates the effects of green regulations, green technical capabilities, green economic resources, and green human resources on the adoption of green innovation management in SMEs.

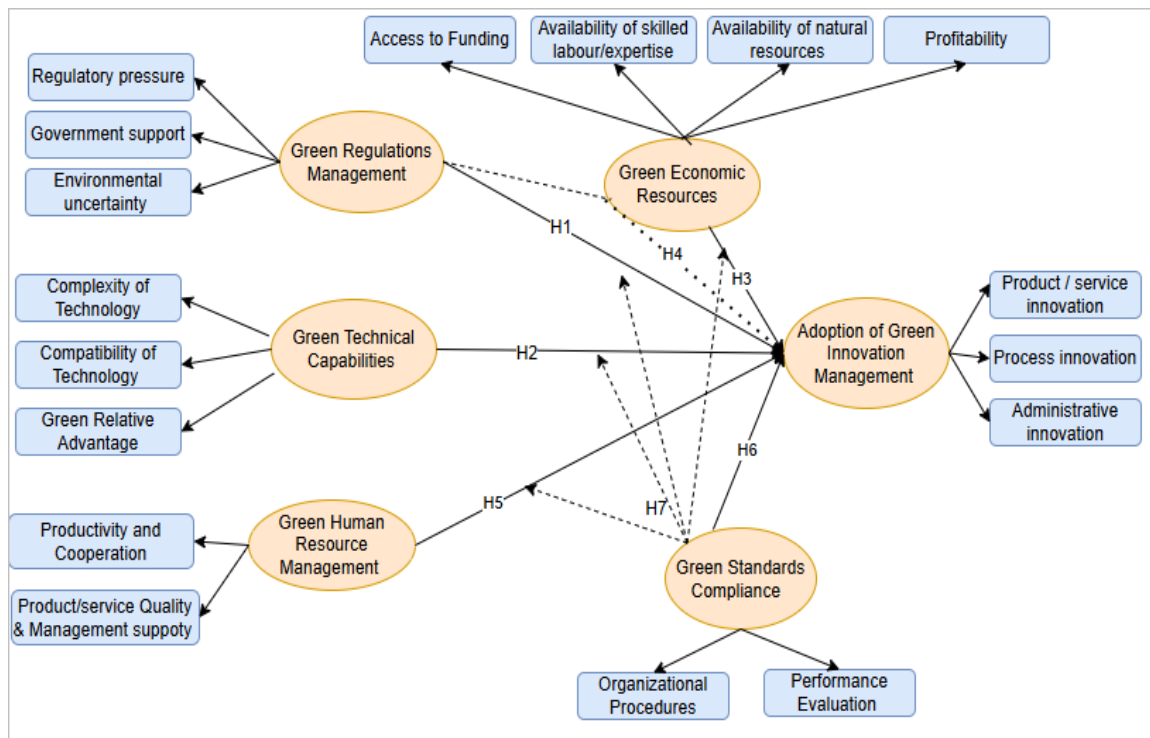


Figure 2.8: Conceptual Framework of the Study

Source: Author's elaboration

The framework shown in Figure 2.8 offers major contributions into the dynamics and interrelations among drivers concerning the adoption of green innovation management by SMEs in Poland and Thailand. It enables a methodical analysis of green innovation practices by improving our knowledge of green adoption in emerging economies. The conceptual framework graphically illustrates

the theoretical structures and relationships between them, assisting researchers and practitioners in developing research hypotheses. It provides a basis for empirical studies and directs future investigations by identifying gaps and suggesting potential areas for additional examination.

The majority of the studies included in the literature review were based on a broad perspective and focused on the determinants influencing the adoption of green innovation management by SMEs. This research specifically investigates the emerging economies of Poland and Thailand, and analyses data from their SMEs to obtain detailed information on the drivers of green innovation management. The next chapter examines the approach and techniques utilized in this study.

## **CHAPTER 3. RESEARCH METHODOLOGY FOR INVESTIGATING GREEN INNOVATION DRIVERS IN SMEs**

### **3.1. Research Design**

This research adopted the survey research design to investigate the drivers of green innovation management in SMEs under a case study of Poland and Thailand. The survey design involves collecting data from sample respondents and analysing using appropriate techniques to develop results and insights.

The study adopted the quantitative research methodology. The quantitative methodology involved collecting primary data and applying appropriate statistical techniques to analyse the data. For this study, primary data was collected from a representative sample of SMEs. The data was then analysed to develop findings and make policy recommendations and conclusions. For the survey research design, the following steps were followed.

**Step 1:** This step examines suitable literature, theories, concepts, articles, internet statistics, and academic papers contributing to the research study's argument. The development of research objectives and research questions.

**Step 2:** A theoretical literature analysis is performed to identify the appropriate study latent and observed variables. The evaluated theoretical literature explains the relationship between selected study latent variables.

**Step 3:** Formulation of the study methodology: techniques, data collection, results analysis and presentation. The study methods were developed based on theoretical assumptions. Measurement scales were developed and identified based on the theoretical foundation of NRBV and TBL. Variables were identified by referencing previous literature. The finalized measurement scales for the identified variables were formulated by compiling these sources. A quantitative research approach was employed from a representative sample size of not less than 400 respondents from Poland and Thailand, respectively, making a total of at least 800 respondents. The respondents were SMEs

representatives, including SME Owner, SME Management Staff, SME Employees, and other positions.

**Step 4:** Data analysis will be the next step, testing the model's fitness using confirmatory factor analysis (CFA). The reliability and validity status and hypotheses of the study will be analysed using the structural equation model (SEM).

### 3.2. Study Population and Sample Size

The population of the research were the registered SMEs in Poland and Thailand. Current estimates of SMEs in Thailand are at over 3.2 million (Statista Research Department, 2024). Poland recorded around 2.16 million SMEs (Sas, 2023), giving a combined population of 5.36 million SMEs between both countries. The target representative sample are SME Owner, SME Management Staff, SME Employees, and other positions.

Since the population of the study was large, it was impossible to conduct a census. As such, a representative sample was selected. To develop the sample and collect data, the non-probability random sampling design was adopted to choose samples from the population. The main rationale for employing the non-probability sampling strategy was diverse nature of SMEs respondents from Poland and Thailand (Schillewaert, et al., 1998). The sampling technique implies retrieving the sample subjects from the target population (Stratton, 2023; Vicente, 2023). The convenience sampling technique was applied in the study.

The sample size was estimated using the Cochran Formula for sample size estimation with 95% confidence level (Cochran, 1991). The formula is given as:

$$n = \frac{Z^2(p)(q)}{e^2} \quad \text{Equation (1)}$$

Where,

n = sample size needed

Z = 1.96 (for 95% confidence level)

p = proportion of SMEs with the characteristic of interest (0.5 for maximum variability)

e = allowable error (5%)

q = Complement of Proportion (q):  $1-p = 0.5$

Substituting the values in equation (1) to estimate for Poland and Thailand, where Thailand's population was estimated at 3.2 million, while Poland's population was put at 2.16 million SMEs based on the literature. Thus, the sample size for both aspects of the study become.

$$\text{Poland/Thailand: } n = \frac{(1.96)^2(0.5)(1-0.5)}{(0.005)^2} = 384.16$$

Since the population size (N) is finite (2.16 million), the adjusted sample size (n) is calculated using the formula:

$$n = \frac{n_0}{1 + \frac{n_0-1}{N}}$$

$$n = \frac{384.16}{1 + \frac{384.16-1}{2160000}} = 384.09, \text{ rounded off to 400 for Poland sample size.}$$

Substituting similarly for Thailand, it becomes:

$$n = \frac{384.16}{1 + \frac{384.16-1}{3200000}} = 383.79, \text{ rounded off to 400 for Thailand sample size.}$$

To provide robustness and provide additional confidence to the data collection process, the researcher rounded the sample size to 400 each for both countries. Thus, the sample size for Poland becomes a minimum of 400, and Thailand was a minimum of 400 respondents, making an overall sample of 800.

The researcher then utilized convenience sampling, which involves selecting the respondents who were available and reachable to respond to the questionnaire. This technique was considered suitable because it allowed the researcher to gather data from readily accessible participants who were willing to participate, which to provide insights into the drivers influencing green innovation adoption in these regions (Cochran, 1991; Etikan, et al., 2016; Marshall, 1996).

### 3.3. Study Variables and Constructs

The study's latent and observed variables were developed concerning a suitable theoretical framework and literature review. Six latent variables were developed with their observed variables. The variables are summarized herein.

#### 1. *Exogenous Latent Variables*

i) ***Green Regulations Management*** consisted of three observed variables.

- *Regulatory pressure*
- *Government support*
- *Environmental uncertainty*

ii) ***Green Technical Capabilities*** consisted of three observed variables.

- *Complexity of technology*
- *Compatibility of technology*
- *Green relative advantage*

iii) ***Green Economic resources*** consisted of four observed variables.

- *Access to funding/loans*
- *Availability of skilled labor/expertise*
- *Availability of natural resources*
- *Profitability*

iv) ***Green Human Resources Management*** consisted of two observed variables.

- *Productivity and cooperation*
- *Product/service quality and management support*

v) ***Green Standards Compliance*** consisted of two observed variables.

- *Organizational procedures*
- *Performance evaluation*

## 2. *Exogenous Latent Variables*

vi) ***Adoption of Green Innovation Management*** consisted of three observed variables.

- *Product innovation*
- *Process innovation.*
- *Administrative innovation*

### **3.4. Data Collection Techniques and Instruments**

The study used primary data collected from the study respondents. A structured questionnaire comprising closed-ended questions was used as the study instrument. The questionnaire was prepared and administered online using Google Forms. The link to the survey was distributed to the study population through social media platforms and email distribution lists, with a target of at least 400 respondents for each country. The sample respondents were invited to answer and submit their responses electronically. The data collection lasted for four months from 01 July 2024 and 31 October 2024.

The questionnaire was first drafted in English; then translated into Polish for data collection in Poland and Thai for data collection in Thailand to ensure better comprehension by participants. The reliability of the acquired data was assessed by testing its internal consistency using Cronbach's alpha. This test is employed when the study questionnaire consists of Likert-type items. The questionnaire was structured as follows:

**Part I:** Demographic data collected the personal data of the respondents, such as gender, age, educational level, employment status, work experience, industry, years of SME operation, annual revenue of the SME, and number of employees.

**Part II:** The latent variable questions comprised questions assessing latent and observed variables. The latent variables questions included Green Regulations Management, Green Technical Capabilities, Green Economic Resources, Green Human Resources Management, Green Standards Compliance, and Adoption of Green Innovation Management. The

translated questionnaire was proofread and certified by local native language speakers of Polish and Thai to ensure consistency with the research objectives.

The questions in the latent variables were developed from previous literature, with adjustments done to fit this study. Table 3.1 summarizes the latent variables, observed variables, the items/questions used, and the sources used in their development.

Table 3.1: Study Constructs Observed Variables and Items

| Construct                           | Observed Variable and Items                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | References                                                                                   |
|-------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| <b>Green Regulations Management</b> | Regulatory pressure <ul style="list-style-type: none"> <li>- Regulatory agencies are supportive of green innovation implementation.</li> <li>- Regulatory agencies regularly conduct inspections to ensure compliance with rules.</li> <li>- Regulatory agencies enforce green innovation guidelines through incentives and penalties.</li> </ul>                                                                                                                                                                                                                                                                                   | Huang and Lei (2021); Horbach et al. (2012); Zubeltzu-Jaka et al. (2018); Wang et al. (2021) |
|                                     | Government support <ul style="list-style-type: none"> <li>- Tax/subsidy incentives for renewable energy investments have significantly lowered our financial barriers to introduce renewable solutions e.g. installing solar panels on industrial roofs, LNG, etc.</li> <li>- We are aware of and actively engage with government programs or initiatives designed to promote green regulations within our industry, like the Industry 4.0 or Green Investment Scheme.</li> <li>- Green regulations influence our strategic decisions, prompting us to invest in resource efficiency and create new green product lines.</li> </ul> |                                                                                              |

|                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                             |
|-------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|
|                                     | <p>Environmental uncertainty</p> <ul style="list-style-type: none"> <li>- Green policies and regulations have accelerated the progress and adoption of green technologies like water recycling.</li> <li>- Policies supporting green innovation regulation subsidies has assisted SMEs in acquiring necessary resources to compete with larger enterprises.</li> <li>- We have developed new eco-friendly products and services due to the government's focus on green technology, encouraging its adoption.</li> </ul>                               |                                                                                                             |
| <b>Green Technical Capabilities</b> | <p>Complexity of technology</p> <ul style="list-style-type: none"> <li>- The advancement of green technology necessitates the development of new skills in innovation management due to its complexity.</li> <li>- Our organization created a user-friendly green innovation knowledge base for employees to access materials and best practices.</li> <li>- We have employed successful strategies to manage/overcome technological complexity challenges in adopting and integrating green technologies within our technical capability.</li> </ul> | <p>Rao and Holt (2005); Fahad et al. (2022); Shen et al. (2018); Bhatia, (2021); Barbieri et al. (2023)</p> |
|                                     | <p>Compatibility of technology</p> <ul style="list-style-type: none"> <li>- Our company successfully ensured compatibility of green initiatives with our environmental responsibility and operational excellence values.</li> <li>- We have reduced energy usage and exceeded our environmental performance targets by adopting renewable energy sources.</li> <li>- We have measures in place to continuously improve our technical capability in managing</li> </ul>                                                                                |                                                                                                             |

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                         |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
|                                 | and optimizing the compatibility of green technologies.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                         |
|                                 | <p>Green relative advantage</p> <ul style="list-style-type: none"> <li>- Implementing green innovation management has improved our corporate image.</li> <li>- Implementing green innovation management leads to better economic benefits.</li> <li>- Transparency about our green activities and measurable environmental progress have improved our brand, credibility, and customer loyalty.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                         |
| <b>Green Economic Resources</b> | <p>Access to funding/loans</p> <ul style="list-style-type: none"> <li>- Government funding is available to implement green innovation.</li> <li>- Our company dedicates specific funds to green innovation.</li> </ul> <p>Availability of Skilled Labor/Expertise</p> <ul style="list-style-type: none"> <li>- Our company partnered with the local university to train employees on green innovation best practices.</li> <li>- Our company is able to attract highly skilled employees who specialize in green innovation management.</li> </ul> <p>Availability of Natural Resources</p> <ul style="list-style-type: none"> <li>- We optimize resource management by partnering with local green suppliers to minimize negative environmental impacts such as pollution.</li> <li>- We have invested in resource-saving technologies like waste recycling, biomass, etc.</li> </ul> | <p>Liu and Chen (2022); Ma et al. (2023); Doran and Ryan (2012); Lee and He (2022).</p> |

|                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                           |
|-----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|
|                                         | <b>Profitability</b> <ul style="list-style-type: none"> <li>- Balancing profitability with the integration of green economic resources is a key priority for our company's development strategy.</li> <li>- We are implementing green innovation management because it is profitable.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                           |
| <b>Green Human Resources Management</b> | <b>Productivity and Cooperation</b> <ul style="list-style-type: none"> <li>- We encourage employees to suggest and implement green initiatives through company-wide competitions and idea boards.</li> <li>- Our performance reviews include green metrics and traditional performance indicators, such as energy consumption reduction and waste minimization.</li> <li>- There is a high level of cooperation and collaboration among employees in implementing green practices to improve productivity.</li> </ul> <b>Product/Service Quality and Management Support</b> <ul style="list-style-type: none"> <li>- We offer dedicated training programs on green innovation concepts, like life cycle assessment, eco-design, etc., for all employees.</li> <li>- We provide resources and support to ensure the proper implementation of green practices to enhance product/service quality.</li> <li>- We recognize and reward employees for their contributions to improving green innovation product/service quality.</li> </ul> | Song et al. (2021); Sobaih et al. (2020); Munawar et al. (2022); Masri and Jaaron (2017). |
| <b>Green Standards Compliance</b>       | <b>Organizational procedures</b> <ul style="list-style-type: none"> <li>- We have implemented planning and control measures with regard to green standards in our practices.</li> <li>- We have put in place organizational procedures to integrate green standards and</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Hu et al. (2023); Brogi and Menichini (2019); Borsatto and Amui (2019);                   |

|                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                     |
|-------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
|                                                       | <p>compliance requirements into our daily operations.</p> <ul style="list-style-type: none"> <li>- Implementing green standard compliant organizational procedures such as (ISO 14001) has facilitated improvements in our resource efficiency and waste management practices.</li> </ul> <p>Performance evaluation</p> <ul style="list-style-type: none"> <li>- Our real-time environmental information is linked to green standards compliance metrics and track energy consumption, waste generation, and resource utilization.</li> <li>- Our performance tracking system encompasses not only green product lifecycle but also employee green engagement, and skills development.</li> <li>- We conduct periodic analyses and evaluations to measure green innovation compliance with green standards.</li> </ul> | <p>Potoski and Prakash (2005); Toha et al. (2020)</p>                                                                               |
| <p><b>Adoption of Green Innovation Management</b></p> | <p>Product Innovation</p> <ul style="list-style-type: none"> <li>- We prioritize the development of environmentally friendly products/services as part of our business strategy.</li> <li>- We regularly integrate eco-friendly materials into our product/service innovation efforts.</li> <li>- We launch innovative green products/services using eco-labelling to demonstrate our commitment to green product design and marketing.</li> </ul> <p>Process Innovation</p> <ul style="list-style-type: none"> <li>- We actively seek to optimize production processes to minimize environmental impact as part of our innovation strategy.</li> <li>- We have implemented green practices and technologies to reduce energy consumption</li> </ul>                                                                   | <p>Jun et al. (2021); Shahzad et al. (2022); Yin et al. (2022); Nunes and Bennett (2008); Luan et al. (2023); Bai et al. (2024)</p> |

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |
|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|  | <p>and waste generation in our operational processes.</p> <ul style="list-style-type: none"> <li>- We have successfully implemented eco-friendly practices and technologies to reduce our carbon footprint and environmental impact across operational processes.</li> </ul> <p><b>Administrative Innovation</b></p> <ul style="list-style-type: none"> <li>- We implemented a remote work policy and virtual collaboration tools to reduce our carbon footprint from commuting and travel.</li> <li>- Implementing administrative innovations like printing only essential communication and signing digital documents instead of paper to enhance environmental protection.</li> <li>- Our managers and supervisors are trained on green leadership principles and encouraged to incorporate green concepts in their decision-making processes.</li> </ul> |  |
|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|

Source: author's elaboration

The data was collected via online Google Forms, and constructed using the 5-point Likert Scale. These questions were formulated based on the existing literature and input from other scholars. The Likert scale consisted of a 5-point scale comprising the following components:

‘5’ – strongly agree; ‘4’ – agree; ‘3’ – neutral; ‘2’ – disagree; ‘1’ – strongly disagree

Data collected was the basis for conducting the empirical analysis using appropriate techniques to answer the developed hypotheses and address the research objectives. The questionnaire used for data collection adhered to the prescribed framework. A panel of six experts were engaged to assess the questionnaire's validity, reliability, and item-objective congruence (IOC). The IOC assisted in assessing the alignment between the questions in the questionnaire and their capacity to meet the study objectives and questions. The expected level of acceptance is between -1 and +1.0. In this case:

Congruent = +1, Questionable = 0; Incongruent = -1

However, if the answer is lower than 0.5, the questions must be improved to fit the study objectives and research questions (Turner and Carlson, 2003). Those with a higher score than 0.5 were reserved. In this case, just a few were observed to be below the recommended level. The questionnaire was evaluated by professors and experts with extensive business management knowledge. Six experts were utilized, with three each from Poland and Thailand. The research questionnaire is presented in Appendix A while the IOC measuring the reliability and validity of the research instrument is presented in Appendix B.

Upon evaluation of the reviewers' rating (IOC index), only two items/questions were below 0.5. These were item 3 and item 8 in the 'green regulation management.' For Item 3, the previous question, "Regulatory agencies enforce green innovation guidelines and punish defaulters," was improved to "Regulatory agencies enforce green innovation guidelines through incentives and penalties." For item number 3, it was improved from "Green innovation regulations subsidies have levelled the playing field for SMEs, helping us compete with larger enterprises" to "Policies supporting green innovation regulations subsidies has assisted SMEs in acquiring necessary resources to compete with large enterprises."

### **3.5. Reliability, Validity and Model Fitness Evaluation**

#### ***Reliability Analysis***

Two techniques were adopted to test the reliability of the study constructs: Cronbach's Alpha and the Composite Reliability. The Cronbach's alpha coefficient was computed to evaluate the entirety of the questionnaire. An acceptable level of Cronbach's alpha was defined as being greater than 0.7 (Gliem and Gliem, 2003). The Cronbach's alpha was evaluated based on the following criteria in Table 3.2.

Table 3.2: Cronbach's Alpha Criteria

| <b>Cronbach's Alpha</b> | <b>External Consistency</b> |
|-------------------------|-----------------------------|
| $\alpha \geq 0.9$       | Excellent                   |
| $0.9 > \alpha \geq 0.8$ | Good                        |
| $0.8 > \alpha \geq 0.7$ | Acceptable                  |
| $0.7 > \alpha \geq 0.6$ | Questionable                |
| $0.6 > \alpha \geq 0.5$ | Poor                        |
| $0.5 > \alpha$          | Unacceptable                |

Source: Gliem and Gliem (2003).

A Cronbach's alpha coefficient above 0.70 would be deemed appropriate and acceptable in the interpretation of results. Nevertheless, if the value falls below 0.7, it becomes imperative to reassess the items in the questionnaire.

The initial tests of reliability analysis using Cronbach's alpha was conducted on first 30 questionnaire responses. These first responses were considered as a pilot study. The analysis was conducted to ensure that the reliability of the data to be collected was satisfactory. The results of the analysis showed that the Cronbach's alpha for both Poland and Thailand met the required threshold of  $>0.70$ . As such, the questionnaire was considered appropriate to correct research data that meets the required reliability.

Table 3.3: Cronbach's alpha Reliability Analysis of first 30 responses

| <b>Latent Variables</b>          | <b>Poland Cronbach's Alpha</b> | <b>Thailand Cronbach's Alpha</b> |
|----------------------------------|--------------------------------|----------------------------------|
| Green Economic Resources         | 0.771                          | 0.951                            |
| Green Regulations Management     | 0.702                          | 0.932                            |
| Green Human Resources Management | 0.776                          | 0.895                            |
| Green Technical Capabilities     | 0.795                          | 0.920                            |
| Green Standards Compliance       | 0.870                          | 0.856                            |
| Green Innovation Management      | 0.818                          | 0.861                            |

Source: author's elaboration

Composite Reliability (CR) technique was also adopted to measure the reliability of the study constructs. CR was obtained by conducting the Confirmatory Factor Analysis (CFA) to test the pre-defined factor structure. The required threshold for CR is  $>0.7$ , with  $>0.8$  considered good and  $>0.9$  considered excellent reliability (Alarcón et al., 2015).

### ***Validity Analysis***

Two techniques were adopted to measure the validity of the study constructs: standardized factor loadings and average variance extraction (AVE). Their test statistics were obtained by conducting the Confirmatory Factor Analysis (CFA).

For the standardized factor loadings, they were used to measure the convergent validity. This indicates how well the individual items (measures) in the scale capture the intended latent construct. Higher values (closer to 1) indicate a stronger relationship between the item and the construct. The adopted threshold is that, generally, loadings above 0.5 are considered acceptable, while values above 0.7 are preferred (Purwanto, 2021).

For the AVE, it was also used to measure convergent validity and discriminant validity. The convergent validity shows how much variance in the items is explained by the construct they are intended to measure, while the discriminant validity assesses if the construct is distinct from other constructs in the model. A higher AVE indicates a greater proportion of variance in the items explained by the construct compared to measurement error. The threshold is that AVE values above 0.5 are considered acceptable, indicating the construct explains more than half of the variance in its measures. Discriminant validity is supported if the square root of each construct's AVE is greater than the highest correlation between that construct and any other construct in the model (Fornell-Larcker criterion) (Rosli et al., 2021).

### ***Model Fitness Evaluation***

The Confirmatory Factor Analysis (CFA) was used to evaluate the model's fitness. It assessed the adequacy and precision of the scale's model, specifically regarding the interplay between the latent and observable variables. The statistical analysis includes the covariance analysis on the variance analysis of all the variables used in the overall study, which conforms to the Structural Equation Model (SEM) to check its accuracy and completeness. Covariance analysis was utilized to examine how well the observed variables (indicators) represent the latent factors. The details of the fit indices used are presented in Table 3.3.

Table 3.4: Congruence Evaluation Table between the Conceptual Framework and Empirical Data

| Statistics                        | Symbol   | Objectives                                                                      | Threshold required |
|-----------------------------------|----------|---------------------------------------------------------------------------------|--------------------|
| Chi-squares                       | $X^2$    | To test the congruence of empirical data and conceptual framework               | Ns. ( $p > 0.05$ ) |
| Relative Chi-square               | $X^2/df$ | To test the congruence of empirical data and conceptual framework               | $X^2/df < 2.00$    |
| Goodness of Fit Index             | GFI      | To measure GFI, between 0-1.00                                                  | $> 0.90$           |
| Comparative Fit Index             | CFI      | To compare the fit of a target model to the fit of an independent or null model | $> 0.90$           |
| Normed Fit Index                  | NFI      | Measures NFI between 0 and 1                                                    | $> 0.90$           |
| Tucker Lewis index                | TLI      | To measure TLI, between 0-1.00                                                  | $> 0.90$           |
| Root mean square of approximation | RMSEA    | To show conceptual framework errors in for of RMSEA between 0-100               | $< 0.05$           |

Source: Wheaton et al. (1977)

### 3.6. Data Analysis

In this section, the empirical analysis of the study hypotheses was conducted. However, several preliminary analyses were conducted before the actual analysis of the hypotheses was conducted. First was the descriptive statistics, aimed at evaluating the demographic characteristics of the respondents. The second was the correlation analysis to evaluate the relationship between the study constructs. Third was the reliability, validity, and model fitness tests discussed in the previous section.

For hypotheses testing, the study utilized Structural Equation Modeling (SEM) to assess the primary goals, which aim to examine the drivers that influence SMEs' adoption of green innovation management in the emerging economies of Poland and Thailand. SEM is a statistical method used to analyse and demonstrate the causal links between variables in a research project. The analysis often relies on the examination of the study hypotheses. Three major analyses were conducted in SEM using Amos version 26:

- I. The first analysis included evaluating the latent variables, which are the effects of independent variables on the dependent variables, in accordance with the stated hypotheses. This analysis was performed for both Poland and Thailand.
- II. The second analysis evaluated the effects of the moderating variable (green standard compliance) on the relationship between the latent independent variables and the latent dependent variable(s). This was conducted independently for both Poland and Thailand datasets.
- III. The third objective was a multi-group SEM analysis, which compared the statistics of the two countries (Poland and Thailand). Multi-group analysis evaluated whether there was a difference between Poland and Thailand in terms of the relationship between the independent variables of the study.

### **3.7. Ethical Considerations**

Ethical considerations played a major part during the entire duration of this study. Before data collection, the researcher obtained the necessary permissions from the appropriate institutions. The researcher additionally guaranteed that the acquired data was exclusively utilized for the specific research objectives outlined in this study. The personal information obtained from the respondents was treated with utmost confidentiality and was never disclosed to any third party. The information gathered from the participants was securely preserved to uphold their respect for privacy and confidentiality. In addition, the Institutional Review Board (IRB) approval was exempted because the study was conducted online with anonymous study respondents.

This chapter provided insight into the methods employed in doing the research for the study. The study adopted a quantitative research method. The study employed primary data acquired using a questionnaire from a representative sample for quantitative research purposes. The basic data was further evaluated utilizing statistical approaches. The analysis conducted included descriptive statistics for demographic and responses, correlation analysis, reliability and validity tests using CFA, and Structural Equation Modelling (SEM). Multi-group SEM analysis was also used to compare the results between Poland and Thailand. The results formed the basis of discussions and implications of the study.

## **CHAPTER 4. EMPIRICAL ANALYSIS AND KEY INSIGHTS INTO GREEN INNOVATION DRIVERS IN SMES IN POLAND AND THAILAND**

### **4.1. Review of Research Questions**

The chapter aims to present and analyse the findings on the drivers of green innovation management in SMEs in Poland and Thailand. The study was developed following several sub-sections. The study is divided into two major sections (1) Presentation of Findings for Poland SMEs adoption of green innovation management and (2) Presentation of Findings for Thailand SMEs adoption of green innovation management. For each of these sections, there following subsections were utilized demographic statistics analysis, respondents' opinion descriptives, normality, and correlation analysis, model fitness analysis (confirmatory factor analysis (CFA), hypotheses evaluation (structural equation modelling (SEM), and multigroup analysis.

The study aimed at a minimum sample size of 400 respondents in each country. To ensure satisfactory data collection, the link to the survey was distributed to the study population through social media platforms and email distribution lists targeting 800 invitations for each country, with consideration to the respondents reluctance to participate in surveys due to factors such as time and nonavailability (Bais et al., 2020; Minderop and Weiß, 2023; Ochoa and Revilla, 2023; Smith et al., 2019). Data was collected in a period of four months. The actual data collected was 462 responses from Poland and 445 from Thailand. After the data was cleaned, the study remained with 428 responses for Poland yielding 53.50% response rate, and 413 responses for Thailand with a response rate of 51.625%.

The main objective of this research was to investigate and determine the drivers that influence green innovation management in small and medium enterprises (SMEs) in Poland and Thailand. It was addressed by the following specific objectives:

**RO1:** To conduct a comparative analysis of SMEs green innovation management practices in Poland and Thailand business environments.

**RO2:** To discover the drivers influencing SMEs' adoption of Green Innovation management in Poland and Thailand.

**RO3:** To determine the influence of green standards compliance on the drivers of SMEs' adoption of green innovation management.

**RO4:** To develop actionable policy recommendations to enhance SMEs' adoption of Green Innovation management in their business operations and strategies.

## 4.2. Results of Green Innovation Management for SMEs Respondents in Poland

### *Demographic Statistics Analysis for Polish SMEs Respondents*

This section presents the descriptive statistics findings for the respondents' demographics for SMEs in Poland. The results are presented and summarized in Table 4.1, followed by discussions.

Table 4.4: Demographic Statistics for Polish SMEs Respondents

| Demographic Characteristics |                                    | Frequency (n) | Percent (%) |
|-----------------------------|------------------------------------|---------------|-------------|
| Gender                      | Male                               | 258           | 60.3        |
|                             | Female                             | 170           | 39.7        |
|                             | Others                             | 0             | 0.0         |
| Age                         | 18-27 years (Gen Z)                | 306           | 71.5        |
|                             | 28-43 years (Gen Y or Millennials) | 73            | 17.1        |
|                             | 44-59 years (Gen X)                | 44            | 10.3        |
|                             | 60-78 years (Baby Boomers)         | 5             | 1.2         |
|                             | 79-99 years (Silent Gen)           | 0             | 0.0         |
| Highest Educational Level   | Primary School                     | 27            | 6.3         |
|                             | Secondary School                   | 51            | 11.9        |
|                             | Undergraduate degree               | 224           | 52.3        |
|                             | Postgraduate degree                | 126           | 29.4        |
| No of Employees             | 10-49                              | 269           | 62.9        |
|                             | 50-249                             | 159           | 37.1        |
| Industry of Operation       | Agriculture                        | 24            | 5.6         |
|                             | Construction                       | 42            | 9.8         |
|                             | Energy                             | 34            | 7.9         |
|                             | Food Processing                    | 28            | 6.5         |
|                             | Health                             | 14            | 3.3         |
|                             | Manufacturing                      | 88            | 20.6        |
|                             | Retail and Services                | 46            | 10.7        |

|                   |                      |     |      |
|-------------------|----------------------|-----|------|
|                   | Tourism              | 12  | 2.8  |
|                   | Transportation       | 62  | 14.5 |
|                   | Others               | 78  | 18.2 |
| Employment Status | SME Owner            | 76  | 17.8 |
|                   | SME Management Staff | 259 | 60.5 |
|                   | SME Employee         | 27  | 6.3  |
|                   | Other Positions      | 66  | 15.4 |
| Work Experience   | 0-4 years            | 236 | 55.1 |
|                   | 5-10 years           | 133 | 31.1 |
|                   | 11-15 years          | 33  | 7.7  |
|                   | 16-20 years          | 15  | 3.5  |
|                   | >20 years            | 11  | 2.6  |

Source: Author's own calculations

The results regarding gender indicated that males comprised the majority, 60.3% of the respondents, while females comprised the least, 39.7%. Considering the age of the respondents, Gen Z (18 – 27 years) was the majority, comprising 71.5%, followed by Generation Y and Millennials (28 – 43 years), comprising 17.1%, and then Gen X (10.3%) and lastly Baby boomers (1.2%). The level of education was evaluated by indicating the respondents' highest level of education. Most respondents were those with undergraduate degrees (52.3%), those with postgraduate degrees (29.4%), and those with secondary school education comprising 11.9%. The study also evaluated the number of employees in the SME firms, where the majority were those with 10-49 employees (62.9%) while those with 50 – 249 employees were 37.1%. The industry of operation of employees was also evaluated, where the manufacturing industry was the most common, comprising 20.6%, followed by the others not included (18.2%), the transport sector (14.5%), and then the retail and services sector (10.7%). The sector with the least was tourism (2.8%). The employee's status was also evaluated, where the majority were found to be SME Management Staff (60.5%) then those who identified as SME Owners (17.8%), and those in other forms of positions (15.4%). The work experience of the respondents was also evaluated, where the majority of respondents were those with 0-4 years of experience (55.1%) and then those with 5-10 years of experience (31.1%). Those with over 20 years of experience were the least (2.6%).

### ***SMEs Respondents' Opinion Descriptives for Poland***

In this section, the Poland SMEs respondents' views regarding the study questions, observed, and latent variables of the study were analyzed and reported. Six latent variables were evaluated in this study: Green Technical Capabilities, Green Regulations, Green Economic Resources, Adoption of Green Innovation Management, Green Human Resources Management, and Green Standards Compliance. The results of each of these are discussed in the following section.

#### ***Green Regulations Management for Polish SMEs Respondents***

The study responses were collected using a structured questionnaire drafted using 5-Point Likert scale as follows: 1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree and 5 = strongly agree. The results are presented in Table 4.2.

| Variables                                                                                                                                                                                              | Opinion Levels |     |      |      |      | Mean       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|-----|------|------|------|------------|
|                                                                                                                                                                                                        |                | 1   | 2    | 3    | 4    | 5          |
| <b>Regulatory Pressure</b>                                                                                                                                                                             |                |     |      |      |      | <b>3.6</b> |
| Regulatory agencies are supportive of green innovation implementation.                                                                                                                                 | n              | 24  | 43   | 126  | 132  | 103        |
|                                                                                                                                                                                                        | %              | 5.6 | 10   | 29.4 | 30.8 | 24.1       |
| Regulatory bodies regularly conduct inspections to ensure compliance with rules.                                                                                                                       | n              | 18  | 44   | 124  | 128  | 114        |
|                                                                                                                                                                                                        | %              | 4.2 | 10.3 | 29   | 29.9 | 26.6       |
| Regulatory agencies enforce green innovation guidelines through incentives and penalties                                                                                                               | n              | 19  | 48   | 149  | 116  | 96         |
|                                                                                                                                                                                                        | %              | 4.4 | 11.2 | 34.8 | 27.1 | 22.4       |
| <b>Government Support</b>                                                                                                                                                                              |                |     |      |      |      | <b>3.7</b> |
| Tax/subsidy incentives for renewable energy investments have significantly lowered our financial barriers to introduce renewable solutions e.g. installing solar panels on industrial roofs, LNG, etc. | n              | 15  | 30   | 127  | 154  | 102        |
|                                                                                                                                                                                                        | %              | 3.5 | 7    | 29.7 | 36   | 23.8       |
| We are aware of and actively engage with government programs or initiatives designed to promote green regulations within our industry, like the Industry 4.0 or Green Investment Scheme.               | n              | 14  | 39   | 123  | 135  | 117        |
|                                                                                                                                                                                                        | %              | 3.3 | 9.1  | 28.7 | 31.5 | 27.3       |
| Green regulations influence our strategic decisions, prompting us to invest in resource efficiency and create new green product lines.                                                                 | n              | 7   | 58   | 121  | 148  | 94         |
|                                                                                                                                                                                                        | %              | 1.6 | 13.6 | 28.3 | 34.6 | 22         |

|                                                                                                                                                   |   |     |     |      |      |      |            |
|---------------------------------------------------------------------------------------------------------------------------------------------------|---|-----|-----|------|------|------|------------|
| <b>Environmental Uncertainty</b>                                                                                                                  |   |     |     |      |      |      | <b>3.7</b> |
| Green policies and regulations have accelerated the progress and adoption of green technologies like water recycling systems.                     | n | 18  | 42  | 118  | 148  | 102  | 3.6        |
|                                                                                                                                                   | % | 4.2 | 9.8 | 27.6 | 34.6 | 23.8 |            |
| Policies supporting green innovation regulation subsidies has assisted SMEs in acquiring necessary resources to complete with larger enterprises. | n | 18  | 37  | 125  | 133  | 115  | 3.7        |
|                                                                                                                                                   | % | 4.2 | 8.6 | 29.2 | 31.1 | 26.9 |            |
| We have developed new eco-friendly products and services due to the government's focus on green technology, encouraging its adoption              | n | 11  | 41  | 130  | 140  | 106  | 3.7        |
|                                                                                                                                                   | % | 2.6 | 9.6 | 30.4 | 32.7 | 24.8 |            |

Source: author's own calculations

The latent variable of *Green Regulations Management* for Poland SMEs respondents was evaluated and illustrated in Table 4.2 using three observed variables of Regulatory pressure, Government support, and Environmental uncertainty. The mean responses for Regulatory pressure were 3.6 (Agree), with the highest item being “Regulatory agencies are supportive of green innovation implementation” (mean = 3.6). The average for Government support was 3.7 (Agree), with the highest item being “Tax/subsidy incentives for renewable energy investments have significantly lowered our financial barriers to installing solar panels on industrial roofs, LNG, and other renewable solutions.” (mean = 3.7). The average for the availability of Environmental uncertainty was 3.7 (Agree), with the highest item being “Policies supporting green innovation regulation subsidies has assisted SMEs in acquiring necessary resources to complete with larger enterprises” (mean = 3.7).

### ***Green Technical Compatibility for Polish SMEs Respondents***

The study responses were collected using a structured questionnaire drafted using 5-Point Likert scale: 1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree and 5 = strongly agree. The results are presented in Table 4.3.

Table 4.3: Green Technical Capabilities for Polish SMEs Respondents

| Variables                                                                                                                                                                     | Opinion Levels |     |      |      |      | Mean       |            |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|-----|------|------|------|------------|------------|
|                                                                                                                                                                               | 1              | 2   | 3    | 4    | 5    |            |            |
| <b>Complexity of Technology</b>                                                                                                                                               |                |     |      |      |      | <b>3.5</b> |            |
| The advancement of green technology necessitates the development of new skills in innovation management due to its complexity.                                                | n              | 19  | 48   | 123  | 136  | 102        | 3.6        |
|                                                                                                                                                                               | %              | 4.4 | 11.2 | 28.7 | 31.8 | 23.8       |            |
| Our organization created a user-friendly green innovation knowledge base for employees to access materials and best practices.                                                | n              | 27  | 48   | 113  | 122  | 118        | 3.6        |
|                                                                                                                                                                               | %              | 6.3 | 11.2 | 26.4 | 28.5 | 27.6       |            |
| We have employed successful strategies to manage/overcome technological complexity challenges in adoption and integrating green technologies within our technical capability. | n              | 28  | 58   | 129  | 126  | 87         | 3.4        |
|                                                                                                                                                                               | %              | 6.5 | 13.6 | 30.1 | 29.4 | 20.3       |            |
| <b>Compatibility of Technology</b>                                                                                                                                            |                |     |      |      |      |            | <b>3.4</b> |
| Our company successfully ensured the compatibility of green initiatives with our environmental responsibility and operational excellence values.                              | n              | 23  | 64   | 137  | 133  | 71         | 3.4        |
|                                                                                                                                                                               | %              | 5.4 | 15   | 32   | 31.1 | 16.6       |            |
| We have reduced energy usage and exceeded our environmental performance targets by adopting renewable energy sources.                                                         | n              | 25  | 57   | 135  | 124  | 87         | 3.4        |
|                                                                                                                                                                               | %              | 5.8 | 13.3 | 31.5 | 29   | 20.3       |            |
| We have measures in place to continuously improve our technical capability in managing and optimizing the compatibility of green technologies.                                | n              | 24  | 57   | 130  | 130  | 87         | 3.5        |
|                                                                                                                                                                               | %              | 5.6 | 13.3 | 30.4 | 30.4 | 20.3       |            |
| <b>Green Relative Advantage</b>                                                                                                                                               |                |     |      |      |      |            | <b>3.6</b> |
| Implementing green innovation management has improved our corporate image.                                                                                                    | n              | 22  | 41   | 155  | 120  | 90         | 3.5        |
|                                                                                                                                                                               | %              | 5.1 | 9.6  | 36.2 | 28   | 21         |            |
| Implementing green innovation management leads to better economic benefits                                                                                                    | n              | 19  | 39   | 124  | 135  | 111        | 3.7        |
|                                                                                                                                                                               | %              | 4.4 | 9.1  | 29   | 31.5 | 25.9       |            |
| Transparency about our green activities and measurable environmental progress has improved our brand, credibility, and customer loyalty                                       | n              | 15  | 41   | 116  | 152  | 104        | 3.7        |
|                                                                                                                                                                               | %              | 3.5 | 9.6  | 27.1 | 35.5 | 24.3       |            |

Source: author's own calculations

The latent variable of *Green Technical Compatibility* was evaluated and illustrated in Table 4.3 using three observed variables – Complexity of technology,

Compatibility of technology, and Green relative advantage. The mean responses for Complexity of technology were 3.5 (Agree), with the highest items being “Our organization created a user-friendly green innovation knowledge base for employees to access materials and best practices”; “The advancement of green technology necessitates the development of new skills in innovation management due to its complexity” (mean = 3.6). The average for Compatibility of technology was 3.4 (Agree), with the highest item being “We have measures in place to continuously improve our technical capability in managing and optimizing the compatibility of green technologies.” (mean = 3.5). The average for Green relative advantage was 3.6 (Agree), with the highest items being “Implementing green innovation management leads to better economic benefits”; “Transparency about our green activities and measurable environmental progress has improved our brand, credibility, and customer loyalty” (mean = 3.7).

#### ***Green Economic Resources for Polish SMEs Respondents***

The study responses were collected using a structured questionnaire drafted using 5-Point Likert scale: 1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree and 5 = strongly agree. The results are presented in Table 4.4.

Table 4.4: Green Economic Resources for Polish SMEs Respondents

| Variables                                                                                                                              | Opinion Levels |      |      |      |      | Mean       |
|----------------------------------------------------------------------------------------------------------------------------------------|----------------|------|------|------|------|------------|
|                                                                                                                                        | 1              | 2    | 3    | 4    | 5    |            |
| <b>Access to Funding/Loans</b>                                                                                                         |                |      |      |      |      | <b>3.6</b> |
| Government funding is available to implement green innovation.                                                                         | n 18           | 44   | 138  | 130  | 98   | 3.6        |
|                                                                                                                                        | % 4.2          | 10.3 | 32.2 | 30.4 | 22.9 |            |
| Our company dedicates specific funds to green innovation.                                                                              | n 21           | 42   | 111  | 133  | 121  | 3.7        |
|                                                                                                                                        | % 4.9          | 9.8  | 25.9 | 31.1 | 28.3 |            |
| <b>Availability of Skilled Labor/Expertise</b>                                                                                         |                |      |      |      |      | <b>3.6</b> |
| Our company partnered with a local university to train employees on green innovation best practices.                                   | n 19           | 49   | 121  | 117  | 122  | 3.6        |
|                                                                                                                                        | % 4.4          | 11.4 | 28.3 | 27.3 | 28.5 |            |
| Our company is able to attract highly skilled employees who specialize in green innovation management.                                 | n 27           | 50   | 132  | 109  | 110  | 3.5        |
|                                                                                                                                        | % 6.3          | 11.7 | 30.8 | 25.5 | 25.7 |            |
| <b>Availability of Natural Resources</b>                                                                                               |                |      |      |      |      | <b>3.6</b> |
| We optimize resource management by partnering with local green suppliers to minimize negative environmental impacts such as pollution. | n 18           | 46   | 128  | 128  | 108  | 3.6        |
|                                                                                                                                        | % 4.2          | 10.7 | 29.9 | 29.9 | 25.2 |            |
|                                                                                                                                        | n 20           | 36   | 114  | 150  | 108  | 3.7        |

|                                                                                                                             |   |     |      |      |      |      |            |
|-----------------------------------------------------------------------------------------------------------------------------|---|-----|------|------|------|------|------------|
| We have invested in resource-saving technologies like waste recycling, biomass, etc.                                        | % | 4.7 | 8.4  | 26.6 | 35   | 25.2 |            |
| <b>Profitability</b>                                                                                                        |   |     |      |      |      |      | <b>3.4</b> |
| Balancing profitability with integrating green economic resources is a key priority for our company's development strategy. | n | 40  | 63   | 144  | 94   | 87   |            |
|                                                                                                                             | % | 9.3 | 14.7 | 33.6 | 22   | 20.3 | 3.3        |
| We are implementing green innovation management because it is profitable                                                    | n | 21  | 49   | 130  | 131  | 97   |            |
|                                                                                                                             | % | 4.9 | 11.4 | 30.4 | 30.6 | 22.7 | 3.5        |

Source: author's own calculations

The latent variable of *Green Economic Resources* was evaluated and illustrated in Table 4.4 using three observed variables of access to funding/loans, availability of skilled labour/expertise, availability of natural resources, and profitability. The mean response for access to funding was 3.6 (Agree), with the highest item being “Our company dedicates specific funds for green innovation” (mean = 3.7). The average for the availability of skilled labour/expertise was 3.6 (Agree), with the highest item being “Our company partnered with a local university to train our employees on green innovation best practices” (mean = 3.6). The average for the availability of natural resources was 3.6 (Agree), with the highest item being “We have invested in resource-saving technologies like waste recycling, biomass, etc.” (mean = 3.7). The average for profitability was 3.4 (Agree), with the highest item being “We are implementing green innovation management because it is profitable” (mean = 3.5).

### ***Green Human Resource Management for Polish SMEs Respondents***

The study responses were collected using a structured questionnaire drafted using 5-Point Likert scale as follows: 1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree and 5 = strongly agree. The results are presented in Table 4.5.

Table 4.5: Green Human Resources Management for Polish SMEs Respondents

| Variables                                                                                                            | Opinion Levels |     |      |      |      | Mean |     |
|----------------------------------------------------------------------------------------------------------------------|----------------|-----|------|------|------|------|-----|
|                                                                                                                      | 1              | 2   | 3    | 4    | 5    |      |     |
| Productivity and Cooperation                                                                                         |                |     |      |      |      | 3.5  |     |
| We encourage employees to suggest and implement green initiatives through company-wide competitions and idea boards. | n              | 20  | 61   | 143  | 122  | 82   | 3.4 |
|                                                                                                                      | %              | 4.7 | 14.3 | 33.4 | 28.5 | 19.2 |     |
| Our performance reviews include green metrics and traditional performance                                            | n              | 17  | 38   | 155  | 121  | 97   | 3.6 |
|                                                                                                                      | %              | 4   | 8.9  | 36.2 | 28.3 | 22.7 |     |

indicators, such as energy consumption reduction and waste minimization.

There is a high level of cooperation and collaboration among employees in implementing green practices to improve productivity.

|                                                                                                                                     |   |     |      |      |      |      |            |
|-------------------------------------------------------------------------------------------------------------------------------------|---|-----|------|------|------|------|------------|
| <b>Product/Service Quality and Management Support</b>                                                                               |   |     |      |      |      |      | <b>3.5</b> |
| We offer dedicated training programs on green innovation concepts, like life cycle assessment, eco-design, etc., for all employees. | n | 20  | 52   | 132  | 132  | 92   | 3.5        |
|                                                                                                                                     | % | 4.7 | 12.1 | 30.8 | 30.8 | 21.5 |            |
| We provide resources and support to ensure the proper implementation of green practices to enhance product/service quality.         | n | 24  | 54   | 137  | 138  | 75   | 3.4        |
|                                                                                                                                     | % | 5.6 | 12.6 | 32   | 32.2 | 17.5 |            |
| We recognize and reward employees for their contributions to improving green innovation product/service quality                     | n | 20  | 49   | 141  | 134  | 84   | 3.5        |
|                                                                                                                                     | % | 4.7 | 11.4 | 32.9 | 31.3 | 19.6 |            |

Source: author's own calculations

The latent variable of *Green Human Resource Management* was evaluated and illustrated in Table 4.5 using three observed variables – Productivity and Cooperation and Product/Service Quality and Management Support. The mean responses for Productivity and Cooperation were 3.5 (Agree), with the highest item being “Our performance reviews include green metrics, such as energy consumption reduction and waste minimization, alongside traditional performance indicators.” (mean = 3.6). The average for Product/Service Quality and Management Support was 3.5 (Agree), with the highest item being “We offer dedicated training programs on green innovation concepts, like life cycle assessment and eco-design, etc. for all employees” (mean = 3.5).

### ***Green Standards Compliance for Polish SMEs Respondents***

The study responses were collected using a structured questionnaire drafted using 5-Point Likert scale: 1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree and 5 = strongly agree. The results are presented in Table 4.6.

Table 4.5: Green Standards Compliance for Polish SMEs Respondents

| Variables                                                                                                                                                                            | Opinion Levels |      |      |      |      | Mean       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|------|------|------|------|------------|
|                                                                                                                                                                                      | 1              | 2    | 3    | 4    | 5    |            |
| <b>Organizational Procedures</b>                                                                                                                                                     |                |      |      |      |      | <b>3.6</b> |
| We have implemented planning and control measures with regard to green standards in our practices.                                                                                   | n 23           | 45   | 108  | 143  | 109  | 3.6        |
|                                                                                                                                                                                      | % 5.4          | 10.5 | 25.2 | 33.4 | 25.5 |            |
| We have put in place organizational procedures to integrate green standards and compliance requirements into our daily operations.                                                   | n 18           | 46   | 112  | 141  | 111  | 3.7        |
|                                                                                                                                                                                      | % 4.2          | 10.7 | 26.2 | 32.9 | 25.9 |            |
| The implementation of green standard compliant organizational procedures such as (ISO 14001) has facilitated improvements in our resource efficiency and waste management practices. | n 20           | 51   | 148  | 127  | 82   | 3.5        |
|                                                                                                                                                                                      | % 4.7          | 11.9 | 34.6 | 29.7 | 19.2 |            |
| <b>Performance Evaluation</b>                                                                                                                                                        |                |      |      |      |      | <b>3.7</b> |
| Our real-time environmental dashboards are linked to green standards compliance metrics and track energy consumption, waste generation, and resource utilization.                    | n 16           | 43   | 120  | 130  | 119  | 3.7        |
|                                                                                                                                                                                      | % 3.7          | 10   | 28   | 30.4 | 27.8 |            |
| Our performance tracking system encompasses not only green product lifecycle but also employee green engagement and skills development.                                              | n 20           | 45   | 110  | 146  | 107  | 3.6        |
|                                                                                                                                                                                      | % 4.7          | 10.5 | 25.7 | 34.1 | 25   |            |
| We conduct periodic analyses and evaluations to measure green innovation compliance with green standards.                                                                            | n 12           | 50   | 113  | 147  | 106  | 3.7        |
|                                                                                                                                                                                      | % 2.8          | 11.7 | 26.4 | 34.3 | 24.8 |            |

Source: author's own calculations

The latent variable of *Green Standards Compliance* was evaluated and displayed in Table 4.6 using two observed variables: Organizational procedures and Performance evaluation. The mean responses for Organizational procedures were 3.6 (Agree), with the highest item being “We have put in place organizational procedures to integrate green standards and compliance requirements into our daily

operations.” (mean = 3.7). The average for Compatibility of technology was 3.7 (Agree), with the highest items being “Our real-time environmental dashboards, linked to green standards compliance metrics, track energy consumption, waste generation, and resource utilization”; “We conduct periodic analyses and evaluations to measure green innovation compliance with green standards” (mean = 3.7).

### ***Adoption of Green Innovation Management for Polish SMEs Respondents***

The study responses were collected using a structured questionnaire drafted using 5-Point Likert scale: 1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree and 5 = strongly agree. The results are presented in Table 4.7.

Table 4.6: Adoption of Green Innovation Management for Polish SMEs Respondents

| Variables                                                                                                                                                      |   | Opinion Levels |      |      |      |      | Mean       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----------------|------|------|------|------|------------|
|                                                                                                                                                                |   | 1              | 2    | 3    | 4    | 5    |            |
| <b>Product/Service Innovation</b>                                                                                                                              |   |                |      |      |      |      | <b>3.6</b> |
| We prioritize the development of environmentally friendly products/services as part of our business strategy.                                                  | n | 29             | 41   | 144  | 120  | 94   | 3.5        |
|                                                                                                                                                                | % | 6.8            | 9.6  | 33.6 | 28   | 22   |            |
| We regularly integrate eco-friendly materials into our product/service innovation efforts                                                                      | n | 19             | 42   | 119  | 138  | 110  | 3.7        |
|                                                                                                                                                                | % | 4.4            | 9.8  | 27.8 | 32.2 | 25.7 |            |
| We launch innovative green products/services using eco-labelling to demonstrate our commitment to green product design and marketing.                          | n | 25             | 37   | 125  | 143  | 98   | 3.6        |
|                                                                                                                                                                | % | 5.8            | 8.6  | 29.2 | 33.4 | 22.9 |            |
| <b>Process Innovation</b>                                                                                                                                      |   |                |      |      |      |      | <b>3.6</b> |
| We actively seek to optimize production processes to minimize environmental impact as part of our innovation strategy                                          | n | 11             | 47   | 123  | 163  | 84   | 3.6        |
|                                                                                                                                                                | % | 2.6            | 11   | 28.7 | 38.1 | 19.6 |            |
| We have implemented green practices and technologies to reduce energy consumption and waste generation in our operational processes.                           | n | 13             | 42   | 131  | 143  | 99   | 3.6        |
|                                                                                                                                                                | % | 3              | 9.8  | 30.6 | 33.4 | 23.1 |            |
| We have successfully implemented eco-friendly practices and technologies to reduce our carbon footprint and environmental impact across operational processes. | n | 17             | 45   | 103  | 160  | 103  | 3.7        |
|                                                                                                                                                                | % | 4              | 10.5 | 24.1 | 37.4 | 24.1 |            |

|                                                                                                                                                                        |   |     |      |      |      |      |            |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|-----|------|------|------|------|------------|
| <b>Administrative Innovation</b>                                                                                                                                       |   |     |      |      |      |      | <b>3.6</b> |
| We implemented a remote work policy and virtual collaboration tools to reduce our carbon footprint from commuting and travel.                                          | n | 25  | 51   | 116  | 136  | 100  |            |
|                                                                                                                                                                        | % | 5.8 | 11.9 | 27.1 | 31.8 | 23.4 | 3.5        |
| Implementing administrative innovations like printing only essential communication and signing digital documents instead of paper to enhance environmental protection. | n | 20  | 49   | 124  | 140  | 95   |            |
|                                                                                                                                                                        | % | 4.7 | 11.4 | 29   | 32.7 | 22.2 | 3.6        |
| Our managers and supervisors are trained on green leadership principles and encouraged to incorporate green concepts in their decision-making processes.               | n | 16  | 43   | 126  | 143  | 100  |            |
|                                                                                                                                                                        | % | 3.7 | 10   | 29.4 | 33.4 | 23.4 | 3.6        |

Source: author's own calculations

The latent variable *Adoption of Green Innovation Management* was evaluated and shown in Table 4.7 using three observed variables: product innovation, process innovation and administration. The mean responses for product innovation were 3.6 (Agree), with the highest item being “We regularly integrate eco-friendly materials into our product/service innovation efforts.” (mean = 3.7). The average for process innovation was 3.6 (Agree), with the highest item being “We have successfully implemented eco-friendly practices and technologies to reduce our carbon footprint and environmental impact across operational processes.” (mean = 3.7). The average for administration innovation was 3.6 (Agree), with the highest item being “Implementing administrative innovations like printing only essential communication and signing digital documents instead of paper to enhance environmental protection.” (mean = 3.6).

### ***Normality and Correlation Analysis for Polish SMEs Respondents***

The normality of the study variables was conducted to determine where the study constructs were normally distributed. The normality tests were analysed using Skewness and Kurtosis. The correlation analysis was conducted to evaluate the relationship between the study variables.

This section presents the results of normality tests. The tests were conducted on the six latent variables of the study. The latent variable of green regulations management was measured by three observed variables - regulatory pressure,

government support, and environmental uncertainty. The latent variable of green technical capabilities consisted of three observed variables - complexity of technology, technology compatibility, and green relative advantage. The green economic resources consisted of four observed variables - access to funding/loans, availability of skilled labour/expertise, availability of natural resources, and profitability. The latent variable of green human resources management consisted of two observed variables: productivity and cooperation and product/service quality and management support. The latent variable of green standards compliance consisted of two observed variables: organizational procedures and performance evaluation. Green innovation management consisted of three observed variables: product innovation, process innovation, and administrative innovation. The results for skewness and kurtosis are presented in Table 4.8.

Table 4.7: Normality Analysis Results of Poland SMEs Respondents

| <b>Variables</b>                                 | <b>Skewness</b> | <b>Kurtosis</b> |
|--------------------------------------------------|-----------------|-----------------|
| <b>Green Economic Resources</b>                  |                 |                 |
| · Access to funding/loans                        | -0.47           | -0.30           |
| · Availability of skilled labour/expertise       | -0.40           | -0.55           |
| · Availability of natural resources              | -0.50           | -0.40           |
| - Profitability                                  | -0.24           | -0.49           |
| <b>Green Regulations Management</b>              |                 |                 |
| · Regulatory pressure                            | -0.39           | -0.23           |
| · Government support                             | -0.35           | -0.17           |
| · Environmental uncertainty                      | -0.32           | -0.13           |
| <b>Green Human Resources Management</b>          |                 |                 |
| · Productivity and cooperation                   | -0.14           | -0.24           |
| · Product/service quality and management support | -0.29           | -0.07           |
| <b>Green Technical Capabilities:</b>             |                 |                 |
| · Complexity of technology                       | -0.32           | -0.38           |
| · Compatibility of technology                    | -0.22           | -0.32           |
| · Green relative advantage                       | -0.43           | -0.11           |
| <b>Green Standards Compliance</b>                |                 |                 |
| · Organizational procedures                      | -0.40           | -0.05           |
| · Performance evaluation                         | -0.52           | -0.06           |
| <b>Green Innovation Management</b>               |                 |                 |
| · Product innovation                             | -0.55           | -0.13           |
| · Process innovation.                            | -0.40           | -0.02           |
| · Administrative innovation                      | -0.41           | -0.11           |

Source: author's own calculations

The skewness for the green economic resources variable ranged from -0.24 to -0.50, while kurtosis ranged from -0.30 to -0.55. The skewness for the green regulation management variable ranged from -0.32 to -0.39, while kurtosis ranged from -0.13 to -0.23. For the green human resource management variable, the skewness ranged from -0.14 to -0.29, while kurtosis ranged from -0.07 to -0.24. The skewness for the green technical capabilities variable ranged from -0.22 to -0.43, while kurtosis ranged from -0.11 to -0.38. The skewness for the green standard compliance variable ranged from -0.40 to -0.52, while kurtosis ranged from -0.05 to -0.06. The skewness for the green standard compliance variable ranged from -0.40 to -0.52, while kurtosis ranged from -0.02 to -0.13. The required threshold for skewness is  $\pm 3$ , while kurtosis is  $\pm 10$  for a normally distributed data (Kline, 2011). This threshold was satisfied, confirming the normality of the data.

In this section, the relationship between the latent variables and the observed variables of the data from Poland was evaluated using the Pearson correlation as shown in Table 4.9. The results are presented for each of the observed variables used to measure the latent variables. The correlation coefficients for the green economic resources variable ranged from 0.426\*\* to 0.688\*\*, which were positive and significant. The correlation coefficients for the green regulation management variable ranged from 0.596\*\* to 0.731\*\*, which were positive and significant. The correlation coefficients for the green human resource management variable were 0.702\*\*, which were positive and significant. The correlation coefficients for the green technical capabilities variable ranged from 0.608\*\* to 0.670\*\*, which were positive and significant. The correlation coefficients for the green standards compliance variable were 0.793\*\*, which was positive and significant. The correlation coefficients for adopting green innovation management variable ranged from 0.687\*\* to 0.745\*\*, which were positive and significant. The correlation coefficients within the required threshold of between 0.3 and 0.8 indicated that the observed variables used were suitable and satisfactory in conducting structural equation modelling. The last analysis was the multi-group analysis. the multi-group analysis compared the results for each of the studies, in this instance the Poland data, to see the differences and similarities on the results obtained.

Table 4.9: Correlation Analysis for Polish SMEs Respondents

| a                                 | 1      | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     | 11     | 12     | 13     | 14     | 15     | 16     | 17 |
|-----------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----|
| (1) Access to Fund                | 1      |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |    |
| (2) Skilled Labour                | .688** | 1      |        |        |        |        |        |        |        |        |        |        |        |        |        |        |    |
| (3) Natural Resources             | .436** | .461** | 1      |        |        |        |        |        |        |        |        |        |        |        |        |        |    |
| (4) Profitability                 | .591** | .636** | .426** | 1      |        |        |        |        |        |        |        |        |        |        |        |        |    |
| (5) Regulatory Pressure           | .562** | .560** | .496** | .695** | 1      |        |        |        |        |        |        |        |        |        |        |        |    |
| (6) Government Support            | .491** | .506** | .596** | .529** | .596** | 1      |        |        |        |        |        |        |        |        |        |        |    |
| (7) Environmental Uncertainty     | .540** | .549** | .591** | .550** | .622** | .731** | 1      |        |        |        |        |        |        |        |        |        |    |
| (8) Productivity and Cooperation  | .505** | .566** | .568** | .551** | .619** | .574** | .671** | 1      |        |        |        |        |        |        |        |        |    |
| (9) Product/Service Quality       | .512** | .541** | .502** | .561** | .644** | .479** | .564** | .702** | 1      |        |        |        |        |        |        |        |    |
| (10) Compatibility of Technology  | .469** | .471** | .493** | .453** | .534** | .558** | .602** | .603** | .583** | 1      |        |        |        |        |        |        |    |
| (11) Complexity of Technology     | .510** | .512** | .485** | .566** | .570** | .558** | .567** | .673** | .587** | .670** | 1      |        |        |        |        |        |    |
| (12) Green Relative Advantage     | .527** | .505** | .582** | .530** | .545** | .606** | .643** | .580** | .633** | .608** | .628** | 1      |        |        |        |        |    |
| (13) Organizational Procedure     | .515** | .506** | .624** | .454** | .541** | .606** | .646** | .575** | .626** | .626** | .580** | .787** | 1      |        |        |        |    |
| (14) Performance Evaluation       | .517** | .503** | .560** | .424** | .512** | .530** | .573** | .530** | .596** | .546** | .539** | .712** | .793** | 1      |        |        |    |
| (15) Product / Service Innovation | .478** | .473** | .547** | .429** | .522** | .519** | .568** | .509** | .540** | .540** | .507** | .673** | .740** | .806** | 1      |        |    |
| (16) Process Innovation           | .531** | .542** | .545** | .521** | .553** | .559** | .625** | .539** | .564** | .601** | .639** | .667** | .688** | .672** | .718** | 1      |    |
| (17) Administrative Innovation    | .514** | .535** | .606** | .494** | .553** | .602** | .607** | .562** | .598** | .557** | .599** | .632** | .680** | .675** | .687** | .745** | 1  |

Note: \*\*\* means significant at 0.01% level of significance; \*\* means significant at 0.05% level of significance; \* means significant at 0.1 level of significance;

Source: author's own calculations

### ***Evaluating the Conceptual Framework Data for Polish SMEs Respondents***

In this section, the model adopted for the study was evaluated for its suitability. The evaluation was conducted using three techniques – the first-order confirmatory factor analysis (FO-CFA), the second-order confirmatory factor analysis (SO-CFA), and the reliability and validity analysis. The results are presented in the following section.

#### ***First Order Confirmatory Factor Analysis (FO-CFA) for Polish SMEs Respondents***

##### ***First Order CFA: Green Economic Resource for Polish SMEs Respondents***

The green economic resources (GER) were measured by four latent variables - access to funding/loans (Access to funding), availability of skilled labour/expertise (Skilled labour), availability of natural resources (Natural Resources), and profitability (Profit). The results (Figure 4.1) indicated that Chi-square was 0.713 and the degrees of freedom were 2 (implying a saturated model). GFI = 0.999; IFI = 1; CFI = 1 and NFI = 1 showing a fit model. The factor loadings ranged from 0.55 (Natural Resources) to 0.85 (Skilled labour). These results indicated that the data fit the model well.

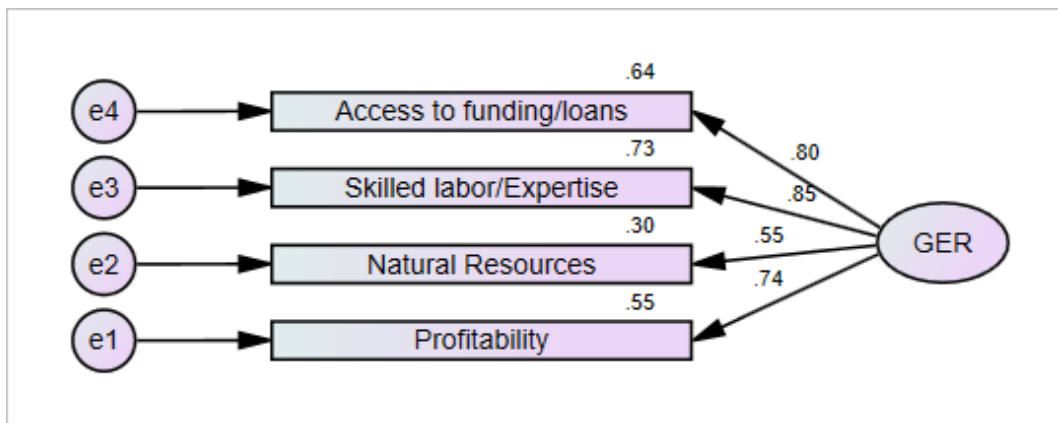


Figure 4.1: First Order CFA for Polish SMEs Respondents of Green Economic Resources

Source: author's own calculations

#### *First Order CFA - Green Regulations Management for Polish SMEs Respondents*

The green regulation management for Polish SMEs respondents was evaluated using three observed variables, namely regulatory pressure (Regulatory pressure), government support (Government support), and environmental uncertainty (Environmental uncertainty). The results (Figure 4.2) indicated that Chi-square was 0 and the degrees of freedom were 0 (implying a saturated model). GFI = 1; IFI = 1; CFI = 1 and NFI = 1 showing a fit model. The factor loadings ranged from 0.71 (Regulatory pressure) to 0.87 (Environmental uncertainty). These results indicated that the data fit the model well.

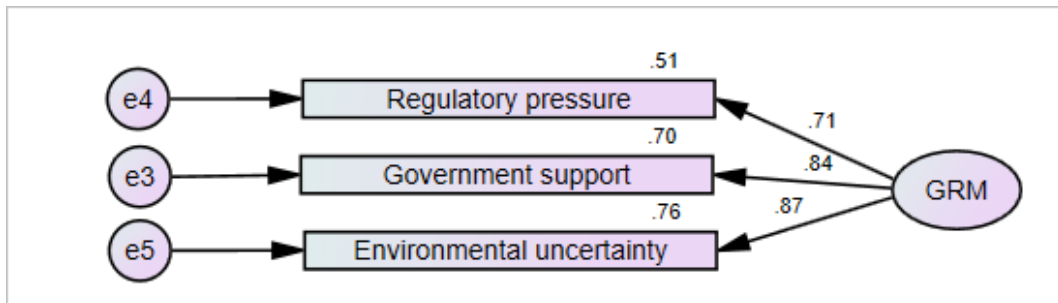


Figure 4.2: First Order CFA for Polish SMEs Respondents of Green Regulations Management

Source: author's own calculations

#### *First Order CFA: Green Human Resources Management for Polish SMEs Respondents*

Two observed variables were used for the green human resource management latent variables: productivity and cooperation (Productivity and cooperation) and Product/service quality and management support (product/service quality). The results (Figure 4.3) indicated that Chi-square was 0 and the degrees of freedom were 0 (implying a saturated model). GFI = 1; IFI = 1; CFI = 1 and NFI = 1 showing a fit model. The factor loadings ranged from 0.84 (Productivity and cooperation) to 0.84 (product/service quality). These results indicated that the data fit the model well.

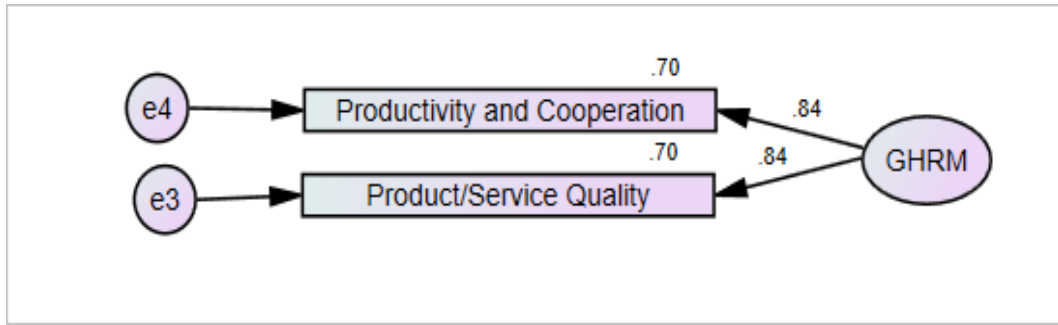


Figure 4.3: First Order CFA for Polish SMEs Respondents of Green Human Resources Management

Source: author's own calculations

#### *First Order CFA: Green Technical Capabilities for Poland SMEs Respondents*

The green technical capabilities variable was evaluated using three observed variables, namely complexity of technology (Complexity of technology), compatibility of technology (Compatibility of technology), and green relative advantage (Green relative advantage). The results (Figure 4.4) indicated that Chi-square was 0 and the degrees of freedom were 0 (implying a saturated model). GFI = 1; IFI = 1; CFI = 1 and NFI = 1 showing a fit model. The factor loadings ranged from 0.75 (Green relative advantage) to 0.83 (Compatibility of technology). These results indicated that the data fit the model well.

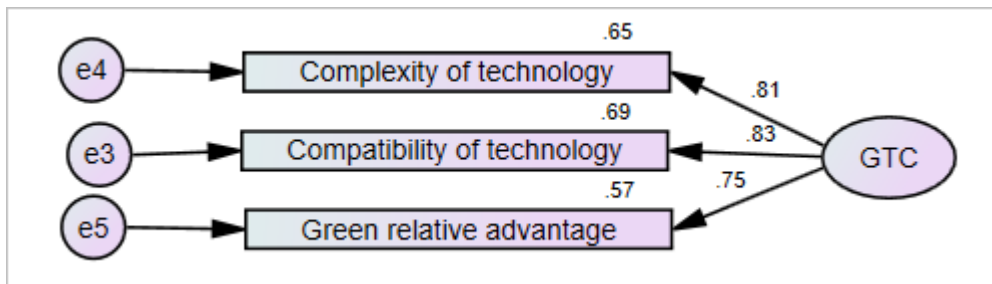


Figure 4.4: First Order CFA for Poland SMEs Respondents of Green Technical Capabilities

Source: author's own calculations

#### *First Order CFA: Green Standards Compliance for Polish SMEs Respondents*

The green standards compliance was measured using two latent variables: organizational procedures (Organizational procedures) and performance evaluation (Performance evaluation). The results (Figure 4.5) indicated that Chi-square was 0 and the degrees of freedom were 0 (implying a saturated model). GFI = 1; IFI = 1; CFI = 1 and NFI = 1 showing a fit model. The factor loadings were 0.89 for both Organizational procedures and Performance evaluation. These results indicated that the data fit the model well.

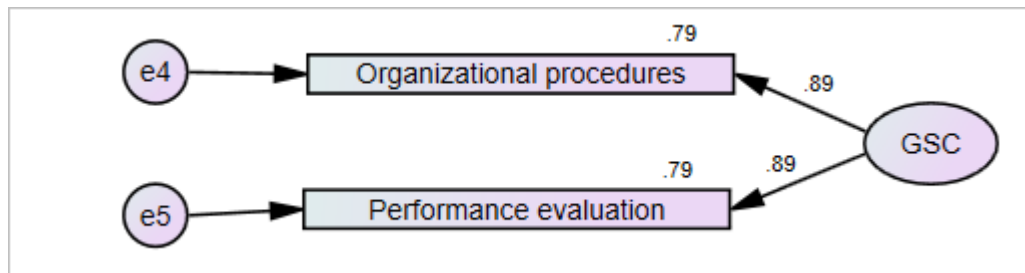


Figure 4.5: First Order CFA for Polish SMEs Respondents of Green Standards Compliance

Source: author's own calculations

#### *First Order CFA: Adoption of Green Innovation Management for Poland SMEs Respondents*

Adoption of green innovation management was evaluated using three observed variables: product innovation (Product Innovation), process innovation (Process Innovation), and administrative innovation (Administrative Innovation). The results (Figure 4.6) indicated that Chi-square was 0 and the degrees of freedom were 0 (implying a saturated model). GFI = 1; IFI = 1; CFI = 1 and NFI = 1 showing a fit model. The factor loadings ranged from 0.81 (Product Innovation) to 0.88 (Process Innovation). These results indicated that the data fit the model well.

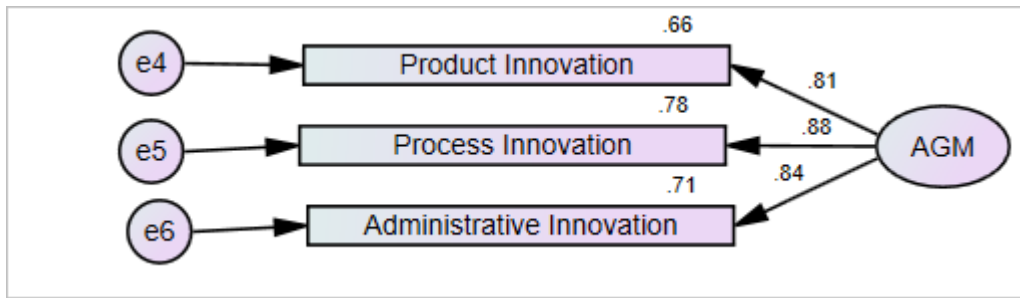


Figure 4.6: First Order CFA for Polish SMEs Respondents in Adoption of Green Innovation Management

Source: author's own calculations

### *Second Order Confirmatory Factor Analysis (SO-CFA) for Polish SMEs Respondents*

In this section, the second-order CFA was conducted to evaluate the fitness of the proposed conceptual model. Figure 4.7 shows the results of the CFA analysis, indicating the latent variables and observed variables factors loading. The results for the fitness indices are summarized in Table 4.10.

The results indicated that the chi-square statistic for the model was significant  $\chi^2/df$  ratio = 4.444 (considered acceptable since it was below 5 and was being influenced by sample size) (Schumacker and Lomax, 2010; Hu and Bentler, 1999). For other fit indices, the CFI = 0.943, TLI = 0.920, NFI = 0.928 and IFI = 0.943 provided an excellent fit since the values were greater than 0.9 or close to 1.0 as shown in Table 4.10. Additionally, the RMSEA is 0.090 (slightly above the threshold of 0.80), while the RMR = 0.040 below 0.08 (Browne and Cudeck, 1989; Schumacker and Lomax, 2010). Considering that almost all the fit indices met the required threshold, the data was considered to fit well into the adopted model.

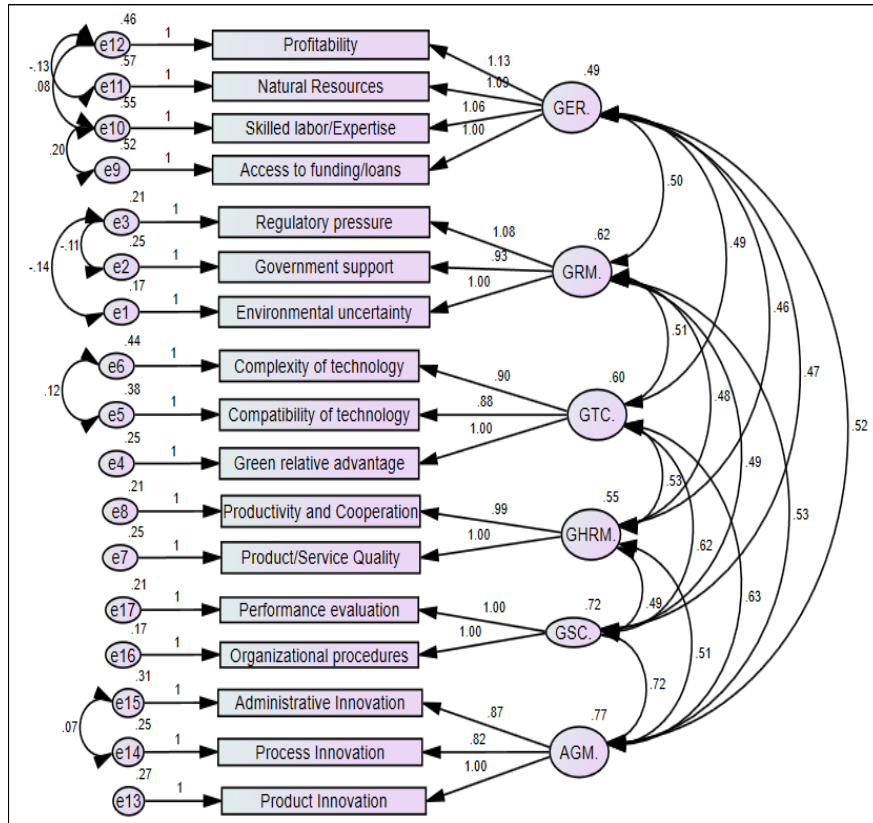


Figure 4.7: Second Order Confirmatory Factor Analysis (SO-CFA) for Polish SMEs Respondents

Source: author's own calculations

Table 4.10: Model Fit Indices for Polish SMEs Respondents

| Fit Indices       | Required threshold | Statistics Value |
|-------------------|--------------------|------------------|
| CMIN/DF           | <5                 | 4.440            |
| GFI               | ≥0.80              | 0.895            |
| NFI               | ≥0.90              | 0.928            |
| TLI               | ≥0.90              | 0.920            |
| IFI               | ≥0.90              | 0.943            |
| CFI               | ≥0.90              | 0.943            |
| RMR               | <0.08              | 0.040            |
| RMSEA             | <0.08              | 0.090            |
| <b>Conclusion</b> |                    | <b>Model Fit</b> |

Source: author's own calculations

In addition to the model fitness indices, the relationship between the latent variables and their observed variables was evaluated. The associated beta weights, t-statistics values, and standardized multiple correlations were determined.

The results indicated that Green Innovation Management (AGM) standardized beta adoption ranged from 0.808 to 0.861. The standardized multiple correlations ranged from 0.652 to 0.760. The composite reliability (CR) was 0.88, the average variance extracted (AVE) was 0.716, and Cronbach's Alpha was 0.884. The reliability requirements were met as both CR and Cronbach's alpha were above 0.7, and the validity threshold was satisfied as both beta weights and AVE were above 0.5.

The results indicated that Green Economic Resources (GER) standardized beta ranged from 0.697 to 0.760. The standardized multiple correlations ranged from 0.486 to 0.578. The composite reliability (CR) was 0.81, the average variance extracted (AVE) was 0.518, and Cronbach's Alpha was 0.813. The reliability requirements were met as both CR and Cronbach's alpha were above 0.7, and the validity threshold was satisfied as both beta weights and AVE were above 0.5.

The results indicated that Green Human Resources Management (GHRM) standardized beta ranged from 0.827 to 0.849. The standardized multiple correlations ranged from 0.683 to 0.721. The composite reliability (CR) was 0.825, the average variance extracted (AVE) was 0.702, and Cronbach's Alpha was 0.826. The reliability requirements were met as both CR and Cronbach's alpha were above 0.7, and the validity threshold was satisfied as both beta weights and AVE were above 0.5.

The results indicated that Green Regulations Management (GRM) standardized beta ranged from 0.825 to 0.887. The standardized multiple correlations ranged from 0.680 to 0.787. The composite reliability (CR) was 0.826, the average variance extracted (AVE) was 0.613, and Cronbach's Alpha was 0.828. The reliability requirements were met as both CR and Cronbach's alpha were above 0.7, and the validity threshold was satisfied as both beta weights and AVE were above 0.5.

The results indicated that Green Standards Compliance (GSC) standardized beta ranged from 0.882 to 0.899. The standardized multiple correlations ranged from 0.778 to 0.809. The composite reliability (CR) was 0.885, the average variance extracted (AVE) was 0.693, and Cronbach's Alpha was 0.886. The reliability requirements were met as both CR and Cronbach's alpha were above 0.7, and the validity threshold was satisfied as both beta weights and AVE were above 0.5.

The results indicated that Green Technical Capabilities (GTC) standardized beta ranged from 0.728 to 0.842. The standardized multiple correlations ranged from 0.531 to 0.709. The composite reliability (CR) was 0.815, the average variance extracted (AVE) was 0.596, and Cronbach's Alpha was 0.827. The reliability requirements were met as both CR and Cronbach's alpha were above 0.7, and the validity threshold was satisfied as both beta weights and AVE were above 0.5. These results are summarized in Table 4.11.

Table 4.11: Reliability and Validity Analysis for Polish SMEs Respondents

| <b>Latent V.</b> | <b>Observed V.</b>           | <b>Beta Weight</b>                               | <b>Estimate</b> | <b>S.E.</b> | <b>t-values</b> | <b>Sqd. multiple Correlations</b> |
|------------------|------------------------------|--------------------------------------------------|-----------------|-------------|-----------------|-----------------------------------|
| AGM              |                              | CR= 0.88; AVE = 0.716; Cronbach's Alpha = 0.884  |                 |             |                 |                                   |
|                  | Product Innovation           | 0.861                                            | 1.000           |             |                 | 0.742                             |
|                  | Process Innovation           | 0.824                                            | 0.859           | 0.039       | 21.064***       | 0.760                             |
|                  | Administrative Innovation    | 0.808                                            | 0.907           | 0.043       | 21.319***       | 0.652                             |
| GER              |                              | CR= 0.81; AVE = 0.518; Cronbach's Alpha = 0.813  |                 |             |                 |                                   |
|                  | Skilled labour               | 0.709                                            | 1.064           | 0.062       | 17.192***       | 0.503                             |
|                  | Natural resource             | 0.712                                            | 1.093           | 0.081       | 13.482***       | 0.507                             |
|                  | Access to Fund               | 0.697                                            | 1.000           |             |                 | 0.486                             |
|                  | Profitability                | 0.760                                            | 1.126           | 0.078       | 14.411***       | 0.578                             |
| GHRM             |                              | CR= 0.825; AVE = 0.702; Cronbach's Alpha = 0.826 |                 |             |                 |                                   |
|                  | Product/service quality      | 0.827                                            | 1.000           |             |                 | 0.683                             |
|                  | Productivity and cooperation | 0.849                                            | 0.994           | 0.050       | 19.752***       | 0.721                             |
| GRM              |                              | CR= 0.826; AVE = 0.613; Cronbach's Alpha = 0.828 |                 |             |                 |                                   |
|                  | Environmental uncertainty    | 0.887                                            | 1.000           |             |                 | 0.787                             |
|                  | Government support           | 0.825                                            | 0.928           | 0.045       | 20.524***       | 0.680                             |
|                  | Regulatory pressure          | 0.882                                            | 1.079           | 0.060       | 17.869***       | 0.787                             |
| GSC              |                              | CR= 0.885; AVE = 0.693; Cronbach's Alpha = 0.886 |                 |             |                 |                                   |
|                  | Organizational procedure     | 0.899                                            | 1.000           |             |                 | 0.809                             |
|                  | Performance evaluation       | 0.882                                            | 1.002           | 0.038       | 26.195***       | 0.778                             |
| GTC              |                              | CR= 0.815; AVE = 0.596; Cronbach's Alpha = 0.827 |                 |             |                 |                                   |

|  |                             |       |       |       |           |       |
|--|-----------------------------|-------|-------|-------|-----------|-------|
|  | Green relative advantage    | 0.842 | 1.000 |       |           | 0.709 |
|  | Compatibility of technology | 0.740 | 0.878 | 0.050 | 17.658*** | 0.548 |
|  | Complexity of technology    | 0.728 | 0.905 | 0.052 | 17.408*** | 0.531 |

Source: author's own calculations

### *SEM Analysis for Polish SMEs Respondents*

After being satisfied with the specified model's fitness, reliability, and validity levels, the study was appropriate for evaluating the study hypotheses. The hypotheses evaluated the relationship between the study variables. Structural equation modelling (SEM) was adopted to conduct this analysis. The following analysis steps were conducted.

The initial model that evaluated the suitability of the SEM model fitness. The fitness evaluation evaluated the fit indices such as chi-square, RMSEA, CFA, NFA, GFA, etc.

The actual SEM analysis evaluated the hypotheses of the study by analysing the relationship between the study variables.

Mediation analysis, which investigated the mediation effect of the green economic resources.

Moderation analysis investigated the mediation effect of green standards compliance on the relationship between GER, GRM, GHRM, GTC, and AGM.

### *Initial SEM Model for Polish SMEs Respondents*

The initial SEM model was used to evaluate the SEM model fitness. This aspect of the study was focused on evaluating the drivers of green innovation management adoption in SMEs in Poland. Various latent variables and observed variables were used. Table 4.12 summarizes the variables and their symbols.

Table 4.128: Variables Used in the SEM Model for Polish SMEs Respondents

| <b>Variables</b>                               |
|------------------------------------------------|
| <b>Green Economic Resources (GER)</b>          |
| Access to Funding/Loans                        |
| Availability of Skilled Labor/Expertise        |
| Availability of Natural Resources              |
| Profitability                                  |
| <b>Green Regulations Management (GRM)</b>      |
| Environmental Uncertainty                      |
| Government Support                             |
| Regulatory Pressure                            |
| <b>Green Human Resources Management (GHRM)</b> |
| Productivity and Cooperation                   |
| Product/Service Quality and Management Support |
| <b>Green Technical Capabilities (GTC)</b>      |
| Complexity of Technology                       |
| Compatibility of Technology                    |
| Green Relative Advantage                       |
| <b>Green Standards Compliance (GSC)</b>        |
| Organizational Procedures                      |
| Performance Evaluation                         |
| <b>Green Innovation Management (AGM)</b>       |
| Product Innovation                             |
| Process Innovation.                            |
| Administrative Innovation                      |

Source: author's own elaborations

Based on the developed conceptual framework, the SEM model in Figure 4.8 was developed using SPSS-AMOS software v26.

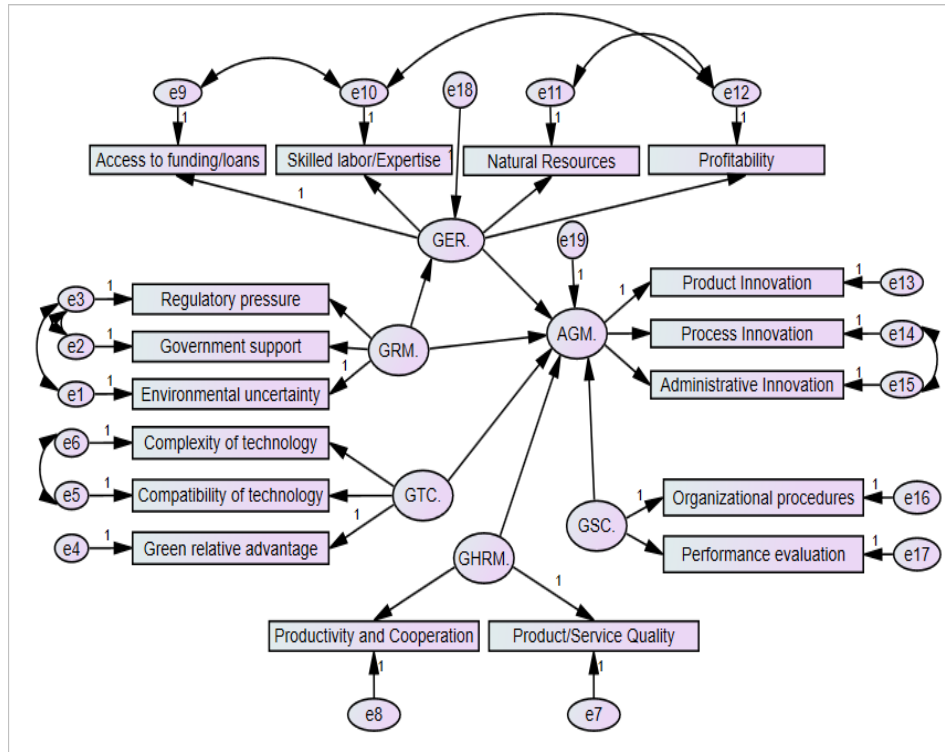


Figure 4.8: Initial SEM Model for Polish SMEs Respondents

Source: author's own calculations

### ***Hypotheses Analysis – Direct Effects for Polish SMEs Respondents***

The actual SEM model was conducted to evaluate the relationship between the latent variables and determine the set questions. The results are summarized in Table 4.13 and displayed in Figure 4.9.

Table 4.13: Hypotheses Analysis of Direct Effects for Polish SMEs Respondents

| Hypotheses | Path relationship | Estimate | S.E.  | C.R.   | P     |
|------------|-------------------|----------|-------|--------|-------|
| H1         | GRM → AGM         | 0.041    | 0.078 | 0.529  | 0.597 |
| H2         | GTC → AGM         | 0.266    | 0.069 | 3.847  | ***   |
| H3         | GER → AGM         | 0.277    | 0.102 | 2.719  | 0.007 |
| H5         | GHRM → AGM        | -0.053   | 0.06  | -0.887 | 0.375 |
| H6         | GSC → AGM         | 0.726    | 0.061 | 11.821 | ***   |

GER = Green Economic Resources, GRM = Green Regulations Management, GHRM = Green Human Resources Management, GTC = Green Technical Capabilities, GSC = Green Standards Compliance, AGM = Adoption of Green Innovation Management

Source: author's own calculations

The first analysis was the direct effects analysis. The results indicated that green regulation management (GRM) has a positive and insignificant effect on the adoption of green innovation management (AGM) ( $\beta = 0.041$ ,  $p = 0.597$ ).

Green technical capabilities (GTC) have a positive and significant influence on the adoption of green innovation management (AGM) ( $\beta = 0.266$ ,  $p = 0.000$ ).

Green economic resources (GER) have a positive and significant influence on the adoption of green innovation management (AGM) ( $\beta = 0.277$ ,  $p = 0.007$ ).

Green human resources management (GHRM) has a negative and insignificant influence on the adoption of green innovation management (AGM) ( $\beta = -0.053$ ,  $p = 0.375$ ).

Green standards compliance (GSC) has a positive and significant influence on the adoption of green innovation management (AGM) ( $\beta = 0.726$ ,  $p = 0.000$ ).

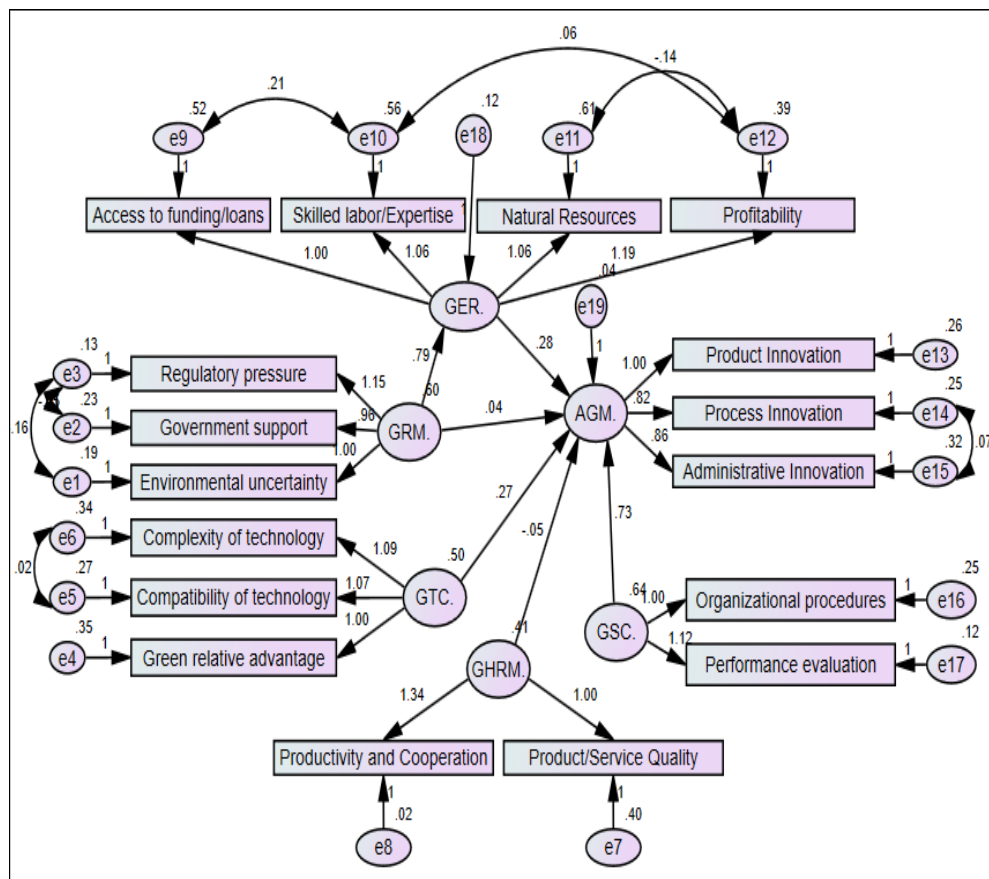


Figure 4.9: Hypotheses Analysis of the Direct Effects for Polish SMEs Respondents

Source: author's own calculations

### ***Hypotheses Analysis- Mediation Effects for Polish SMEs Respondents***

To evaluate the mediation effect of green economic resources (GER) on the relationship between green regulation management (GRM) and adoption of green innovation management (AGM). The bootstrapping technique was adopted for mediation analysis. The results indicated in Table 4.14 that the indirect path GRM → GER → AGM) was significant ( $\beta = 0.219$ ,  $p = 0.045$ ), suggesting that green economic resources were a significant mediator.

Table 4.14: Hypotheses Analysis for Mediation Effects of Polish SMEs Respondents

|           | <b>Relationship</b>  | <b>Total Effects</b> | <b>Direct Effects</b> | <b>Indirect Effects</b> | <b>Decision</b>       |
|-----------|----------------------|----------------------|-----------------------|-------------------------|-----------------------|
| <b>H4</b> | GRM → GER → AGM      | 0.260<br>(0.010)     | 0.041 (0.631)         | 0.219<br>(0.045)        | Significant mediation |
|           | Note: Beta (p-value) |                      |                       |                         |                       |

Source: author's own calculations

### ***Hypotheses Analysis for Moderation Effect of the Polish SMEs Respondents***

The moderation analysis was conducted to evaluate the moderating effect of green standards compliance (GSC) on the effects of green human resource management, green technical capabilities, green regulations, and green economic resources on the adoption of green innovation management are shown in Figure 4.10.

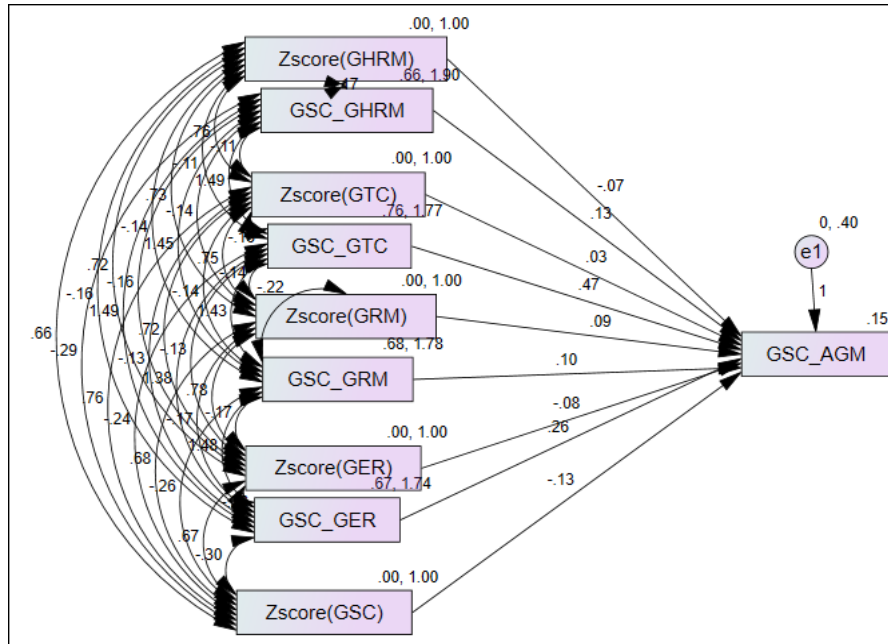


Figure 4.10: Hypotheses Analysis for Moderation Effect of Polish SMEs Respondents

Source: author's own calculations

Table 4.15: Hypotheses Analysis for Moderation Effect of Polish SMEs Respondents

| Hypothesis | Path Relationship  | Estimate | S.E.  | C.R.   | P     |
|------------|--------------------|----------|-------|--------|-------|
| <b>H7</b>  | ZGTC → GSC_AGM     | 0.031    | 0.061 | 0.515  | 0.606 |
|            | ZGSC → GSC_AGM     | -0.127   | 0.051 | -2.469 | 0.014 |
|            | ZGRM → GSC_AGM     | 0.095    | 0.059 | 1.615  | 0.106 |
|            | ZGHRM → GSC_AGM    | -0.07    | 0.053 | -1.321 | 0.187 |
|            | ZGER → GSC_AGM     | -0.083   | 0.057 | -1.474 | 0.141 |
|            | GSC_GTC → GSC_AGM  | 0.469    | 0.046 | 10.171 | ***   |
|            | GSC_GRM → GSC_AGM  | 0.099    | 0.049 | 2.011  | 0.044 |
|            | GSC_GHRM → GSC_AGM | 0.131    | 0.045 | 2.905  | 0.004 |
|            | GSC_GER → GSC_AGM  | 0.259    | 0.052 | 5.023  | ***   |

Source: author's own calculations

The moderation analysis was conducted using the interaction method. The results indicated that the interaction between green standards compliance and green technical capabilities (GSC\_GTC) positively and significantly influences AGM ( $\beta = 0.469$ ,  $p=0.000$ ). This meant that GSC moderates the effect of GTC on AGM (See Table 4.15).

The interaction between green standards compliance and green regulation management (GSC\_GRM) positively and significantly influences AGM ( $\beta = 0.099$ ,  $p=0.044$ ). This meant that GSC moderates the effect of GRM on AGM.

The interaction between green standards compliance and green human resource management (GSC\_GHRM) positively and significantly influences AGM ( $\beta = 0.131$ ,  $p=0.004$ ). This meant that GSC moderates the effect of GHRM on AGM.

The interaction between green standards compliance and green economic resources management (GSC\_GER) positively and significantly influences AGM ( $\beta = 0.259$ ,  $p=0.000$ ). This meant that GSC moderates the effect of GER on AGM.

#### **4.3. Results of Green Innovation Management for SMEs Respondents in Thailand**

##### ***Demographic Statistics for Thai SMEs Respondents***

This section presents the findings of the descriptive statistics for the demographics of the respondents in Thailand. The results are presented and summarized in Table 4.16, followed by discussions.

The results regarding gender indicated that females were the majority, comprising 55% of the respondents, while the males were the least, comprising 45%.

Considering the age of the respondents, Gen Z (18 – 27 years) was the majority, comprising 59.8%, followed by Gen X (44-59 years), comprising 21.1%, and then Generation Y and Millennials (28 – 43 years) comprising of 14%, and the least was a silent generation (79 – 99 years) comprising 1.7%.

The level of education was evaluated by indicating the highest level of education of the respondents. Most respondents were those with secondary school education (83.5%), followed by those with postgraduate degrees (13.3%), and those with undergraduate education comprising 3.1%.

The study also evaluated the number of employees in the SME firms, where the majority were those with 6 – 50 employees (74.3%) while those with 51 – 200 employees were 25.7%.

The industry of employee operation was also evaluated, where the retail and service sectors were the most common, comprising 17.9%, followed by those in the manufacturing sector (10.7%) and then the construction sector (11.4%). Those considered as ‘others’ comprised of 37%). The least sector was energy (0.5%).

The employee’s status was also evaluated, where the majority were found to be SME owners (49.2%), followed by SME Management Staff (25.2%), and those classified as SME Employees (16.5%).

The work experience of the respondents was also evaluated, where the majority of respondents were those with 0-4 years of experience (56.4%) and then those with more than 20 years of experience were the least (20.3%), and then those with 5-10 years of experience (10.4%).

Table 4.16: Demographic Statistics Analysis for Thai SMEs Respondents

| Demographic Characteristics |                                    | Frequency (n) | Percent (%) |
|-----------------------------|------------------------------------|---------------|-------------|
| Gender                      | Male                               | 186           | 45          |
|                             | Female                             | 227           | 55          |
|                             | Others                             | 0             | 0.0         |
| Age                         | 18-27 years (Gen Z)                | 247           | 59.8        |
|                             | 28-43 years (Gen Y or Millennials) | 58            | 14          |
|                             | 44-59 years (Gen X)                | 87            | 21.1        |
|                             | 60-78 years (Baby Boomers)         | 13            | 3.1         |
|                             | 79-99 years (Silent Gen)           | 7             | 1.7         |
| Highest Education level     | Secondary School                   | 345           | 83.5        |
|                             | Undergraduate degree               | 13            | 3.1         |
|                             | Postgraduate degree                | 55            | 13.3        |
| No of Employees             | 6-50                               | 307           | 74.3        |
|                             | 51-200                             | 106           | 25.7        |
| Industry of Operation       | Agriculture                        | 21            | 5.1         |
|                             | Construction                       | 47            | 11.4        |
|                             | Energy                             | 2             | 0.5         |
|                             | Food Processing                    | 20            | 4.8         |
|                             | Health                             | 15            | 3.6         |
|                             | Manufacturing                      | 44            | 10.7        |
|                             | Retail and Services                | 74            | 17.9        |
|                             | Tourism                            | 33            | 8           |
|                             | Transportation                     | 4             | 1           |
|                             | Others                             | 153           | 37          |
| Employment Status           | SME Owner                          | 203           | 49.2        |
|                             | SME Management Staff               | 104           | 25.2        |

|                 |                 |     |      |
|-----------------|-----------------|-----|------|
|                 | SME Employee    | 68  | 16.5 |
|                 | Other Positions | 38  | 9.2  |
| Work Experience | 0-4 years       | 233 | 56.4 |
|                 | 5-10 years      | 43  | 10.4 |
|                 | 11-15 years     | 18  | 4.4  |
|                 | 16-20 years     | 35  | 8.5  |
|                 | >20 years       | 84  | 20.3 |

Source: author's own calculations

### ***Respondents' Opinion Descriptives in Thailand***

In this section, the SMEs respondents' views regarding the study questions, observed and latent variables of the study were analysed and reported for Thailand. This study evaluated six latent variables: Green Technical Capabilities, Green Regulations, Green Economic Resources, Adoption of Green Innovation Management, Green Human Resources Management and Green Standards Compliance. The results of each of these are discussed in the following section.

### ***Green Regulations Management for Thai SMEs Respondents***

The study responses were collected using a structured questionnaire drafted using 5-Point Likert scale. The results are presented in Table 4.18.

Table 4.18: Green Regulations Management for Thai SMEs Respondents

| Variables                                                                                                                                                                                              |   | Opinion Levels |     |      |      |      | Mean |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----------------|-----|------|------|------|------|
|                                                                                                                                                                                                        |   | 1              | 2   | 3    | 4    | 5    |      |
| <b>Regulatory Pressure</b>                                                                                                                                                                             |   |                |     |      |      |      | 3.8  |
| Regulatory agencies are supportive of green innovation implementation.                                                                                                                                 | n | 7              | 19  | 118  | 180  | 89   | 3.8  |
|                                                                                                                                                                                                        | % | 1.7            | 4.6 | 28.6 | 43.6 | 21.5 |      |
| Regulatory agencies regularly conduct inspections to ensure compliance with rules.                                                                                                                     | n | 8              | 19  | 134  | 162  | 90   | 3.7  |
|                                                                                                                                                                                                        | % | 1.9            | 4.6 | 32.4 | 39.2 | 21.8 |      |
| Regulatory agencies enforce green innovation guidelines through incentives and penalties.                                                                                                              | n | 9              | 28  | 120  | 163  | 93   | 3.7  |
|                                                                                                                                                                                                        | % | 2.2            | 6.8 | 29.1 | 39.5 | 22.5 |      |
| <b>Government Support</b>                                                                                                                                                                              |   |                |     |      |      |      | 3.8  |
| Tax/subsidy incentives for renewable energy investments have significantly lowered our financial barriers to introduce renewable solutions e.g. installing solar panels on industrial roofs, LNG, etc. | n | 7              | 23  | 108  | 166  | 109  | 3.8  |
|                                                                                                                                                                                                        | % | 1.7            | 5.6 | 26.2 | 40.2 | 26.4 |      |
| We are aware of and actively engage with government programs or initiatives designed to promote green regulations within our                                                                           | n | 8              | 15  | 118  | 177  | 95   | 3.8  |
|                                                                                                                                                                                                        | % | 1.9            | 3.6 | 28.6 | 42.9 | 23   |      |

|                                                                                                                                                  |   |     |     |      |      |      |  |     |
|--------------------------------------------------------------------------------------------------------------------------------------------------|---|-----|-----|------|------|------|--|-----|
| industry, like the Industry 4.0 or Green Investment Scheme                                                                                       |   |     |     |      |      |      |  |     |
| Green regulations influence our strategic decisions, prompting us to invest in resource efficiency and create new green product lines            | n | 9   | 12  | 120  | 173  | 99   |  |     |
|                                                                                                                                                  | % | 2.2 | 2.9 | 29.1 | 41.9 | 24   |  | 3.8 |
| <b>Environmental Uncertainty</b>                                                                                                                 |   |     |     |      |      |      |  | 3.8 |
| Green policies and regulations have accelerated the progress and adoption of green technologies like water recycling systems.                    | n | 5   | 16  | 118  | 189  | 85   |  |     |
|                                                                                                                                                  | % | 1.2 | 3.9 | 28.6 | 45.8 | 20.6 |  | 3.8 |
| Policies supporting green innovation regulation subsidies has assisted SMEs in acquiring necessary resources to compete with larger enterprises. | n | 9   | 15  | 124  | 172  | 93   |  |     |
|                                                                                                                                                  | % | 2.2 | 3.6 | 30   | 41.6 | 22.5 |  | 3.8 |
| We have developed new eco-friendly products and services due to the government's focus on green technology, encouraging its adoption             | n | 6   | 15  | 111  | 178  | 103  |  |     |
|                                                                                                                                                  | % | 1.5 | 3.6 | 26.9 | 43.1 | 24.9 |  | 3.9 |

Source: author's own calculations

The latent variable of Green Regulations Management for Thailand was evaluated using three observed variables – Regulatory pressure, Government support, and Environmental uncertainty. The mean responses for Regulatory pressure were 3.8 (Agree), with the highest item being “Regulatory agencies are supportive of green innovation implementation” (mean = 3.8). The average for Government support was 3.8 (Agree), with the highest item being “Tax/subsidy incentives for renewable energy investments have significantly lowered our financial barriers to introduce renewable solutions e.g. installing solar panels on industrial roofs, LNG, etc.” (mean = 3.8). The average for the availability of Environmental uncertainty was 3.8 (Agree), with the highest item being “We have developed new eco-friendly products and services due to the government's focus on green technology, encouraging its adoption” (mean = 3.9).

### ***Green Technical Compatibility for Thai SMEs Respondents***

The study responses were collected using a structured questionnaire drafted using 5-Point Likert scale: 1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree and 5 = strongly agree. The results are presented in Table 4.20.

Table 4.20: Green Technical Capabilities for Thai SMEs Respondents

| Variables                                                                                                                                                                    | Opinion Levels |     |      |      |      | Mean |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|-----|------|------|------|------|
|                                                                                                                                                                              | 1              | 2   | 3    | 4    | 5    |      |
| <b>Complexity of Technology</b>                                                                                                                                              |                |     |      |      |      | 3.8  |
| The advancement of green technology necessitates the development of new skills in innovation management due to its complexity.                                               | n 10           | 8   | 94   | 189  | 112  | 3.9  |
|                                                                                                                                                                              | % 2.4          | 1.9 | 22.8 | 45.8 | 27.1 |      |
| Our organization created a user-friendly online green innovation knowledge base for employees to access materials and best practices.                                        | n 6            | 11  | 125  | 188  | 83   | 3.8  |
|                                                                                                                                                                              | % 1.5          | 2.7 | 30.3 | 45.5 | 20.1 |      |
| We have employed successful strategies to manage/overcome technological complexity challenges in adopting and integrating green technologies within our technical capability | n 9            | 13  | 116  | 199  | 76   | 3.8  |
|                                                                                                                                                                              | % 2.2          | 3.1 | 28.1 | 48.2 | 18.4 |      |
| <b>Compatibility of Technology</b>                                                                                                                                           |                |     |      |      |      | 3.8  |
| Our company successfully ensured compatibility of green initiatives with our environmental responsibility and operational excellence values.                                 | n 9            | 9   | 123  | 183  | 89   | 3.8  |
|                                                                                                                                                                              | % 2.2          | 2.2 | 29.8 | 44.3 | 21.5 |      |
| We have reduced energy usage and exceeded our environmental performance targets by adopting renewable energy sources.                                                        | n 12           | 19  | 115  | 173  | 94   | 3.8  |
|                                                                                                                                                                              | % 2.9          | 4.6 | 27.8 | 41.9 | 22.8 |      |
| We have measures in place to continuously improve our technical capability in managing and optimizing the compatibility of green technologies.                               | n 11           | 19  | 127  | 175  | 81   | 3.7  |
|                                                                                                                                                                              | % 2.7          | 4.6 | 30.8 | 42.4 | 19.6 |      |
| <b>Green Relative Advantage</b>                                                                                                                                              |                |     |      |      |      | 3.8  |
| Implementing green innovation management has improved our corporate image.                                                                                                   | n 6            | 25  | 137  | 171  | 74   | 3.7  |
|                                                                                                                                                                              | % 1.5          | 6.1 | 33.2 | 41.4 | 17.9 |      |
| Implementing green innovation management leads to better economic benefits                                                                                                   | n 4            | 11  | 125  | 175  | 98   | 3.9  |
|                                                                                                                                                                              | % 1            | 2.7 | 30.3 | 42.4 | 23.7 |      |
| Transparency about our green activities and measurable environmental progress has improved our brand, credibility, and customer loyalty                                      | n 5            | 9   | 126  | 176  | 97   | 3.9  |
|                                                                                                                                                                              | % 1.2          | 2.2 | 30.5 | 42.6 | 23.5 |      |

Source: author's own calculations

The latent variable of *Green Technical Compatibility* for Thai SMEs respondents was evaluated using three observed variables; Complexity of technology,

Compatibility of technology, and Green relative advantage. The mean responses for Complexity of technology were 3.8 (Agree), with the highest item being “The advancement of green technology necessitates the development of new skills in innovation management due to its complexity” (mean = 3.9). The average for Compatibility of technology was 3.8 (Agree), with the highest items being “Our company successfully ensured compatibility of green initiatives with our environmental responsibility and operational excellence values”; “We have reduced energy usage and exceeded our environmental performance targets by adopting renewable energy sources” (mean = 3.8). The average for Green relative advantage was 3.8 (Agree), with the highest item being “Implementing green innovation management leads to better economic benefits” (mean = 3.9).

### ***Green Economic Resources for Thai SMEs Respondents***

The study responses were collected using a structured questionnaire drafted using 5-Point Likert scale: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree. The results are presented in Table 4.17.

Table 4.17: Green Economic Resources for Thai SMEs Respondents

| Variables                                                                                                                              | Opinion Levels |     |     |      |      | Mean       |
|----------------------------------------------------------------------------------------------------------------------------------------|----------------|-----|-----|------|------|------------|
|                                                                                                                                        |                | 1   | 2   | 3    | 4    | 5          |
| <b>Access to Funding/Loans</b>                                                                                                         |                |     |     |      |      | <b>3.8</b> |
| Government funding is available to implement green innovation.                                                                         | n              | 10  | 14  | 112  | 157  | 120        |
|                                                                                                                                        | %              | 2.4 | 3.4 | 27.1 | 38   | 29.1       |
| Our company dedicates specific funds to green innovation.                                                                              | n              | 6   | 21  | 114  | 195  | 77         |
|                                                                                                                                        | %              | 1.5 | 5.1 | 27.6 | 47.2 | 18.6       |
| <b>Availability of Skilled Labor/Expertise</b>                                                                                         |                |     |     |      |      | <b>3.8</b> |
| Our company partnered with the local universities to train employees on green innovation best practices.                               | n              | 7   | 23  | 121  | 179  | 83         |
|                                                                                                                                        | %              | 1.7 | 5.6 | 29.3 | 43.3 | 20.1       |
| Our company is able to attract highly skilled employees who specialize in green innovation management.                                 | n              | 8   | 22  | 128  | 179  | 76         |
|                                                                                                                                        | %              | 1.9 | 5.3 | 31   | 43.3 | 18.4       |
| <b>Availability of Natural Resources</b>                                                                                               |                |     |     |      |      | <b>3.8</b> |
| We optimize resource management by partnering with local green suppliers to minimize negative environmental impacts such as pollution. | n              | 7   | 18  | 134  | 163  | 91         |
|                                                                                                                                        | %              | 1.7 | 4.4 | 32.4 | 39.5 | 22         |
| We have invested in resource-saving technologies like waste recycling, biomass, etc.                                                   | n              | 4   | 17  | 115  | 161  | 116        |
|                                                                                                                                        | %              | 1   | 4.1 | 27.8 | 39   | 28.1       |

|                                                                                                                                    |   |     |     |      |      |      |            |
|------------------------------------------------------------------------------------------------------------------------------------|---|-----|-----|------|------|------|------------|
| <b>Profitability</b>                                                                                                               |   |     |     |      |      |      | <b>3.7</b> |
| Balancing profitability with the integration of green economic resources is a key priority for our company's development strategy. | n | 7   | 21  | 138  | 165  | 82   |            |
|                                                                                                                                    | % | 1.7 | 5.1 | 33.4 | 40   | 19.9 | 3.7        |
| We are implementing green innovation management because it is profitable                                                           | n | 8   | 23  | 144  | 152  | 86   |            |
|                                                                                                                                    | % | 1.9 | 5.6 | 34.9 | 36.8 | 20.8 | 3.7        |

Source: author's own calculations

The latent variable of green economic resources for Thailand was evaluated using three observed variables; access to funding/loans, availability of skilled labour/expertise, availability of natural resources, and profitability. The mean response for access to funding was 3.8 (Agree), with the highest item being “Government funding is available to implement green innovation” (mean = 3.9). The average for the availability of skilled labour/expertise was 3.8 (Agree), with the highest item being “Our company partnered with the local university to train our employees on green innovation best practices” (mean = 3.8). The average for the availability of natural resources was 3.8 (Agree), with the highest item being “We have invested in resource-saving technologies like waste recycling, biomass, etc.” (mean = 3.9). The average for profitability was 3.7 (Agree), with the highest item being “We are implementing green innovation management because it is profitable” (mean = 3.7).

### ***Green Human Resource Management for Thai SMEs Respondents***

The study responses were collected using a structured questionnaire drafted using 5-Point Likert scale. The results are presented in Table 4.19.

Table 4.19: Green Human Resources Management for Thai SMEs Respondents

| Variables                                                                                                                                          |   | Opinion Levels |     |      |      |      | Mean |
|----------------------------------------------------------------------------------------------------------------------------------------------------|---|----------------|-----|------|------|------|------|
|                                                                                                                                                    |   | 1              | 2   | 3    | 4    | 5    |      |
| Productivity and Cooperation                                                                                                                       |   |                |     |      |      |      | 3.7  |
| We encourage employees to suggest and implement green initiatives through company-wide competitions and idea boards.                               | n | 17             | 30  | 122  | 178  | 66   | 3.6  |
|                                                                                                                                                    | % | 4.1            | 7.3 | 29.5 | 43.1 | 16   |      |
| Our performance reviews include green metrics and traditional performance indicators, such as energy consumption reduction and waste minimization. | n | 8              | 22  | 120  | 187  | 76   | 3.7  |
|                                                                                                                                                    | % | 1.9            | 5.3 | 29.1 | 45.3 | 18.4 |      |

|                                                                                                                                     |   |     |     |      |      |      |     |
|-------------------------------------------------------------------------------------------------------------------------------------|---|-----|-----|------|------|------|-----|
| There is a high level of cooperation and collaboration among employees in implementing green practices to improve productivity.     | n | 8   | 14  | 124  | 181  | 86   | 3.8 |
|                                                                                                                                     | % | 1.9 | 3.4 | 30   | 43.8 | 20.8 |     |
| <b>Product/Service Quality and Management Support</b>                                                                               |   |     |     |      |      |      | 3.6 |
| We offer dedicated training programs on green innovation concepts, like life cycle assessment, eco-design, etc., for all employees. | n | 32  | 33  | 119  | 159  | 70   | 3.5 |
|                                                                                                                                     | % | 7.7 | 8   | 28.8 | 38.5 | 16.9 |     |
| We provide resources and support to ensure the proper implementation of green practices to enhance product/service quality.         | n | 22  | 29  | 125  | 173  | 64   | 3.6 |
|                                                                                                                                     | % | 5.3 | 7   | 30.3 | 41.9 | 15.5 |     |
| We recognize and reward employees for their contributions to improving green innovation product/service quality                     | n | 16  | 20  | 133  | 171  | 73   | 3.6 |
|                                                                                                                                     | % | 3.9 | 4.8 | 32.2 | 41.4 | 17.7 |     |

Source: author's own calculations

The latent variable of Green Human Resource Management for Thailand was evaluated using three observed variables: Productivity and Cooperation and Product/Service Quality and Management Support. The mean responses for Productivity and Cooperation were 3.7 (Agree), with the highest item being “There is a high level of cooperation and collaboration among employees in implementing green practices to improve productivity.” (mean = 3.8). The average for Product/Service Quality and Management Support was 3.6 (Agree), with the highest item being “We provide resources and support to ensure the proper implementation of green practices for enhancing product/service quality” (mean = 3.6).

### ***Green Standards Compliance for Thai SMEs Respondents***

The study responses were collected using a structured questionnaire drafted using 5-Point Likert scale. The results are presented in Table 4.21.

Table 4.21: Green Standards Compliance for Thai SMEs Respondents

| Variables                                                                                                                                                                           | Opinion Levels |      |      |      |      | Mean |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|------|------|------|------|------|
|                                                                                                                                                                                     | 1              | 2    | 3    | 4    | 5    |      |
| <b>Organizational Procedures</b>                                                                                                                                                    |                |      |      |      |      | 3.6  |
| We have implemented planning and control measures with regard to green standards in our practices.                                                                                  | n 13           | 47   | 139  | 130  | 84   | 3.5  |
|                                                                                                                                                                                     | % 3.1          | 11.4 | 33.7 | 31.5 | 20.3 |      |
| We have put in place organizational procedures to integrate green standards and compliance requirements into our daily operations.                                                  | n 13           | 32   | 142  | 132  | 94   | 3.6  |
|                                                                                                                                                                                     | % 3.1          | 7.7  | 34.4 | 32   | 22.8 |      |
| The implementation of green standard-compliant organizational procedures such as (ISO14001) has facilitated improvements in our resource efficiency and waste management practices. | n 17           | 36   | 133  | 139  | 88   | 3.6  |
|                                                                                                                                                                                     | % 4.1          | 8.7  | 32.2 | 33.7 | 21.3 |      |
| <b>Performance Evaluation</b>                                                                                                                                                       |                |      |      |      |      | 3.6  |
| Our real-time environmental dashboards are linked to green standards compliance metrics and track energy consumption, waste generation, and resource utilization.                   | n 14           | 44   | 124  | 137  | 94   | 3.6  |
|                                                                                                                                                                                     | % 3.4          | 10.7 | 30   | 33.2 | 22.8 |      |
| Our performance tracking system encompasses green product lifecycle, employee green engagement, and skills development.                                                             | n 18           | 40   | 136  | 139  | 80   | 3.5  |
|                                                                                                                                                                                     | % 4.4          | 9.7  | 32.9 | 33.7 | 19.4 |      |
| We conduct periodic analyses and evaluations to measure green innovation compliance with green standards.                                                                           | n 14           | 44   | 137  | 125  | 93   | 3.6  |
|                                                                                                                                                                                     | % 3.4          | 10.7 | 33.2 | 30.3 | 22.5 |      |

Source: author's own calculations

The latent variable of *Green Standards Compliance* for Thailand was evaluated using two observed variables; Organizational procedures and Performance evaluation. The mean responses for Organizational procedures were 3.6 (Agree), with the highest items being “We have put in place organizational procedures to integrate green standards and compliance requirements into our daily operations.”; “The implementation of green standard-compliant organizational procedures such as (ISO14001) has facilitated improvements in our resource efficiency and waste management practices” (mean = 3.6). The average for Performance Evaluation was 3.6 (Agree), with the highest items being “Our real-time environmental dashboards are linked to green standards compliance metrics and track energy consumption, waste

generation, and resource utilization.”; “We conduct periodic analyses and evaluations to measure green innovation compliance with green standards.” (mean = 3.6).

### ***Adoption of Green Innovation Management for Thai SMEs Respondents***

The study responses were collected using a structured questionnaire drafted using 5-Point Likert scale: 1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree and 5 = strongly agree. The results are presented in Table 4.22.

Table 4.22: Adoption of Green Innovation Management for Thai SMEs Respondents

| Variables                                                                                                                                                      |   | Opinion Levels |     |      |      |      | Mean |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----------------|-----|------|------|------|------|
|                                                                                                                                                                |   | 1              | 2   | 3    | 4    | 5    |      |
| <b>Product Innovation</b>                                                                                                                                      |   |                |     |      |      |      | 3.8  |
| We prioritize the development of environmentally friendly products/services as part of our business strategy.                                                  | n | 14             | 15  | 128  | 165  | 91   | 3.7  |
|                                                                                                                                                                | % | 3.4            | 3.6 | 31   | 40   | 22   |      |
| We regularly integrate eco-friendly materials into our product/service innovation efforts                                                                      | n | 7              | 12  | 127  | 184  | 83   | 3.8  |
|                                                                                                                                                                | % | 1.7            | 2.9 | 30.8 | 44.6 | 20.1 |      |
| We launch innovative green products/services using eco-labelling to demonstrate our commitment to green product design and marketing.                          | n | 5              | 20  | 128  | 177  | 83   | 3.8  |
|                                                                                                                                                                | % | 1.2            | 4.8 | 31   | 42.9 | 20.1 |      |
| <b>Process Innovation</b>                                                                                                                                      |   |                |     |      |      |      | 3.8  |
| We actively seek to optimize production processes to minimize environmental impact as part of our innovation strategy                                          | n | 6              | 10  | 129  | 177  | 91   | 3.8  |
|                                                                                                                                                                | % | 1.5            | 2.4 | 31.2 | 42.9 | 22   |      |
| We have implemented green practices and technologies to reduce energy consumption and waste generation in our operational processes.                           | n | 5              | 19  | 116  | 185  | 88   | 3.8  |
|                                                                                                                                                                | % | 1.2            | 4.6 | 28.1 | 44.8 | 21.3 |      |
| We have successfully implemented eco-friendly practices and technologies to reduce our carbon footprint and environmental impact across operational processes. | n | 9              | 16  | 127  | 176  | 85   | 3.8  |
|                                                                                                                                                                | % | 2.2            | 3.9 | 30.8 | 42.6 | 20.6 |      |
| <b>Administrative Innovation</b>                                                                                                                               |   |                |     |      |      |      | 3.7  |
| We implemented a remote work policy and virtual collaboration tools to reduce our carbon footprint from commuting and travel.                                  | n | 9              | 20  | 124  | 176  | 84   | 3.7  |
|                                                                                                                                                                | % | 2.2            | 4.8 | 30   | 42.6 | 20.3 |      |
| The implementation of administrative innovations has proven to be instrumental in enhancing our company's adherence to green innovation management protocols.  | n | 7              | 14  | 130  | 183  | 79   | 3.8  |
|                                                                                                                                                                | % | 1.7            | 3.4 | 31.5 | 44.3 | 19.1 |      |
| Our managers and supervisors are trained on green leadership principles and encouraged to incorporate green concepts in their decision-making processes.       | n | 13             | 15  | 123  | 179  | 83   | 3.7  |
|                                                                                                                                                                | % | 3.1            | 3.6 | 29.8 | 43.3 | 20.1 |      |

Source: author's own calculations

The latent variable *Adoption of Green Innovation Management* for Thai SMEs respondents was evaluated using three observed variables namely, product/service innovation, process innovation and administration. The mean responses for product innovation were 3.8 (Agree), with the highest items being “We regularly integrate eco-friendly materials into our product/service innovation efforts”; “We launch innovative green products/services using eco-labelling to demonstrate our commitment to green product design and marketing” (mean = 3.8). The average for process innovation was 3.8 (Agree), with the identical scores for all the three items as “We actively seek to optimize production processes to minimize environmental impact as part of our innovation strategy”; “We have implemented green practices and technologies to reduce energy consumption and waste generation in our operational processes”; “We have successfully implemented eco-friendly practices and technologies to reduce our carbon footprint and environmental impact across operational processes.” (mean = 3.8). The average for administration innovation was 3.7 (Agree), with the highest item being “The implementation of administrative innovations has proven to be instrumental in enhancing our company's adherence to green innovation management protocols. (mean = 3.8).

### **Normality and Correlation Analysis for Thai SMEs Respondents**

The normality of the study variables for Thailand was conducted to determine where the study constructs were normally distributed. The normality tests were analysed using Skewness and Kurtosis. The correlation analysis was conducted to evaluate the relationship between the study variables.

#### *Normality Test of Thai SMEs Respondents*

This section presents the results of normality tests. The tests were conducted on the six latent variables of the study.

The latent variable of green regulations management was measured by three observed variables - regulatory pressure, government support and environmental uncertainty. The latent variable of green technical capabilities consisted of three observed variables complexity of technology, compatibility of technology and green relative advantage. Green economic resources consisted of four observed variables: access to funding/loans, availability of skilled labour/expertise, availability of natural resources, and profitability. The latent variable of green

human resources management consisted of two observed variables: productivity and cooperation, product/service quality, and management support. The latent variable of green standards compliance consisted of two observed variables: organizational procedures and performance evaluation. Green innovation management consisted of three observed variables, namely product innovation, process innovation and administrative innovation. The results for skewness and kurtosis are presented in Table 4.23.

Table 4.23: Normality Tests for Thai SMEs Respondents

| Variables                                        | Skewness | Kurtosis |
|--------------------------------------------------|----------|----------|
| <b>Green Economic Resources</b>                  |          |          |
| · Access to Funding/Loans                        | -0.74    | 0.86     |
| · Availability of Skilled Labour/Expertise       | -0.57    | 0.77     |
| · Availability of Natural Resources              | -0.52    | 0.42     |
| · Profitability                                  | -0.44    | 0.33     |
| <b>Green Regulations Management</b>              |          |          |
| · Regulatory Pressure                            | -0.56    | 0.76     |
| · Government Support                             | -0.64    | 1.05     |
| · Environmental Uncertainty                      | -0.66    | 1.25     |
| <b>Green Human Resources Management</b>          |          |          |
| · Productivity and Cooperation                   | -0.79    | 1.47     |
| · Product/Service Quality and Management Support | -0.77    | 0.52     |
| <b>Green Technical Capabilities</b>              |          |          |
| · Complexity of Technology                       | -0.90    | 2.05     |
| · Compatibility of Technology                    | -0.77    | 1.23     |
| · Green Relative Advantage                       | -0.54    | 0.96     |
| <b>Green Standards Compliance</b>                |          |          |
| · Organizational Procedures                      | -0.59    | 0.95     |
| · Performance Evaluation                         | -0.64    | 0.89     |
| <b>Green Innovation Management</b>               |          |          |
| · Product/Service Innovation                     | -0.65    | 1.01     |
| · Process Innovation.                            | -0.14    | -0.32    |
| · Administrative Innovation                      | -0.29    | -0.17    |

Source: author's own calculations

The skewness for the green economic resources variable ranged from -0.44 to -0.74, while kurtosis ranged from 0.33 to 0.86. The skewness for the green regulation management variable ranged from -0.56 to -0.66, while kurtosis ranged from 0.76 to 1.25. For the green human resource management variable, the skewness ranged from -0.77 to -0.79, while kurtosis ranged from 0.52 to 1.47. The skewness for the

green technical capabilities variable ranged from -0.54 to -0.90, while kurtosis ranged from 0.96 to 2.05. The skewness for the green standard compliance variable ranged from -0.59 to -0.64, while kurtosis ranged from 0.89 to 0.95. The skewness for the green standard compliance variable ranged from -0.14 to -0.65, while kurtosis ranged from -0.32 to 1.01. The required threshold for skewness is  $\pm 3$ , while kurtosis is  $\pm 10$  for a normally distributed data (Kline, 2011). This threshold was satisfied, confirming the normality of the data.

The relationship between the latent variables and the observed variables was evaluated. The Pearson correlation was adopted. The results are presented for each of the observed variables used to measure the latent variables.

The correlation coefficients for the green economic resources variable ranged from 0.668\*\* to 0.718\*\*, which were positive and significant.

The correlation coefficients for the green regulation management variable ranged from 0.701\*\* to 0.796\*\*, which were positive and significant.

The correlation coefficients for the green human resource management variable were 0.635\*\*, which were positive and significant.

The correlation coefficients for the green technical capabilities variable ranged from 0.618\*\* to 0.706\*\*, which were positive and significant.

The correlation coefficients for adopting green innovation management variable ranged from 0.741\*\* to 0.809\*\*.

The correlation coefficients for the green standards compliance variable were 0.737\*\*, which was positive and significant. The correlation coefficients of the variables were within the required threshold of between 0.3 and 0.8 indicated that the observed variables used were suitable and satisfactory in conducting structural equation modelling.

Table 4.24: Correlation Analysis for Thai SMEs Respondents

| a                                 | 1      | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     | 11     | 12     | 13     | 14     | 15    | 16     | 17 |
|-----------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|--------|----|
| (1) Access to Funding             | 1      |        |        |        |        |        |        |        |        |        |        |        |        |        |       |        |    |
| (2) Skilled Labour                | .718** | 1      |        |        |        |        |        |        |        |        |        |        |        |        |       |        |    |
| (3) Natural Resources             | .675** | .668** | 1      |        |        |        |        |        |        |        |        |        |        |        |       |        |    |
| (4) Profitability                 | .675** | .698** | .686** | 1      |        |        |        |        |        |        |        |        |        |        |       |        |    |
| (5) Regulatory Pressure           | .613** | .610** | .636** | .685** | 1      |        |        |        |        |        |        |        |        |        |       |        |    |
| (6) Government Support            | .611** | .529** | .592** | .587** | .701** | 1      |        |        |        |        |        |        |        |        |       |        |    |
| (7) Environmental Uncertainty     | .596** | .537** | .591** | .596** | .734** | .796** | 1      |        |        |        |        |        |        |        |       |        |    |
| (8) Productivity and Cooperation  | .522** | .504** | .506** | .504** | .611** | .580** | .600** | 1      |        |        |        |        |        |        |       |        |    |
| (9) Product/Service Quality       | .394** | .382** | .408** | .469** | .536** | .429** | .463** | .635** | 1      |        |        |        |        |        |       |        |    |
| (10) Compatibility of Technology  | .634** | .548** | .599** | .552** | .595** | .620** | .624** | .559** | .507** | 1      |        |        |        |        |       |        |    |
| (11) Complexity of Technology     | .560** | .514** | .563** | .566** | .587** | .591** | .593** | .564** | .603** | .706** | 1      |        |        |        |       |        |    |
| (12) Green Relative Advantage     | .510** | .472** | .520** | .526** | .566** | .564** | .566** | .570** | .512** | .618** | .645** | 1      |        |        |       |        |    |
| (13) Product / Service Innovation | .524** | .472** | .552** | .541** | .601** | .562** | .581** | .581** | .573** | .660** | .712** | .693** | 1      |        |       |        |    |
| (14) Process Innovation           | .584** | .533** | .576** | .589** | .646** | .586** | .644** | .592** | .585** | .674** | .745** | .675** | .791** | 1      |       |        |    |
| (15) Administrative Innovation    | .579** | .553** | .544** | .548** | .614** | .560** | .605** | .611** | .627** | .626** | .703** | .661** | .741** | .809** | 1     |        |    |
| (16) Organizational procedure     | -0.049 | -0.064 | -0.061 | -0.053 | -.111* | -0.016 | -0.051 | -0.08  | -0.058 | -0.06  | -0.031 | 0.038  | 0.02   | -0.042 | 0.041 | 1      |    |
| (17) Performance evaluation       | -0.029 | -.103* | -0.087 | -0.065 | -0.064 | 0.007  | -0.038 | -0.089 | -0.072 | -0.086 | -0.046 | -0.033 | 0.013  | -0.036 | 0.051 | .737** | 1  |

Note: \*\*\* means significant at 0.01% level of significance; \*\* means significant at 0.05% level of significance; \* means significant at 0.1 level of significance;

Source: author's own calculations

### ***Evaluating the Conceptual Framework Data for Thai SMEs Respondents***

Thailand's adopted model for the study was evaluated for its suitability. The evaluation was conducted using three techniques – the first-order confirmatory factor analysis (FO-CFA), the second-order confirmatory factor analysis (SO-CFA), and the reliability and validity analysis. The results are presented in the following section.

#### ***First-order confirmatory factor analysis (FO-CFA) for Thai SMEs Respondents***

##### ***First Order CFA – Green Economic Resource for Thai SMEs Respondents***

The green economic resources (GER) were measured by four latent variables - access to funding/loans (Access to funding), availability of skilled labor/expertise (Skilled labour), availability of natural resources (Natural resources) and profitability (Profit). The results (Figure 4.11) indicated that Chi-square was 3.865 and the degrees of freedom were 2 (implying a saturated model). GFI = 0.995; IFI = 0.998; CFI = 0.998; and NFI = 0.996 showing a fit model. The factor loadings ranged from 0.81 (Natural resources) to 0.84 (Skilled labour). These results indicated that the data fit the model well.

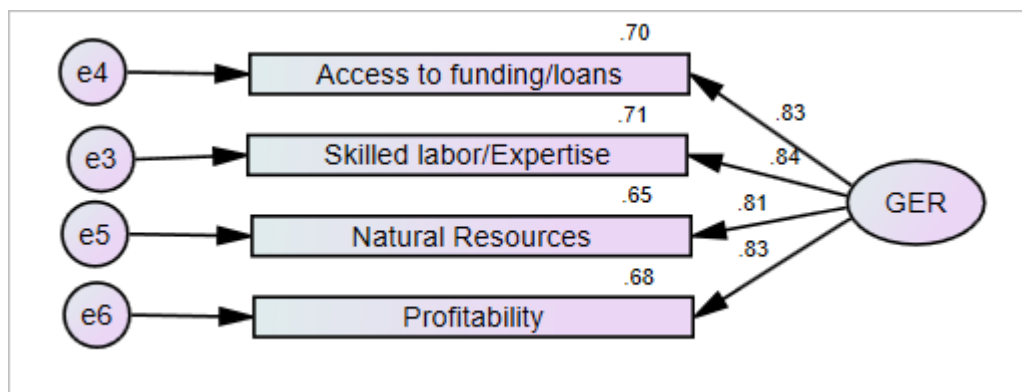


Figure 4.11: First Order CFA for Thai SMEs Respondents of Green Economic Resources

Source: author's own calculations

#### *First Order CFA - Green Regulations Management for Thai SMEs Respondents*

The green regulation management for Thailand was evaluated using three observed variables, namely regulatory pressure (Regulatory pressure), government support (Government support), and environmental uncertainty (Environmental uncertainty). The results (Figure 4.12) indicated that Chi-square was 0 and the degrees of freedom were 0 (implying a saturated model). GFI = 1; IFI = 1; CFI = 1 and NFI = 1 showing a fit model. The factor loadings ranged from 0.80 (Regulatory pressure) to 0.91 (Environmental uncertainty). These results indicated that the data fit the model well.

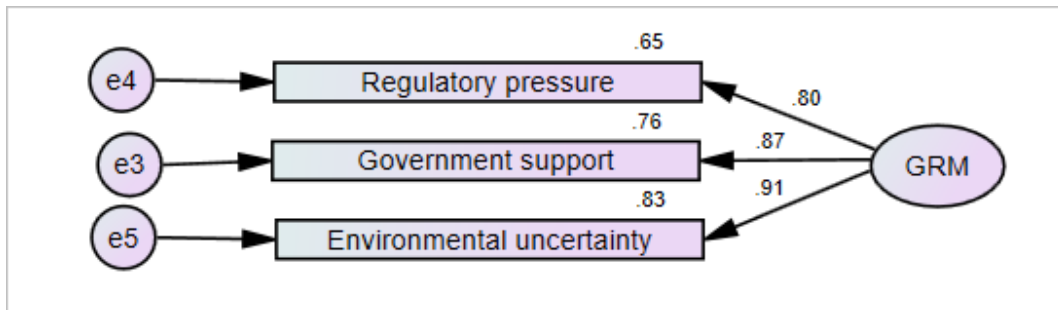


Figure 4.12: First Order CFA for Thai SMEs Respondents of Green Regulations Management

Source: author's own calculations

#### *First Order CFA - Green Human Resources Management for Thai SMEs Respondents*

Two observed variables were used for the green human resource management latent variables: productivity and cooperation (Product and cooperation) and Product/service quality and management support (product/service quality). The results (Figure 4.13) indicated that Chi-square was 0 and the degrees of freedom were 0 (implying a saturated model). GFI = 1; IFI = 1; CFI = 1 and NFI = 1 showing a fit model. The factor loadings ranged from 0.80 (Product and cooperation) to 0.80 (product/service quality). These results indicated that the data fit the model well.

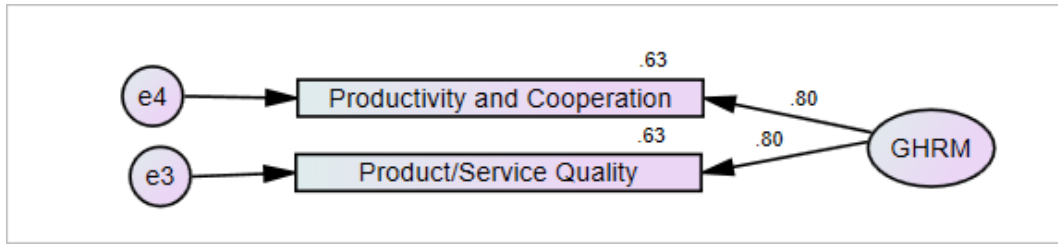


Figure 4.13: First Order CFA for Thai SMEs Respondents of Green Human Resources Management

Source: author's own calculations

#### *First Order CFA - Green Technical Capabilities for Thai SMEs Respondents*

The green technical capabilities variable for Thailand was evaluated using three observed variables, namely complexity of technology (complexity of technology), compatibility of technology (Compatibility of technology) and green relative advantage (Green relative advantage). The results (Figure 4.14) indicated that Chi-square was 0 and the degrees of freedom were 0 (implying a saturated model). GFI = 1; IFI = 1; CFI = 1 and NFI = 1 showing a fit model. The factor loadings ranged from 0.75 (Green relative advantage) to 0.86 (Compatibility of technology). These results indicated that the data fit the model well.

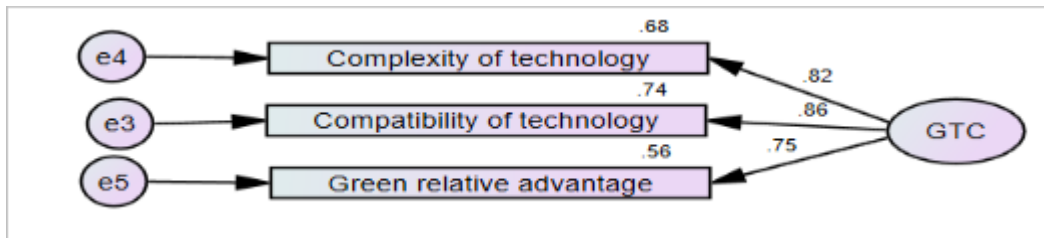


Figure 4.14: First Order CFA for Thai SMEs Respondents of Green Technical Capabilities

Source: author's own calculations

#### *First Order CFA - Green Standards Compliance for Thai SMEs Respondents*

The green standards compliance for Thailand was measured using two latent variables: organizational procedures (Organizational procedure) and performance evaluation (Performance evaluation). The results (Figure 4.15) indicated that Chi-square was 0 and the degrees of freedom were 0 (implying a saturated model). GFI

= 1; IFI = 1; CFI = 1 and NFI = 1 showing a fit model. The factor loadings ranged from 0.86 (Performance evaluation) to 0.86 (Organizational procedure). These results indicated that the data fit the model well.

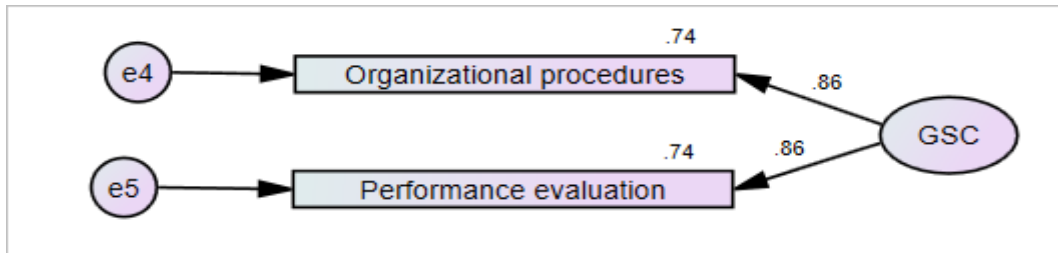


Figure 4.15: First Order CFA for Thai SMEs Respondents of Green Standards Compliance

Source: author's own calculations

#### *First Order CFA – Adoption of Green Innovation Management for Thai SMEs Respondents*

Adoption of green innovation management for Thailand was evaluated using three observed variables: product innovation (Product Innovation), process innovation (Process Innovation), and administrative innovation (Administrative Innovation). The results (Figure 4.16) indicated that Chi-square was 0 and the degrees of freedom were 0 (implying a saturated model). GFI = 1; IFI = 1; CFI = 1 and NFI = 1 showing a fit model. The factor loadings ranged from 0.85 (Product Innovation) to 0.93 (Process Innovation). These results indicated that the data fit the model well.

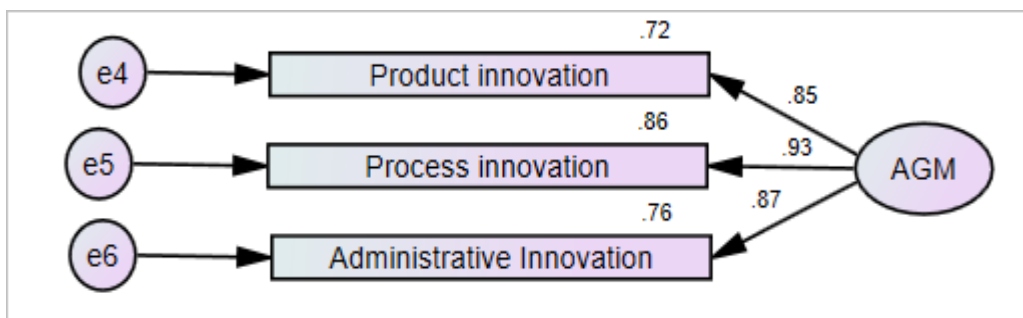


Figure 4.16: First Order CFA for Thai SMEs Respondents in Adoption of Green Innovation Management

Source: author's own calculations

### *Second Order Confirmatory Factor Analysis (SO-CFA) for Thai SMEs Respondents*

In this section, the second-order CFA for Thailand was conducted to evaluate the fitness of the proposed conceptual model. Figure 4.17 shows the results of the CFA analysis, indicating the latent variables and observed variables factors loading. The results for the fitness indices are summarized in Table 4.25.

Table 4.25: Fit Indices Results for Thai SMEs Respondents

| Fit Indices       | Required threshold | Statistics Value |
|-------------------|--------------------|------------------|
| CMIN/DF           | <5                 | 2.287            |
| GFI               | $\geq 0.80$        | 0.939            |
| NFI               | $\geq 0.90$        | 0.959            |
| TLI               | $\geq 0.90$        | 0.968            |
| IFI               | $\geq 0.90$        | 0.976            |
| CFI               | $\geq 0.90$        | 0.976            |
| RMR               | <0.08              | 0.022            |
| RMSEA             | <0.08              | 0.056            |
| <b>Conclusion</b> |                    | <b>Model Fit</b> |

Source: author's own calculations

The results indicated that the chi-square statistic for the model was significant  $\chi^2/df$  ratio = 2.287, which was considered acceptable since it was below 5 and was being influenced by sample size (Schumacker and Lomax, 2010; Hu and Bentler, 1999). For other fit indices, the CFI = 0.976, TLI = 0.968, IFI = 0.976, NFI = 0.959 and RFI = 0.944, which provided an excellent fit, since the values were greater than 0.9 or close to 1.0. Additionally, the RMSEA is 0.056, which is below the threshold of 0.08 (Browne and Cudeck, 1989; Schumacker and Lomax, 2010). RMR is 0.022, which is below the required threshold of 0.08. Considering that all the fit indices met the required threshold, the data was considered too well fit to the adopted model.

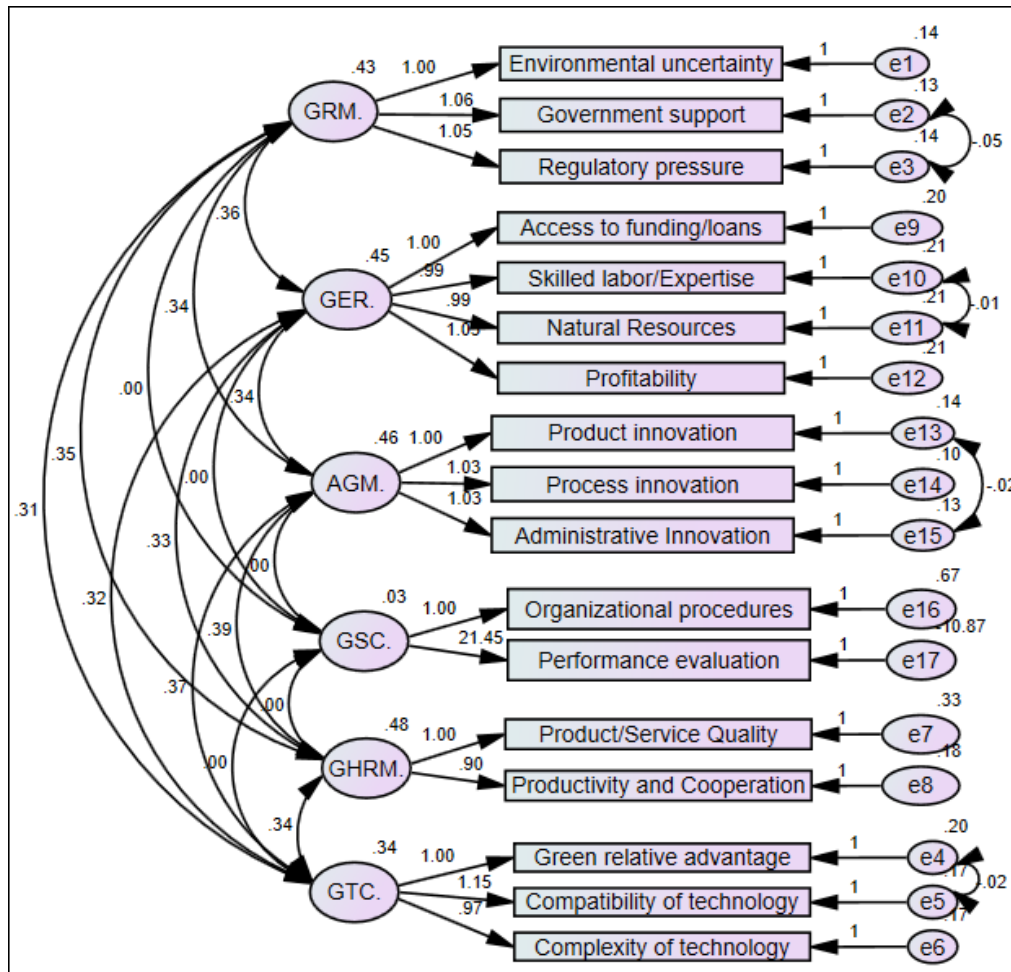


Figure 4.17: Second-Order Confirmatory Factor Analysis (SO-CFA) for Thai SMEs Respondents

Source: author's own calculations

In addition to the model fitness indices, the relationship between the latent variables and their observed variables was evaluated. The associated beta weights, t-statistics values, and standardized multiple correlations were determined.

The results indicated that the adoption of green innovation management (AGM) standardized beta ranged from 0.877 to 0.908. The standardized multiple correlations ranged from 0.769 to 0.824. The composite reliability (CR) was 0.920, the average variance extracted (AVE) was 0.792, and Cronbach's Alpha was 0.921. The reliability requirements were met as both CR and Cronbach's alpha were above 0.7, and the validity threshold was satisfied as both beta weights and AVE were above 0.5.

The results indicated that Green Economic Resources (GER) standardized beta ranged from 0.824 to 0.835. The standardized multiple correlations ranged from 0.680 to 0.697. The composite reliability (CR) was 0.898, the average variance extracted (AVE) was 0.639, and Cronbach's Alpha was 0.898. The reliability requirements were met as both CR and Cronbach's alpha were above 0.7, and the validity threshold was satisfied as both beta weights and AVE were above 0.5.

The results indicated that Green Human Resources Management (GHRM) standardized beta ranged from 0.767 to 0.828. The standardized multiple correlations ranged from 0.588 to 0.685. The composite reliability (CR) was 0.778, the average variance extracted (AVE) was 0.637, and Cronbach's Alpha was 0.783. The reliability requirements were met as both CR and Cronbach's alpha were above 0.7, and the validity threshold was satisfied as both beta weights and AVE were above 0.5.

The results indicated that Green Regulations Management (GRM) standardized beta ranged from 0.867 to 0.888. The standardized multiple correlations ranged from 0.751 to 0.789. The composite reliability (CR) was 0.910, the average variance extracted (AVE) was 0.771, and Cronbach's Alpha was 0.910. The reliability requirements were met as both CR and Cronbach's alpha were above 0.7, and the validity threshold was satisfied as both beta weights and AVE were above 0.5.

The results indicated that Green Standards Compliance (GSC) standardized beta ranged from 0.719 to 0.878. The standardized multiple correlations ranged from 0.636 to 0.739. The composite reliability (CR) was 0.764, the average variance extracted (AVE) was 0.754, and Cronbach's Alpha was 0.754. The reliability requirements were met as both CR and Cronbach's alpha were above 0.7, and the validity threshold was satisfied as both beta weights and AVE were above 0.5.

The results indicated that Green Technical Capabilities (GTC) standardized beta ranged from 0.794 to 0.855. The standardized multiple correlations ranged from 0.631 to 0.731. The composite reliability (CR) was 0.859, the average variance extracted (AVE) was 0.671, and Cronbach's Alpha was 0.863. The reliability requirements were met as both CR and Cronbach's alpha were above 0.7, and the validity threshold was satisfied as both beta weights and AVE were above 0.5. These results are summarized in Table 4.26.

Table 4.26: Reliability and Validity Analysis Results for Thai SMEs Respondents

| Latent V.   | Observed V.                                      | Beta Weights | Estimate | S.E.    | t-values      | Std. Multiple correlations |
|-------------|--------------------------------------------------|--------------|----------|---------|---------------|----------------------------|
| <b>AGM</b>  | CR= 0.920; AVE = 0.792; Cronbach's Alpha = 0.921 |              |          |         |               |                            |
|             | Product Innovation                               | 0.885        | 1.03     | 0.044   | 23.523*<br>** | 0.769                      |
|             | Process Innovation                               | 0.908        | 1.028    | 0.04    | 25.821*<br>** | 0.824                      |
|             | Administrative Innovation                        | 0.877        | 1        |         |               | 0.783                      |
| <b>GER</b>  | CR= 0.898; AVE = 0.639; Cronbach's Alpha = 0.898 |              |          |         |               |                            |
|             | Skilled Labour                                   | 0.825        | 1        |         |               | 0.681                      |
|             | Natural Resource                                 | 0.824        | 0.993    | 0.051   | 19.463*<br>** | 0.680                      |
|             | Access to Fund                                   | 0.835        | 1.032    | 0.051   | 20.091*<br>** | 0.697                      |
|             | Profitability                                    | 0.835        | 0.989    | 0.05    | 19.739*<br>** | 0.697                      |
| <b>GHRM</b> | CR= 0.778; AVE = 0.637; Cronbach's Alpha = 0.783 |              |          |         |               |                            |
|             | Product/Service Quality                          | 0.828        | 0.899    | 0.057   | 15.704*<br>** | 0.685                      |
|             | Productivity & Cooperation                       | 0.767        | 1        |         |               | 0.588                      |
| <b>GRM</b>  | CR= 0.910; AVE = 0.771; Cronbach's Alpha = 0.910 |              |          |         |               |                            |
|             | Environmental Uncertainty                        | 0.867        | 1        |         |               | 0.751                      |
|             | Government Support                               | 0.888        | 1.056    | 0.046   | 23.065*<br>** | 0.789                      |
|             | Regulatory Pressure                              | 0.879        | 1.052    | 0.048   | 21.906*<br>** | 0.773                      |
| <b>GSC</b>  | CR= 0.764; AVE = 0.754; Cronbach's Alpha = 0.782 |              |          |         |               |                            |
|             | Organizational Procedure                         | 0.719        | 1        |         |               | 0.636                      |
|             | Performance Evaluation                           | 0.878        | 21.449   | 259.853 | 0.083         | 0.739                      |
| <b>GTC</b>  | CR= 0.859; AVE = 0.671; Cronbach's Alpha = 0.863 |              |          |         |               |                            |
|             | Green Relative Advantage                         | 0.807        | 0.971    | 0.054   | 17.891*<br>** | 0.631                      |
|             | Compatibility of Technology                      | 0.855        | 1.148    | 0.061   | 18.724*<br>** | 0.731                      |
|             | Complexity of Technology                         | 0.794        | 1        |         |               | 0.652                      |

Source: author's own calculations

### *SEM Analysis for Thai SMEs Respondents*

After being satisfied with the specified model's fitness, reliability, and validity levels, the study was appropriate for evaluating the study hypotheses. The hypotheses evaluated the relationship between the study variables. Structural equation modelling (SEM) was adopted to conduct this analysis. The following analysis steps were conducted.

- The initial model evaluated the suitability of the SEM model fitness. The fitness evaluation evaluated the fit indices such as chi-square, RMSEA, CFA, NFA, GFA, etc.
- The actual SEM analysis evaluated the study's hypotheses by analysing the relationship between the study variables.
- Mediation analysis investigated the mediation effect of green economic resources.
- Moderation analysis investigated the mediation effect of green standards compliance on the relationship between GER, GRM, GHRM, GTC, and AGM.
- The last analysis was the multi-group analysis. The multi-group analysis compared the results for the Poland and Thailand case studies to see the differences and similarities in the results obtained.

### *Initial SEM Model for Thai SMEs Respondents*

The initial SEM model was used to evaluate the SEM model fitness. The aspect of the study was focused on evaluating the drivers of green innovation management adoption for SMEs in Thailand. Various latent variables and observed variables were used. Table 4.27 summarizes the variables and their symbols.

Table 4.27: Variables Used in the SEM Model for Thai SMEs Respondents

| Variables                                 |
|-------------------------------------------|
| <b>Green Economic Resources (GER)</b>     |
| Access to Funding/Loans                   |
| Availability of Skilled Labor/Expertise   |
| Availability of Natural Resources         |
| Profitability                             |
| <b>Green Regulations Management (GRM)</b> |
| Environmental Uncertainty                 |
| Government Support                        |
| Regulatory Pressure                       |

---

**Green Human Resources Management (GHRM)**

Productivity and Cooperation

Product/Service Quality and Management Support

---

**Green Technical Capabilities (GTC)**

Complexity of Technology

Compatibility of Technology

Green Relative Advantage

---

**Green Standards Compliance (GSC)**

Organizational Procedures

Performance Evaluation

---

**Green Innovation Management (AGM)**

Product Innovation

Process Innovation.

Administrative Innovation

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Source: author's own elaborations

Based on the developed conceptual framework, the following SEM model was developed using SPSS-AMOS software v26 as shown in Figure 4.18.

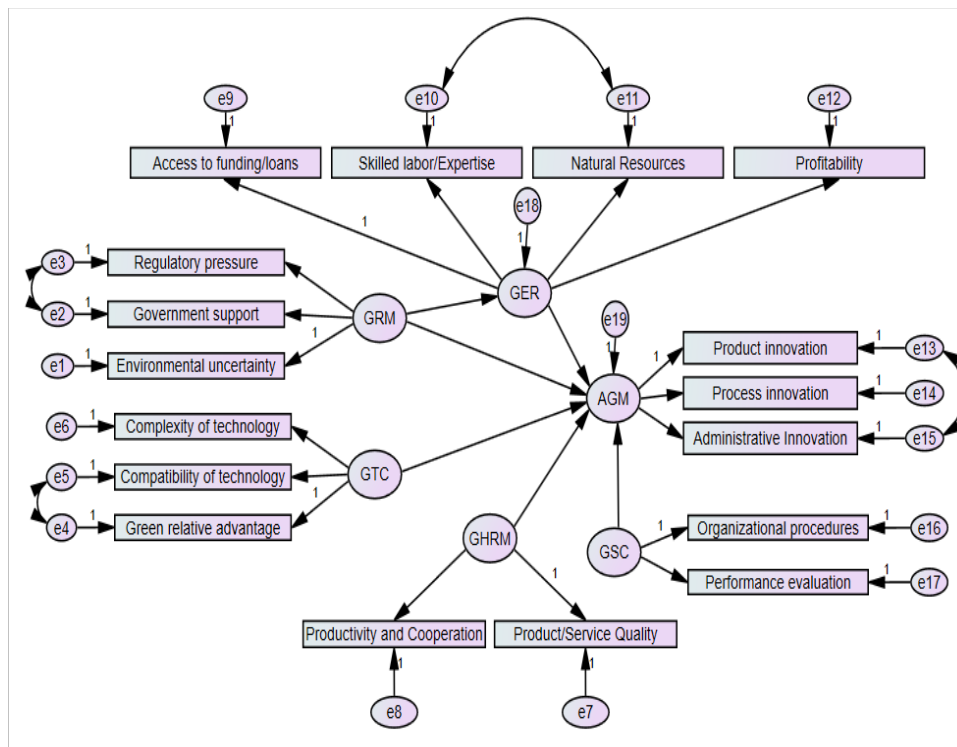


Figure 4.18: Initial SEM Model for Thai SMEs Respondents

Source: author's own calculations

### ***Hypotheses Analysis of Direct Effects for Thai SMEs Respondents***

The actual SEM model for Thailand was conducted to evaluate the relationship between the latent variables and determine the set questions. The results are summarized in Table 4.28.

Table 4.28: Hypotheses Analysis of Direct Effects for Thai SMEs Respondents

| <b>Hypotheses</b> | <b>Relationship</b> |   |     | <b>Estimate</b> | <b>S.E.</b> | <b>C.R.</b> | <b>P</b> |
|-------------------|---------------------|---|-----|-----------------|-------------|-------------|----------|
| <b>H1</b>         | GRM                 | → | AGM | 0.092           | 0.06        | 1.534       | 0.125    |
| <b>H2</b>         | GTC                 | → | AGM | 0.690           | 0.066       | 10.496      | ***      |
| <b>H3</b>         | GER                 | → | AGM | 0.125           | 0.057       | 2.205       | 0.027    |
| <b>H5</b>         | GHRM                | → | AGM | 0.195           | 0.044       | 4.468       | ***      |
| <b>H6</b>         | GSC                 | → | AGM | 0.035           | 0.028       | 1.26        | 0.208    |

GER = Green Economic Resources, GRM = Green Regulations Management, GHRM = Green Human Resources Management, GTC = Green Technical Capabilities, GSC = Green Standards Compliance, AGM = Green Innovation Management

Source: author's own calculations

The first analysis was the direct effects analysis (see Figure 4.19). The results indicated that green regulation management (GRM) has a positive and insignificant effect on the adoption of green innovation management (AGM) ( $\beta = 0.092$ ,  $p = 0.125$ ).

Green technical capabilities (GTC) have a positive and significant influence on the adoption of green innovation management (AGM) ( $\beta = 0.690$ ,  $p = 0.000$ ).

Green economic resources (GER) have a positive and significant influence on the adoption of green innovation management (AGM) ( $\beta = 0.125$ ,  $p = 0.027$ ).

Green human resources management (GHRM) has a positive and significant influence on the adoption of green innovation management (AGM) ( $\beta = 0.195$ ,  $p = 0.000$ ).

Green standards compliance (GSC) has a positive and insignificant influence on the adoption of green innovation management (AGM) ( $\beta = 0.035$ ,  $p = 0.208$ ).

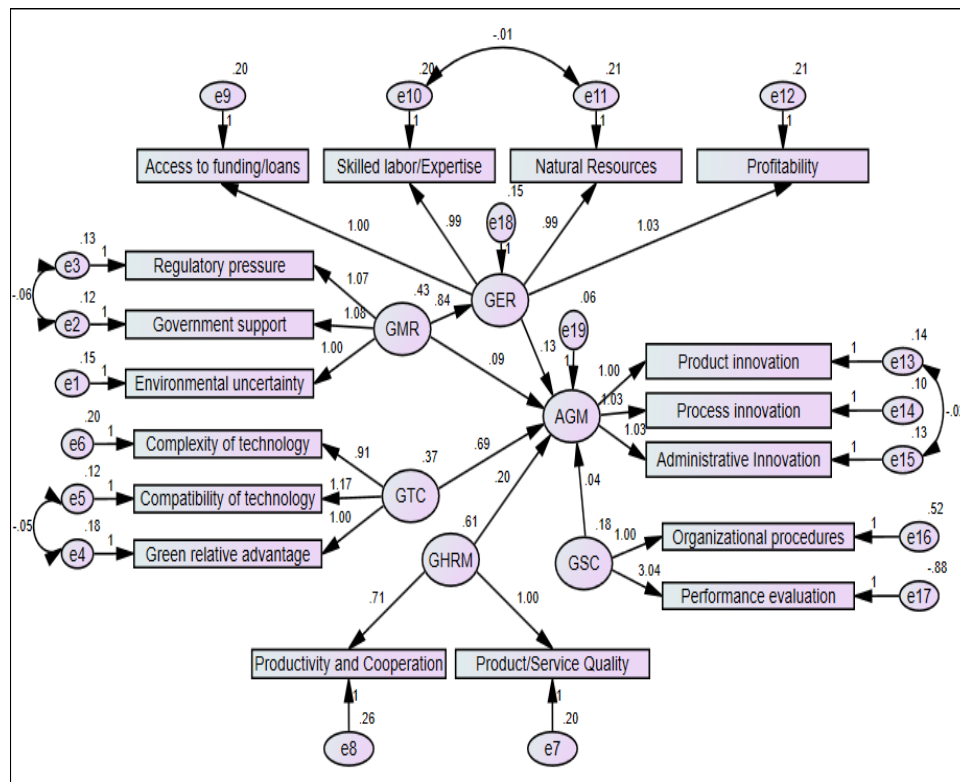


Figure 4.19: Hypotheses Analysis of Direct Effects for Thai SMEs Respondents

Source: author's own calculations

### ***Hypotheses Analysis- Mediation Effects for Thai SMEs Respondents***

To evaluate the mediation effect of green economic resources (GER) on the relationship between green regulation management (GRM) and adoption of green innovation management (AGM). The bootstrapping technique was adopted for mediation analysis. The results in Table 4.29 indicated that the indirect path GRM  $\rightarrow$  GER  $\rightarrow$  AGM) was insignificant ( $\beta = 0.106$ ,  $p = 0.075$ ), suggesting that green economic resources were not a significant mediator.

Table 4.29: Hypotheses Analysis of Mediation Effects for Thai SMEs Respondents

|                      | Relationship                            | Total Effects    | Direct Effects   | Indirect Effects | Decision                   |
|----------------------|-----------------------------------------|------------------|------------------|------------------|----------------------------|
| <b>H4</b>            | GRM $\rightarrow$ GER $\rightarrow$ AGM | 0.198<br>(0.017) | 0.092<br>(0.172) | 0.106<br>(0.075) | insignificant<br>mediation |
| Note: Beta (p-value) |                                         |                  |                  |                  |                            |

Source: author's own calculations

### *Hypotheses Analysis for Moderation Effect of Thai SMEs Respondents*

The moderation analysis was conducted to evaluate the moderating effect of green standards compliance (GSC) on the effects of green human resource management, green technical capabilities, green regulations, and green economic resources on the adoption of green innovation management.

Table 4.30: Hypotheses Analysis of Moderation Effect for Thai SMEs Respondents

| Hypotheses | Path Relationship  | Estimate | S.E.  | C.R.   | P-value |
|------------|--------------------|----------|-------|--------|---------|
|            | ZGTC → GSC_AGM     | 0.055    | 0.04  | 1.384  | 0.166   |
|            | ZGSC → GSC_AGM     | 0.024    | 0.022 | 1.09   | 0.276   |
|            | ZGRM → GSC_AGM     | -0.01    | 0.039 | -0.249 | 0.803   |
|            | ZGHRM → GSC_AGM    | -0.079   | 0.032 | -2.428 | 0.015   |
|            | ZGER → GSC_AGM     | 0.008    | 0.037 | 0.208  | 0.835   |
| <b>H8</b>  | GSC_GTC → GSC_AGM  | 0.558    | 0.039 | 14.249 | ***     |
|            | GSC_GRM → GSC_AGM  | 0.128    | 0.041 | 3.14   | 0.002   |
|            | GSC_GHRM → GSC_AGM | 0.242    | 0.034 | 7.17   | ***     |
|            | GSC_GER → GSC_AGM  | 0.036    | 0.04  | 0.886  | 0.376   |

Source: author's own calculations

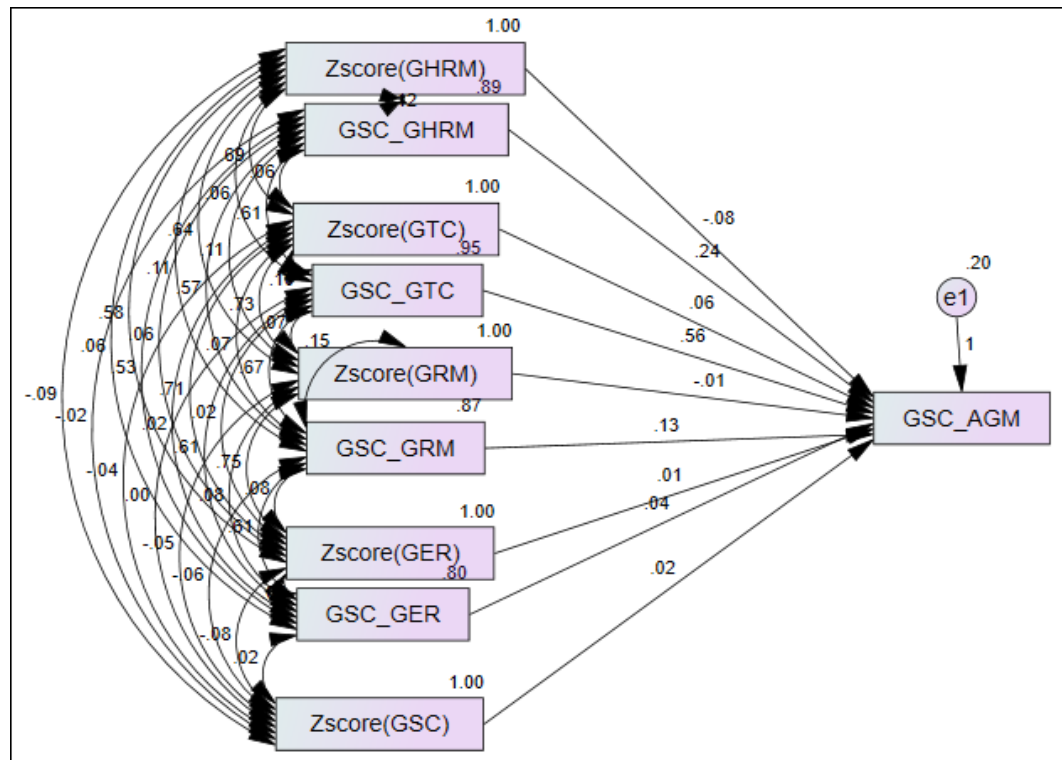


Figure 4.20: Hypotheses Analysis for Moderation Effect of Thai SMEs Respondents

Source: author's own calculations

The moderation analysis for Thailand was conducted using the interaction method (see Figure 4.20). The results indicated that the interaction between green standards compliance and green technical capabilities (GSC\_GTC) positively and significantly influences AGM ( $\beta = 0.558$ ,  $p=0.000$ ). This means that GSC moderates the effect of GTC on AGM.

The interaction between green standards compliance and green regulation management (GSC\_GRM) positively and significantly influences AGM ( $\beta = 0.128$ ,  $p=0.002$ ). This meant that GSC moderates the effect of GRM on AGM.

The interaction between green standards compliance and green human resource management (GSC\_GHRM) positively and significantly influences AGM ( $\beta = 0.242$ ,  $p=0.000$ ). This meant that GSC moderate the effect of GHRM on AGM.

The interaction between green standards compliance and green economic resources management (GSC\_GER) positively and insignificantly influences AGM ( $\beta = 0.036$ ,  $p=0.376$ ). This meant that GSC does not moderate the effect of GER on AGM.

#### **4.4. Multi-Group SEM Analysis for Polish and Thai SMEs Respondents**

The multi-group analysis was conducted to compare the results of both Poland and Thailand on the drivers of green innovation management adoption in SMEs.

The analysis compared the results of the effects of the independent variables - green economic resources, green regulations management, green human resources management, green technical capabilities, green standards compliance – on the adoption of green innovation management.

The comparison variable is ‘country,’ which is a categorical variable comprising two variables: 1 = Poland and 2 = Thailand. The Chi-square difference technique was adopted for the constrained and unconstrained model. The results are presented in Table 4.31.

Table 4.31: Multi-Group SEM Analysis: Path Comparison

|       |        | Poland |      | Thailand |      |         |
|-------|--------|--------|------|----------|------|---------|
| Paths |        | Beta   | P    | Beta     | P    |         |
| GRM.  | → GER. | .930   | ***  | .829     | ***  |         |
| GER.  | → AGM. | .120   | .262 | .094     | .115 | Trimmed |
| GTC.  | → AGM. | .293   | ***  | .739     | ***  |         |
| GHRM. | → AGM. | -.048  | .408 | .190     | ***  |         |
| GSC.  | → AGM. | .646   | ***  | .037     | .182 |         |
| GRM.  | → AGM. | .207   | .073 | .122     | .054 | Trimmed |

Source: author's own calculations

The insignificant paths for Poland and Thailand were trimmed to get the unconstrained model. Paths GER (AGM) and GRM (AGM) were trimmed in this case. The Chi-square = 2851.229 and degrees of freedom = 230 of the unconstrained models were used in the analysis.

The other model constructed was the constrained model, where the paths were constrained by naming with regression weights. The obtained Chi-square was 3021.045, and the degree of freedom was 245.

Using the Chi-square difference, the model evaluated whether the two groups – Poland and Thailand – were different. The constrained and unconstrained model difference was evaluated at 90%, 95% and 99% confidence level.

Table 4.32: Chi-Square Results for Multi-Group Analysis

|                                     | <u>Chi-square</u> | <u>df</u> | <u>P-value</u> | <u>Invariant?</u> |
|-------------------------------------|-------------------|-----------|----------------|-------------------|
| <b><u>Overall Model</u></b>         |                   |           |                |                   |
| Unconstrained                       | 2851.229          | 230       | 0.000          | NO                |
| Fully constrained                   | 3021.045          | 245       |                |                   |
| Number of groups                    |                   | 2         |                |                   |
| Difference                          | 169.816           | 15        |                |                   |
| <b><u>Chi-square Thresholds</u></b> |                   |           |                |                   |
| <i>90% Confidence</i>               | 2853.93           | 231       | 0.100          |                   |
| Difference                          | 2.71              | 1         |                |                   |
| <i>95% Confidence</i>               | 2855.07           | 231       | 0.050          |                   |
| Difference                          | 3.84              | 1         |                |                   |
| <i>99% Confidence</i>               | 2857.86           | 231       | 0.010          |                   |
| Difference                          | 6.63              | 1         |                |                   |

Source: author's own calculations

The results show that the model is invariant (different across Poland and Thailand). In other words, the drivers of green innovation management in SMEs differ in Poland and Thailand.

The Chi-square difference was 169.816, and the degree of freedom difference was 15. The p-value was 0.00 ( $p < 0.1, 0.05, 0.01$ ). This led to the rejection of the null hypothesis, implying that the two models were not invariant (different) across Poland and Thailand. Considering that they were different, it was necessary to check which areas of variables were different. Individual paths were tested to see which paths showed a difference between Poland and Thailand. Each significant path was evaluated using Chi-square tests at 95% confidence levels. The results are summarized in Table 4.33. These results show that there was a difference between Poland and Thailand on three paths:  $GTC \rightarrow AGM$ ,  $GHRM \rightarrow AGM$ , and  $GSC \rightarrow AGM$ .

Table 4.33: Path Comparison for Multi-Group Analysis

| <b>Paths</b>           | <b>Chi-square Results</b> | <b>Threshold (95% CL)</b> | <b>Conclusion</b> |
|------------------------|---------------------------|---------------------------|-------------------|
| $GRM \rightarrow GER$  | 2852.950                  | 2855.07                   | Not different     |
| $GTC \rightarrow AGM$  | 2879.743                  |                           | Different         |
| $GHRM \rightarrow AGM$ | 2857.096                  |                           | Different         |
| $GSC \rightarrow AGM$  | 2969.771                  |                           | Different         |

Source: author's own calculations

## **CHAPTER 5. DISCUSSIONS AND RECOMMENDATIONS**

### **FOR SMES ADOPTION OF GREEN INNOVATION**

### **MANAGEMENT IN POLAND AND THAILAND**

#### **5.1. Discussions of the Findings**

This chapter presents a comprehensive discussion of the findings of the study. The discussions of the findings are prepared with reference to the empirical literature. The discussions were prepared based on the objectives of the study set in the first chapter. It is also done to address the hypotheses of the study showing the relationship of the variables which include green technical capabilities, green regulations management, green economic resources, green human resources management, and green standards compliance. The chapter starts by discussing the findings in comparison with previous literature. A comparison between Poland and Thailand is also done. Then the implications of findings are presented, as well as the recommendations of the study.

#### ***Influence of Green Regulation Management on Adoption of Green Innovation Management in Polish SMEs Respondents***

The first analysis evaluated the effect of green regulation management on the adoption of green innovation management. From the results obtained, for the case of Poland, green regulation management does not significantly influence the SMEs' adoption of green innovation management. It indicated that green regulation management policies, acts, and standards in Poland are not relevant in influencing the aspects of green innovation management practices among SMEs. This could suggest that SMEs take time to lay down legal and regulatory structures that govern green practices (Meidute-Kavaliauskiene et al., 2021; Tyler et al., 2024; Wang et al., 2021). It may also suggest that in Poland, as suggested by Huang and Lei (2021), regulatory measures are necessary but insufficient to effectively integrate green innovation in SME management.

### ***Influence of Green Technical Capabilities on Adoption of Green Innovation Management in Polish SMEs Respondents***

The other analysis conducted was the effect of green technical capabilities towards the green innovation management adoption by SMEs in Poland. The findings indicated that there was a positive and significant relationship between green technical capabilities and the SMEs' adoption of green innovation management practices ( $\beta = 0.266$ ,  $p = 0.000$ ). From these results, it was arguable that technical capabilities factors, such as the complexity of the technology adopted, the technology compatibility, and associated green relative advantage, as suggested are critical considerations for adopting green innovation (Rao & Holt, 2005). The results also indicated that in Poland, considering the SMEs limited market knowledge, there is great need for them to gain technical know-how on green technologies and innovation processes. The knowledge would help for successful adoption of green innovation management.

### ***Influence of Green Economic Resources on Adoption of Green Innovation Management in Polish SMEs Respondents***

In this section, the influence of green economic resources on SMEs' adoption of green innovation management was discussed. The results showed that green economic resources positively and significantly influence SMEs adopting green innovation management practices. It implies that if Poland's SMEs' green economic resources improved by one unit, their adoption of green innovation management practices would also improve by 0.227 units. These findings highlight the importance of SMEs' financial muscles, financial support, and resource allocation in driving and boosting green innovation practices. These findings echo Lee and He (2022), observations that financial resources available to SMEs could be used for green practices such as reduction in environmental impact, minimizing waste, conserving energy, and creating green awareness. In Poland's case, the important green economic resources include skilled labour availability, expertise, natural resources, and profitability. SMEs could leverage these economic resources to enhance their commitment to green innovation management practices.

### ***Influence of Green Human Resource Management on Adoption of Green Innovation Management in Polish SMEs Respondents***

In this section, green human resource management's influence on adopting green innovation management was investigated and discussed. The results revealed that green human resource management has an insignificant influence on Polish SMEs' adoption of green innovation. These results suggest that the aspects of training and development, productivity and cooperation, and product/service quality and management support do not yield sufficient support to drive a significant change in SMEs' green innovation agenda. However, these results contradict those of Song, Yu and Xu (2021), who observed that green human resource management significantly affects green innovation. Sobaih, Hasanein and Elshaer (2020) also observed that human resource management practices play an important role in amplifying green culture within an enterprise. These results suggest a peculiar case for Polish SMEs considering calling for a deeper analysis of how human resource practices are integrated with the overall green strategies in this business environment.

### ***Influence of Green Standards Compliance on Adoption of Green Management Innovation in Polish SMEs Respondents***

The influence of green standards compliance in Poland SMEs' adoption of green innovation management was investigated. The results indicated that compliance with green standards positively and significantly influences SMEs adoption of green innovation management. It was found to have the strongest influence on green innovation management, where one unit improvement in green standards compliance would result in 0.726 improvements in SMEs' green innovation management. These findings align with Toha, Johl and Khan (2020), who indicated that green standards compliance sets international, national, and industry-specific standards that help businesses adhere to the required green practices. These practices enhance resource efficiency, reduce emissions and waste, and contribute to environmental conservation and overall green practices.

### ***Influence of Green Regulation Management on Adoption of Green Innovation Management in Thai SMEs Respondents***

The results for the case of Thailand indicated that green regulation management does not significantly influence the SMEs' adoption of green innovation management. Green regulation implies the policies, laws and standards within a particular setting, organization, or jurisdiction aimed at guiding green practices. In the case of Thailand, though these practices are important (Zubeltzu-Jaka et al., 2018), their influence on green innovation practices are not influential. In other words, while these policies guide green practices, they may not have been fully integrated into Thailand's business environment, especially in SMEs. The results also align with that of Horbach, Rammer and Rennings' (2012) observations that merely having regulatory measures in place is insufficient. An effective implementation and integration of green regulations with other green initiatives is crucial.

### ***Influence of Green Technical Capabilities on Adoption of Green Innovation Management in Thai SMEs Respondents***

The research data showed positive and statistically significant links between green technical capabilities and green innovation adoption by SMEs ( $\beta = 0.69$ ,  $p = 0.000$ ). Thailand SMEs demonstrate a 0.69 unit increase in their green innovation adoption practices for every single-unit enhancement in their technical capabilities. Organizations with sophisticated technical features gain better scope to implement green management systems (Bhatia, 2021). Rao and Holt (2005) defined technical capabilities as the intersection of green technology expertise and innovation capacity and technical infrastructure knowledge. Having advanced forms of structural capital proves critical for businesses to identify and both adopt and execute eco-friendly practices.

### ***Influence of Green Economic Resources Adoption Green Management Innovation in Thai SMEs Respondents***

Research findings show that green economic resources play a significant role in driving SMEs towards adopting green innovation management practices in Thailand. These findings demonstrate how resource availability alongside strategic

resource allocation toward green innovation practices yields enhanced adoption outcomes. Ma et al. (2023) explain how financial resources serve as a fundamental catalyst for green innovation initiatives. The implementation of green funding programs and financial incentives with subsidies serves to accelerate green innovation adoption by Thai SMEs. The research examines four core elements of green economic resources that matter the most to this investigation: SME profitability and natural resource availability alongside skilled workforce availability and financial funding accessibility. Such business capabilities lead towards a sustainable business environment.

### ***Influence of Green Human Resource Management on Adoption of Green Management Innovation in Thai SMEs Respondents***

The other aspect that was investigated was the influence of green human resource management on SMEs adopting green innovation management. The results indicated that green human resource management has a significant and positive influence on adopting green innovation management. These findings align with Ali et al. (2020), who observed that green human resource management is vital for promoting practices that reduce waste, efficiently use resources, and develop a culture of environmental responsibility. This is achieved through green recruitment and selection, prioritizing employees with knowledge, experience and expertise regarding green innovation. Human capital is a key asset in driving green innovation by developing green-oriented performance metrics and an organizational culture geared towards green culture.

### ***Influence of Green Standards Compliance on Adoption of Green Management Innovation in Thai SMEs Respondents***

The study also analysed how SMEs adopting green innovation management are affected by green standards compliance. The research showed that green standards compliance does not generate meaningful influences on Thai SMEs' green innovation practices. Results suggest that green standards policies and compliance measures have not reached complete development maturity in Thailand because their significant impact remains unseen in the local landscape. These results are in line with those of Brogi and Menichini (2019) whose findings indicated that there

no relationship identified between green innovation performance and green certified companies. This research acknowledges the importance of green standards but notes their underdevelopment in Thailand's business environment.

## **5.2. Mediating Effect of Green Economic Resources in Polish and Thai SMEs Respondents**

In addition to the effect of green economic resources on the adoption of green innovation, this study analysed its mediating effect on the effect of green regulation management (GRM) on SMEs' adoption of green innovation management.

In the case of Poland, green economic resources were found to significantly mediate the effect of green resource management on SMEs' adoption of green innovation management. Additionally, green regulation management significantly affected green economic resources. This suggested that economic resources are a crucial mechanism through which green regulations are translated to adopting and including green innovations. It implies that financial and economic support is critical in the process of implementing green initiatives. For the SMEs in Poland, if green resources are effectively managed, there could be better financial outcomes, leading to the overall adoption of green management practices (Doran and Ryan, 2012). It suggests that properly integrating the regulatory framework with the resources management practices would influence green innovation practices in Polish SMEs.

For Thailand's case, the results show that green economic resources do not mediate the effect of green regulation management on green innovation management. Compared to Poland, the influence of economic resources management on SMEs in Thailand may not be well pronounced because of several aspects. First, as suggested by Yue et al. (2021), Thailand's green policies and standards are not well developed, and most SMEs may not be aware of them. Another aspect is that though green innovation is gaining prominence in Thailand, most SMEs may not be committed to investing their financial and human resources heavily in developing policies directed towards green practices.

### **5.3. Moderating Role of Green Standards Compliance of SMEs Respondents in Poland and Thailand**

This section addressed objective three of the study, which stated, ‘To determine the influence of the green standards compliance on the drivers of SMEs adoption of green innovation management’. This objective was investigated by analysing the moderating role of the green standards compliance moderating effect. The research investigated how green standard compliance moderated the effects of GTC, GRM, GHRM, and GER on the AGM. In Poland, it was observed that green standard compliance moderates the effect of all these variables (GTC, GRM, GHRM, and GER) on SMEs' adoption of green innovation management. These findings suggest that while green standard compliance such as ISO 14001 certification and other standards related to green innovation is valuable for overall environmental management, it significantly enhances the impact of technical capabilities, regulatory management, human resource practices, or economic resources on green innovation adoption. This study observes that green standards compliance outlines a framework that firms should use in their effort to identify, manage, and continuously improve environmental performance. In the case of Poland, it was observed that the effectiveness of regulatory management in promoting green innovation does depend on green standards compliance or the overall regulatory system.

For the case of Thailand, the results indicated that green standards compliance mediated the effect of three variables (GTC, GRM, and GHRM) on AGM but not the effect of GER. The results imply that SMEs' robust green technical capabilities enhance their ability to comply with green standards, which in turn leads to improved green innovation management practices. Developing green human resource practices with the guidance of stipulated green standards would also aid in implementing green innovation management. The results also suggest that effective regulatory management is critical in promoting green regulatory compliance and adherence to green standards. Overall, it shows that compliance with green standards is critical in enhancing these other aspects of green innovation management among Thai SMEs. From this observation, this study findings rhymes with Brogi and Menichini (2019), who state that the integration of green standards

and regulations into various aspects of business operations would ensure that appropriate green innovation management aspects are incorporated within SMEs' overall business operations. In the process of developing strategies that promote green innovation, SMEs should consider their adherence to green standards.

#### **5.4. Study Results Comparison for SMEs Respondents in Poland and Thailand**

This section discusses the study's first objective, 'To conduct a comparative analysis of SMEs green innovation management practices in Poland and Thailand businesses environment'. This objective was analysed using a multi-group SEM analysis, which compared the drivers of green innovation management between Poland and Thailand.

Interesting results were obtained, where the findings indicated that green innovation drivers differed in Poland and Thailand. These results were obtained using a Chi-square test, where the Chi-square difference was 169.816, and the degree of freedom difference was 15. The p-value was 0.000 ( $p < 0.1, 0.05, 0.01$ ), which implied that the two models were not invariant (are different) across Poland and Thailand. This implied that the aspects of adopting and implementing green innovation management in Poland and Thailand SMEs varied or different.

The research investigated which aspects or drivers resulted in variation between the two countries. The results found that the adoption of green innovation among SMEs in Poland and Thailand differed across three drivers –green technical capabilities, green human resource management, and green standards compliance. From a critical perspective, the major reasons for the observed differences could be the varied regulatory environment. Compared to Thailand, Polish regulatory framework is considered more robust, offering a stronger foundation for technical capabilities relevant to green innovation practices. Another aspect is industrial maturity differences, where the Thai SMEs may have a lower maturity in terms of technical capabilities and regulatory standards. Poland is also considered to have higher expertise in green technologies. The variations could be attributed to various factors, including regulatory environments, industry maturity, cultural and institutional factors, HR practices, awareness and training, and the perception and value of standards. Understanding these differences is crucial for tailoring strategies

and policies to effectively promote green innovation in SMEs across different contexts.

This research aimed to investigate the driver of green innovation management in small and medium-sized enterprises (SMEs) in Poland and Thailand. The study was driven by the increasing interest in green innovation in the business environment, particularly among the SMEs. Environmental conservation through green practices is a great concern, and SMEs, which comprise the largest proportion of operational businesses, could play a critical role in the green agenda.

The study adopted the Natural Resource Based View and Triple Bottom Line Framework as the guiding theoretical frameworks for the study, with five independent variables (green technical capabilities, green regulations management, green economic resources, green human resources management, and green standards compliance) and one dependent variable, adopting green innovation management. An empirical analysis was conducted using primary data collected from SME representatives in Poland and Thailand.

The results concluded that there were two universally significant drivers of SMEs' green innovation management for both Poland and Thailand – green technical capabilities and green economic resources. They both significantly and positively influence the adoption of green innovation management in the two countries. Similarly, green regulation management was found to have no significant effect on SMEs' green innovation management in both countries. While green human resource management was a significant driver in Thailand, compliance with green standards was a significant driver in Poland.

The study also concludes that green standards compliance was a more slightly relevant factor to Poland as compared to Thailand. This is because green standard compliance moderated the effect of all constructs (green technical capabilities, green regulation management, green human resource management, and green economic resources) on adoption of green innovation. However, in the case of Thailand, green standards compliance moderated the effect of three variables (green regulation management, green human resource management, and green economic resources) on the adoption of green innovation management.

A comparison of the two countries using a multi-group analysis revealed a significant difference between Poland and Thailand. There was a significant difference in the driver of green innovation management by SMEs. An extended analysis revealed the variance in three drivers – green technical capabilities, green human resource management, and green standard compliance. As a result, this study concludes that these drivers should be adopted and implemented with regard to the specific business context in each country.

## **5.5. Study Results Implications**

### ***Theoretical Implications***

Several theoretical implications were proposed from the study, which contributes to the overall green innovation management among SMEs. The first theoretical contribution regards the adopted Natural Resource Based View (NRBV) and the Tripple Bottom Line (TBL) models, which developed the background of this study. The study extended the NRBV and TBL models by adding two variables (human resource management (GHRM) and green standards compliance (GSC)). This study considers the model relevant in researching green innovation practices in the business. As suggested by Hart and Dowell (2011), the model highlights the importance of capabilities related to the natural environment, emphasizing the development of sustainable competitive advantages through pollution prevention, product stewardship, and green practices.

Firstly, the study contributes to the theory by empirically proving the importance of green-specific technical capabilities in achieving a green innovation agenda. Green technical capabilities were found to be significant in both Poland and Thailand. This suggests that technical expertise and capabilities are foundational to adopting green innovations. This aligns with the NRBV and TBL theories, which argues that firm-specific capabilities are essential for competitive advantage (Fahad et al., 2022). In the same breath, this study highlights the importance of financial and economic resources directed toward green initiatives. These would create a friendly environment for other drivers to influence the green innovation management efforts.

The contextual difference between Poland and Thailand was explicitly observed. There were differences in the magnitude and significance of drivers' effects on the adoption of green innovation management between the two countries. From a theoretical point of view, this emphasizes the importance of context-specific factors in shaping the adoption of green practices, supporting the contextual theory of innovation adoption. As a result, innovation adoption theories must account for contextual variability to be fully explanatory.

The study analysed the NRBV and TBL frameworks by two more variables. The included variables - human resource management (GHRM) and green standards compliance (GSC) - proved critical variables in exploring green innovation practices among SMEs. While GHRM was a significant factor in Thailand, GSC was an important driver in Poland. The improved framework offers valuable insights for both researchers and practitioners, suggesting that effective green innovation management requires a holistic approach. The holistic approach would integrate technical capabilities, human resource practices, and green standards compliance. Future research can build on this extended NRBV framework to explore additional constructs and further refine our understanding of sustainable business practices in various contexts.

### ***Practical Implications***

The findings of this study led to the development of several managerial and practical implications that could help Poland and Thailand SMEs in their effort to adopt green innovation management. These actionable insights and recommendations could be implemented by relevant stakeholders, including SME managers, CEOs and policymakers.

The first practical implication is the enhanced market differentiation and competitiveness. For SMEs that adopt and master green innovation management practices will find themselves uniquely positioned as leaders in green agenda. This market differentiation is particularly vital in crowded marketplaces where the green credentials of SMEs can be utilized as a very important competitive advantage, which can enhance brand equity and reputation. Consumer trust increases through green innovation management since customers demonstrate growing environmental awareness which leads them to support businesses view as sustainable operators.

The forward-thinking implementation of green innovation management strategies by SMEs will result in better business image, that would increase the business revenue in the long-run. Increasing demand from multinational companies for green supply chains open contract opportunities for SMEs who receive preferred supplier status while they unlock international trading potential and welcome green interested investors into their business.

The second practical implication is developed from the concept that green innovation management provides SMEs with regulatory compliance standards and legal protection opportunities. Small and medium-sized enterprises that use green innovation management will succeed at meeting regulatory requirements therefore avoiding penalties. They will also avoid costlier late compliance actions. SMEs who achieve compliance with international green standards alongside national green policies receive strengthened operational legitimacy across international markets. Organizations that operate according to green regulations qualify for subsidies and tax breaks and grants which act as catalysts to achieve compliance.

The third practical implication of green innovation management adoption is operational efficiency cost saving measures. The implementation of resource efficiency creates two benefits that include diminished waste and enhanced resource utility alongside the integration of green supply chains. SMEs that deploy renewable energy systems alongside energy-efficient machinery together with waste recycling approaches and material reuse methods and optimized inventory management systems experience reduced long-term expenses. Through implementing energy-saving measures SMEs reduce their exposure to volatile energy tolls while preserving existing resources which ensures their business survives in the long run.

## CONCLUSION

The dissertation adds value by incorporating the concept of management in green innovation in SMEs context. It provides cross-cultural insights by comparing SMEs' drivers of green innovation management practices in Poland and Thailand. The study borrowed from NRBV and TBL frameworks, highlighted significant differences in the role of drivers such as green technical capabilities, green human resources management, and green regulations management. The cross-cultural perspective enhances the global applicability of the findings, demonstrating how green innovation management strategies must be adapted to specific local contexts. Further, a new conceptual model is introduced 'green innovation management in SMEs' that provides new insights into this subject and could be adopted for future research.

The purpose of this study was to investigate the drivers that influence green innovation management in SMEs. Poland and Thailand were considered as the case studies for comparison purposes. The main aim has been achieved through the achievement of the following set objectives. The first objective compared the SMEs' green innovation management practices in Poland and Thailand business environments. The study demonstrated the level of green innovation practices in the SMEs management of both countries. The study demonstrated that both countries experience similar business environments, such as limited resources and technical deficiencies. Additionally, it was observed that their responses to green innovation adoption are shaped by localized factors. For instance, for the case of Poland's, it adheres to European Union regulations. For Thailand's case, it emphasizes on the Bio-Circular-Green (BCG) economy model. These reveal different paths by each nation as far as promoting green practices are concerned. These differences show the importance of to have policies and support systems, which are designed to address the environmental conditions for each of the country.

The second objective was geared towards finding out the drivers that influence SMEs' adoption of green innovation management in Poland and Thailand. This objective was evaluated by carrying out the empirical analysis using SEM. The results indicated that green regulations, green technical capabilities, green

economic resources, green human resources management, and green standards compliance have a significant influence on the SMEs adoption of green innovation management practices. Additionally, the influence of green standards compliance (e.g., ISO 14001) as a moderating factor was evaluated. Further, the effect of green economic resources was evaluated as a mediating factor. Their significant roles in enhancing SMEs' green innovation practices were emphasized. The findings of the relationship between these variables led to the development of theoretical and practical recommendations for the advancements in the field of green innovation management.

The proposed conceptual model, validated through cross-cultural and multi-group analysis, offers a foundation for future research and practical application. Furthermore, the study's insights emphasize the importance of a holistic approach to green innovation that integrates environmental, social, and economic factors, ensuring that SMEs can remain competitive while addressing global green challenges. These findings will serve as a valuable resource for business leaders, policymakers, and academics working toward the shared goal of promoting green development through innovative management practices.

### ***Recommendations***

From the findings of this study, several policy recommendations have been developed. These recommendations are geared towards the adoption of green innovation management by SMEs in Poland and Thailand, and by extension, other emerging economies. This study considers the enhancement of SMEs technical capabilities to absorb green innovation practices as the first policy recommendation. Enhancing technical capabilities involves investing in various aspects that could be necessary to improve their green innovation practices. This, specifically could involve adoption and implementation of programs such as training and awareness and skills acquisition (Rao and Holt, 2005). Enhancing technical capabilities towards green products could play a critical role through training and development programs. Inculcating an innovation culture within the business would encourage employees to discover new ideas that could enhance green agenda for their enterprises.

The second recommendation of the study is considering financial support and investment in driving green initiatives within SMEs. This is because green technical capabilities were found to have a significant influence towards the adoption of green innovation management practices. Financial support and investment could be achieved through internal budget allocation. Additionally, considering the increasing interest in green innovation (Shah et al., 2021). SMEs could source external funds to support their green innovation agenda from various funding options such as government grants, subsidies, and loans specifically targeted at green innovation.

The study also recommends a policy advocacy where governments are encouraged to give incentives and other support to SMEs towards the adoption of green innovation management. The support could be through the provision of tax benefits and reliefs, tax grants and subsidies to accelerate green innovation management adoption across different industries.

The research also recommends the establishment of collaborative networks across different spheres from regional, national, and international collaborative hubs. It is also vital to establish public-private collaborative partnerships and the incubation of green hubs that make it easier of SMEs to key into green initiatives, as these hubs will provide SMEs with access to much needed resources, data, and technologies that drive the adoption of green innovation management. These hubs should also be monitored and evaluated based on performance to ensure they align with environmental goals, while identifying areas to improve.

In Thailand, improving green human resource management would be key to enhancing the green innovation agenda. Developing a comprehensive human resource management practice would engage all stakeholders and cultivate green practices throughout the organization. This research also recommends the importance of integrating human resources and green standards. HR practices that comply with green standards can significantly drive green innovation by ensuring employees are engaged and committed to green initiatives. In Poland's case, this study recommends the importance of leveraging compliance with green standards. SMEs' compliance with green standards such as ISO 14001, designed to minimize environmental impact, could improve resource efficiency and ensure that

businesses operate in an environmentally responsible manner. For SMEs, compliance with green standards can provide several benefits, including enhanced credibility, improved operational efficiency, and better market positioning.

Overall, this research recommends that observing standards that promote green innovation would be critical in SMEs' efforts. It would play as a guiding framework. For Poland and Thailand, some of the green standards they should monitor and adhere to include industry-specific green standards, national and regional standards, and international standards such as ISO 14001 (Reis et al., 2018).

The last managerial recommendation is that SMEs should consider the contextual business environment while adopting and implementing green innovation management initiatives. The reason is that there is variation in the significance and magnitude of drivers influencing SMEs' green innovation management. Therefore, this study recommends that concerned stakeholders, including SME managers and policymakers, should develop tailored strategies for green innovation management. This could be achieved by thoroughly assessing the local business environment, regulatory landscape, cultural attitudes towards green agenda, and existing green practices in the concerned country.

### ***Limitations of the Study***

The study is considered to have been conducted successfully, and significant insights and recommendations regarding the drivers of green innovation in SMEs have been developed. However, several limitations were noted, which need to be discussed because they are important in interpreting the results and guiding future research.

The first and obvious limitation of this study is that it focused on SMEs as the study population. This narrowed focus on SMEs limits the applicability of the findings to larger organizations. The drivers of green innovation management may differ significantly between SMEs and larger enterprises. This study advises that the insights gained may not be directly transferable to larger organizations or different types of businesses. Future studies should consider conducting a comprehensive study comparing SMEs and large firms.

The first limitation of this study is the cross-sectional nature of the research method adopted. The cross-sectional analysis implies that the data regarding the SMEs' green innovation management was collected at a single point in time. This means that the study does not account for changes and variations in time. As a result, the study may not capture the evolving perspectives in green innovation management. Future studies could consider using time series data or conducting the study in two different periods for comparison and capture the change in green innovation perspectives.

Another limitation was cultural and contextual factors. The study compared the drivers of green innovation between Poland and Thailand. However, the study may not have fully accounted for all cultural, economic, and contextual differences influencing green innovation management practices. Local norms, values, and economic conditions can vary widely and affect the adoption of green practices. Therefore, the findings of this study should be applied in this regard. This study advises future studies to consider more cultural context when comparing different regions or countries.

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## LIST OF TABLES

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|--------------------------------------------------------------------------------------------------|-----|
| Table 1.1: EU SMEs Definitions .....                                                             | 14  |
| Table 1.2: Small and Medium Enterprises Definitions .....                                        | 15  |
| Table 1.3: New Categorization of SMEs .....                                                      | 16  |
| Table 2.1: Development of Study Variables from NRBV and TBL models .....                         | 63  |
| Table 3.1: Study Constructs Observed Variables and Items .....                                   | 85  |
| Table 3.2: Cronbach's Alpha Criteria.....                                                        | 92  |
| Table 3.3: Cronbach's alpha Reliability Analysis of first 30 responses .....                     | 92  |
| Table 3.4: Congruence Evaluation Table between the Conceptual Framework and Empirical Data ..... | 94  |
| Table 4.1: Demographic Statistics for Poland SMEs Respondents.....                               | 97  |
| Table 4.3: Green Regulation Management for Poland SMEs Respondents.....                          | 99  |
| Table 4.5: Green Technical Capabilities for Poland SMEs Respondents .....                        | 101 |
| Table 4.2: Green Economic Resources for Poland SMEs Respondents .....                            | 102 |
| Table 4.4: Green Human Resources Management for Poland SMEs Respondents .....                    | 103 |
| Table 4.6: Green Standards Compliance for Poland SMEs Respondents.....                           | 105 |
| Table 4.7: Adoption of Green Innovation Management for Poland SMEs Respondents                   | 106 |
| Table 4.8: Normality Analysis Results of Poland SMEs Respondents.....                            | 108 |
| Table 4.9: Correlation Analysis for Poland SMEs Respondents.....                                 | 110 |
| Table 4.10: Model Fit Indices for Poland SMEs Respondents .....                                  | 116 |
| Table 4.11: Reliability and Validity Analysis for Poland SMEs Respondents .....                  | 118 |
| Table 4.12: Variables Used in the SEM Model for Poland SMEs Respondents.....                     | 120 |
| Table 4.13: Hypotheses Analysis of Direct Effects for Poland SMEs Respondents.....               | 121 |
| Table 4.14: Hypotheses Analysis for Mediation Effects of Poland SMEs Respondents                 | 123 |
| Table 4.15: Hypotheses Analysis for Moderation Effect of Poland SMEs Respondents                 | 124 |
| Table 4.16: Demographic Statistics Analysis for Thailand SMEs Respondents .....                  | 126 |

|                                                                                          |     |
|------------------------------------------------------------------------------------------|-----|
| Table 4.18: Green Regulations Management for Thailand SMEs Respondents .....             | 127 |
| Table 4.20: Green Technical Capabilities for Thailand SMEs Respondents .....             | 129 |
| Table 4.17: Green Economic Resources for Thailand SMEs Respondents .....                 | 130 |
| Table 4.19: Green Human Resources Management for Thailand SMEs Respondents....           | 131 |
| Table 4.21: Green Standards Compliance for Thailand SMEs Respondents.....                | 133 |
| Table 4.22: Adoption of Green Innovation Management for Thailand SMEs Respondents .....  | 134 |
| Table 4.23: Normality Tests for Thailand SMEs Respondents.....                           | 136 |
| Table 4.24: Correlation Analysis for Thailand SMEs Respondents .....                     | 138 |
| Table 4.25: Fit Indices Results for Thailand SMEs Respondents.....                       | 143 |
| Table 4.26: Reliability and Validity Analysis Results for Thailand SMEs Respondents      | 146 |
| Table 4.27: Variables Used in the SEM Model for Thailand SMEs Respondents .....          | 147 |
| Table 4.28: Hypotheses Analysis of Direct Effects for Thailand SMEs Respondents ...      | 149 |
| Table 4.29: Hypotheses Analysis of Mediation Effects for Thailand SMEs Respondents ..... | 150 |
| Table 4.30: Hypotheses Analysis of Moderation Effect for Thailand SMEs Respondents ..... | 151 |
| Table 4.31: Multi-Group SEM Analysis: Path Comparison .....                              | 153 |
| Table 4.32: Chi-Square Results for Multi-Group Analysis.....                             | 153 |
| Table 4.33: Path Comparison for Multi-Group Analysis.....                                | 154 |

## LIST OF FIGURES

|                                                                                                          |     |
|----------------------------------------------------------------------------------------------------------|-----|
| Figure 1.1: Green Supply Chain Management.....                                                           | 26  |
| Figure 2.1: The TBL framework.....                                                                       | 62  |
| Figure 2.2: Green Regulation Management Observed Variables.....                                          | 66  |
| Figure 2.3: Green Technical Capabilities Observed Variables .....                                        | 68  |
| Figure 2.4: Green Economic Resources Observed Variables .....                                            | 70  |
| Figure 2.5: Green Human Resource Management Observed Variables .....                                     | 72  |
| Figure 2.6: Green Standards Compliance Observed Variables.....                                           | 75  |
| Figure 2.7: Adoption of Green Innovation Management Observed Variables .....                             | 77  |
| Figure 2.8: Conceptual Framework of the Study .....                                                      | 78  |
| Figure 4.1: First Order CFA for Poland SMEs Respondents of Green Economic Resources .....                | 111 |
| Figure 4.2: First Order CFA for Poland SMEs Respondents of Green Regulations Management.....             | 112 |
| Figure 4.3: First Order CFA for Poland SMEs Respondents of Green Human Resources Management.....         | 113 |
| Figure 4.4: First Order CFA for Poland SMEs Respondents of Green Technical Capabilities .....            | 113 |
| Figure 4.5: First Order CFA for Poland SMEs Respondents of Green Standards Compliance .....              | 114 |
| Figure 4.6: First Order CFA for Poland SMEs Respondents in Adoption of Green Innovation Management ..... | 115 |
| Figure 4.7: Second Order Confirmatory Factor Analysis (SO-CFA) for Poland SMEs Respondents .....         | 116 |
| Figure 4.8: Initial SEM Model for Poland SMEs Respondents .....                                          | 121 |
| Figure 4.9: Hypotheses Analysis of the Direct Effects for Poland SMEs Respondents .                      | 122 |
| Figure 4.10: Hypotheses Analysis for Moderation Effect of Poland SMEs Respondents .....                  | 124 |

|                                                                                                             |     |
|-------------------------------------------------------------------------------------------------------------|-----|
| Figure 4.11: First Order CFA for Thailand SMEs Respondents of Green Economic Resources .....                | 139 |
| Figure 4.12: First Order CFA for Thailand SMEs Respondents of Green Regulations Management.....             | 140 |
| Figure 4.13: First Order CFA for Thailand SMEs Respondents of Green Human Resources Management.....         | 141 |
| Figure 4.14: First Order CFA for Thailand SMEs Respondents of Green Technical Capabilities.....             | 141 |
| Figure 4.15: First Order CFA for Thailand SMEs Respondents of Green Standards Compliance .....              | 142 |
| Figure 4.16: First Order CFA for Thailand SMEs Respondents in Adoption of Green Innovation Management ..... | 142 |
| Figure 4.17: Second-Order Confirmatory Factor Analysis (SO-CFA) for Thailand SMEs Respondents .....         | 144 |
| Figure 4.18: Initial SEM Model for Thailand SMEs Respondents .....                                          | 148 |
| Figure 4.19: Hypotheses Analysis of Direct Effects for Thailand SMEs Respondents ..                         | 150 |
| Figure 4.20: Hypotheses Analysis for Moderation Effect of Thailand SMEs Respondents .....                   | 151 |

## APPENDICES

### Appendix A - Questionnaire

The purpose of this questionnaire is to investigate the drivers of green innovation management adoption in SMEs in the case of Poland and Thailand. It's a Green Innovation Management Survey with inquiry directed toward senior managers, supervisors, and directors of Small and Medium-sized Enterprises (SMEs) actively engaged in green practices and green businesses. The data gathered will be exclusively utilized for this study within the SME sectors of Poland and Thailand. Kindly respond to the questions to the best of your knowledge and contribute to the rich insights for this research initiative.

#### Section A: Demographics (Tick as appropriate)

1. Your gender:

- |        |     |
|--------|-----|
| Male   | [ ] |
| Female | [ ] |
| Others | [ ] |

2. Please indicate your age bracket:

- |                                    |     |
|------------------------------------|-----|
| 18-27 years (Gen Z)                | [ ] |
| 28-43 years (Gen Y or Millennials) | [ ] |
| 44-59 years (Gen X)                | [ ] |
| 60-78 years (Baby Boomers)         | [ ] |
| 79-99 years (Silent Gen)           | [ ] |

3. Highest level of education:

- |                      |     |
|----------------------|-----|
| Primary School       | [ ] |
| Secondary School     | [ ] |
| Undergraduate degree | [ ] |
| Postgraduate degree  | [ ] |

4. Number of Employees in Poland

- |        |     |
|--------|-----|
| 10-49  | [ ] |
| 50-249 | [ ] |

5. Number of Employees in Thailand

- |        |     |
|--------|-----|
| 6-50   | [ ] |
| 51-200 | [ ] |

6. What industry does your company operate in?

- |                     |     |
|---------------------|-----|
| Agriculture         | [ ] |
| Construction        | [ ] |
| Energy              | [ ] |
| Food Processing     | [ ] |
| Health              | [ ] |
| Manufacturing       | [ ] |
| Retail and Services | [ ] |
| Tourism             | [ ] |
| Transportation      | [ ] |
| Others              | [ ] |

7. Employment Status

- |                      |     |
|----------------------|-----|
| SME Owner            | [ ] |
| SME Management Staff | [ ] |
| SME Employee         | [ ] |
| Other Positions      | [ ] |

8. Work Experience

- |             |     |
|-------------|-----|
| 0-4 years   | [ ] |
| 5-10 years  | [ ] |
| 11-15 years | [ ] |
| 16-20 years | [ ] |
| >20 years   | [ ] |

**Notes for Measurement Items**

Before proceeding with the survey, it is necessary to clarify certain phrases that are often used in order to comprehend the more complex concepts.

- i. Green Economic Resources' incorporates the financial, natural, human, and technological resources and assets that are utilized in the development, production, and distribution of goods and services that prioritize environmental management and green economy.
- ii. Green Regulations Management' includes all the formal control, oversight, and execution of environmental regulations and policies aimed at promoting and ensuring green and eco-friendly practices within various industries and sectors.

- iii. Regulatory agencies in Poland: The Ministry of Climate and Environment, the Main Inspectorate of Environmental Protection, and the General Directorate of Environmental Protection regulate the use of environmental resources.
- iv. Regulatory agencies in Thailand include Department of Environmental Quality Promotion (DEQP), Office of Natural Resources and Environmental Policy and Planning (ONEP), Environmental Impact Evaluation Bureau (EIEB), Energy Policy and Planning Office (EPPO), Department of Alternative Energy Development and Efficiency (DEDE), and Board of Investment (BOI).
- v. Green Human Resources Management' involves the strategic integration of environmental considerations and practices into the traditional human resources functions, aiming to develop an environmentally conscious and green workforce.
- vi. Green Technical Capabilities' refer to the proficiency and capacity to develop and implement eco-friendly technologies and practices.
- vii. Green Standards Compliance' refers to the adherence to the green standards outlined in the ISO 14001 certifications, which sets the criteria for an environmental management system.
- viii. Green Innovation Management - refers to a style of innovation in management that focuses on creating or improving environmentally friendly goods, services, procedures, and practices.
- ix. Green Innovations refer to innovations that focus on preventing pollution, reducing waste, and implementing environmental management.
- x. Administrative Innovations include all measures and policies introduced to improve management of organizational information
- xi. Green Practices' refers to actions that reduce the environmental impact, such as eco-purchase and recycling.

## Section B: Measurement Items

Please respond to the following questions to the best of your knowledge. Tick the relevant box.

Note: Please refer to 'Notes for Measurement Items' below this section to understand the meaning of various terms used.

1= strongly disagree; 2 = disagree, 3 = neutral; 4 = agree; 5 = strongly agree.

| S/No                               | Items                                                                  | 1 | 2 | 3 | 4 | 5 |
|------------------------------------|------------------------------------------------------------------------|---|---|---|---|---|
| <b>Green Regulation Management</b> |                                                                        |   |   |   |   |   |
| 1                                  | Regulatory agencies are supportive of green innovation implementation. |   |   |   |   |   |

|                                     |                                                                                                                                                                                                        |  |  |  |  |  |
|-------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|--|
| 2                                   | Regulatory agencies regularly conduct inspections to ensure compliance with rules.                                                                                                                     |  |  |  |  |  |
| 3                                   | Regulatory agencies enforce green innovation guidelines through incentives and penalties                                                                                                               |  |  |  |  |  |
| 4                                   | Tax/subsidy incentives for renewable energy investments have significantly lowered our financial barriers to introduce renewable solutions e.g. installing solar panels on industrial roofs, LNG, etc. |  |  |  |  |  |
| 5                                   | We are aware of and actively engage with government programs or initiatives designed to enhance green regulations within our industry, such as the Green Investment Scheme.                            |  |  |  |  |  |
| 6                                   | Green regulations influence our strategic decisions, prompting us to invest in resource efficiency and create new green product lines.                                                                 |  |  |  |  |  |
| 7                                   | Green policies and regulations have accelerated the progress and adoption of green technologies.                                                                                                       |  |  |  |  |  |
| 8                                   | Policies supporting green innovation regulations subsidies has assisted SMEs in acquiring necessary resources to compete with large enterprises.                                                       |  |  |  |  |  |
| 9                                   | We have developed new eco-friendly products and services due to the government's focus on green technology, encouraging its adoption.                                                                  |  |  |  |  |  |
| <b>Green Technical Capabilities</b> |                                                                                                                                                                                                        |  |  |  |  |  |
| 10                                  | The advancement of green technology necessitates the development of new skills in innovation management due to its complexity.                                                                         |  |  |  |  |  |
| 11                                  | Our organization created a user-friendly green innovation knowledge base for employees to access materials and best practices.                                                                         |  |  |  |  |  |
| 12                                  | We have employed successful strategies to manage/overcome technological complexity challenges in adopting and integrating green technologies within our technical capability.                          |  |  |  |  |  |
| 13                                  | Our company successfully ensured the compatibility of green initiatives with our environmental responsibility and operational excellence values.                                                       |  |  |  |  |  |

|                                         |                                                                                                                                                |  |  |  |  |  |
|-----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|--|
| 14                                      | We have reduced energy usage and exceeded our environmental performance targets by adopting renewable energy sources.                          |  |  |  |  |  |
| 15                                      | We have measures in place to continuously improve our technical capability in managing and optimizing the compatibility of green technologies. |  |  |  |  |  |
| 16                                      | Implementing green innovation management has improved our corporate image.                                                                     |  |  |  |  |  |
| 17                                      | Implementing green innovation management leads to better economic benefits.                                                                    |  |  |  |  |  |
| 18                                      | Transparency about our green activities and measurable environmental progress have improved our brand, credibility, and customer loyalty.      |  |  |  |  |  |
| <b>Green Economic Resources</b>         |                                                                                                                                                |  |  |  |  |  |
| 19                                      | Government funding is available to implement green innovation.                                                                                 |  |  |  |  |  |
| 20                                      | Our company dedicates specific funds to green innovation.                                                                                      |  |  |  |  |  |
| 21                                      | Our company partnered with the local university to train our employees on green innovation best practices.                                     |  |  |  |  |  |
| 22                                      | Our company is able to attract highly skilled employees who specialize in green innovation management.                                         |  |  |  |  |  |
| 23                                      | We optimize resource management by partnering with local green suppliers to minimize negative environmental impacts such as pollution.         |  |  |  |  |  |
| 24                                      | We have invested in resource-saving technologies like waste recycling, biomass, etc                                                            |  |  |  |  |  |
| 25                                      | Balancing profitability with the integration of green economic resources is a key priority for our company's development strategy.             |  |  |  |  |  |
| 26                                      | We are implementing green innovation management because it is profitable for our business.                                                     |  |  |  |  |  |
| <b>Green Human Resources Management</b> |                                                                                                                                                |  |  |  |  |  |
| 27                                      | We encourage employees to suggest and implement green initiatives through company-wide competitions and idea boards.                           |  |  |  |  |  |

|                                                |                                                                                                                                                                                   |  |  |  |  |  |
|------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|--|
| 28                                             | Our performance reviews include green metrics, such as energy consumption reduction and waste minimization, alongside traditional performance indicators.                         |  |  |  |  |  |
| 29                                             | There is a high level of cooperation among employees in implementing green practices to improve productivity.                                                                     |  |  |  |  |  |
| 30                                             | We offer dedicated training programs on green innovation concepts, like life cycle assessment and eco-design, etc., for all employees.                                            |  |  |  |  |  |
| 31                                             | We provide resources and support to ensure the proper implementation of green practices to enhance product/service quality.                                                       |  |  |  |  |  |
| 32                                             | We recognize and reward employees for their contributions to improving green innovation product/service quality.                                                                  |  |  |  |  |  |
| <b>Green Standards Compliance</b>              |                                                                                                                                                                                   |  |  |  |  |  |
| 33                                             | We have implemented planning and control measures with regard to green standards in our practices.                                                                                |  |  |  |  |  |
| 34                                             | We have established organizational procedures to integrate green standards and compliance requirements into our daily operations.                                                 |  |  |  |  |  |
| 35                                             | The implementation of green standard-compliant, i.e. (ISO14001) organizational procedures has facilitated improvements in our resource efficiency and waste management practices. |  |  |  |  |  |
| 36                                             | Our real-time environmental information is linked to green standards compliance metrics and tracks energy consumption, waste generation, and resource utilization.                |  |  |  |  |  |
| 37                                             | Our performance tracking system encompasses not only green product lifecycle but also employee green engagement and skills development.                                           |  |  |  |  |  |
| 38                                             | We conduct periodic analyses and evaluations to measure green innovation compliance with green standards.                                                                         |  |  |  |  |  |
| <b>Adoption of Green Innovation Management</b> |                                                                                                                                                                                   |  |  |  |  |  |
| 39                                             | We prioritize the development of environmentally friendly products/services as part of our business strategy.                                                                     |  |  |  |  |  |
| 40                                             | We regularly integrate eco-friendly materials into our product/service innovation efforts.                                                                                        |  |  |  |  |  |

|    |                                                                                                                                                                                               |  |  |  |  |  |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|--|
| 41 | We launch innovative green products/services using eco-labeling to demonstrate our commitment to green product design and marketing.                                                          |  |  |  |  |  |
| 42 | We actively seek to optimize production processes to minimize environmental impact as part of our innovation strategy.                                                                        |  |  |  |  |  |
| 43 | We have implemented green practices and technologies to reduce energy consumption and waste generation in our operational processes.                                                          |  |  |  |  |  |
| 44 | We have successfully implemented eco-friendly practices and technologies to reduce our carbon footprint and environmental impact across operational processes.                                |  |  |  |  |  |
| 45 | We implemented a flexible remote work policy and virtual collaboration tools to allow employees to work from home whenever possible to reduce our carbon footprint from commuting and travel. |  |  |  |  |  |
| 46 | Implementing administrative innovations like printing only essential communication and signing digital documents instead of paper to enhance environmental protection.                        |  |  |  |  |  |
| 47 | Our managers and supervisors are trained on green leadership principles and encouraged to incorporate green concepts in their decision-making processes.                                      |  |  |  |  |  |

Source: author's own elaborations

## Appendix B: IOC – Reliability and Validity

The Item-Objective-Congruence (IOC) was adopted to evaluate the study's validity and reliability. IOC was used to evaluate the study questionnaire.

There was an instrument calculation for the IOC between each question and variables. The questions that had an IOC greater than 0.05 were considered appropriate.  $IOC = \frac{\sum R}{N}$

Where: R = Congruence value of each question

N = The number of experts

1 = Congruent

0 = Uncertainty

-1 = Incongruent

The IOC ranges from -1 to +1. Hence, a question was considered good the closer it was to +1. The questions with an IOC of less than 0.6 were revised. Those with IOC less than 0.5 were excluded from the questionnaire (Turner and Carlson, 2003). The range of IOC included:

**+1** = The questions were found to be congruent with the content

**0** = The questions are uncertain if the questions would be congruent with the content

**-1** = The questions are found to be incongruent with the content

The consideration criteria for the IOC was as follows:

1. Questions having IOC between 0.5 – 1.00 = Valid and can be used
2. Questions with IOC below 0.5 = To be revised

The questionnaire was evaluated by a distinguished panel of five experts, comprising three from Poland and two from Thailand, all renowned for their extensive knowledge and expertise in business management. The panel included Prof. Dr. Joanna Kurowska-Pysz from WSB University, specializing in cross-border business; Prof. Dr. Paula Bajdor, from Czestochowa University of Technology, specializing in business management and ecosystems; and Prof. Dr. Janusz Grabara, from Jan Dlugosz University in Czestochowa, an expert in business management and leadership research. Representing Thailand was Assoc. Prof. Dr. Pensri Jaroenwanit, from Khon Kaen Business School, Khon Kaen University, is a seasoned business administration and management expert, and Mr. Suthipong Samitchat, a business entrepreneur representing Toyota Team Thailand.

Completing the panel was Asst. Prof. Dr. William Philip Wall, a specialist in renewable energy, sustainable solutions, and academic research.

Upon evaluating the reviewers' rating (IOC index), only two items/questions were below 0.5. these were item 3 and item 8 in the 'green regulation management.' For Item 3, the previous question, "Regulatory agencies enforce green innovation guidelines and punish defaulters," was improved to "Regulatory agencies enforce green innovation guidelines through incentives and penalties." For item number 3, it was improved from "Green innovation regulations subsidies have leveled the playing field for SMEs, helping us compete with larger enterprises" to "Policies supporting green innovation regulations subsidies has assisted SMEs in acquiring necessary resources to compete with large enterprises." The results are summarized underneath.

#### IOC – Reliability and Validity Table

| S/<br>No                           | Variables and Questions                                                                                                                                                                                    | Assoc. Prof. Dr.<br>Joanna Kurowska-<br>Pysz | Assoc. Prof. Dr.<br>Paula Bajdor | Assoc. Prof. Dr.<br>Janusz Grabara | Assoc. Prof. Dr.<br>Pensri Jaroenwanit | Mr. Suthipong<br>Samitchat | Asst. Prof. Dr.<br>William P. Wall | Total | IOC index |
|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|----------------------------------|------------------------------------|----------------------------------------|----------------------------|------------------------------------|-------|-----------|
| <b>Green Regulation Management</b> |                                                                                                                                                                                                            |                                              |                                  |                                    |                                        |                            |                                    |       |           |
| 1                                  | Regulatory agencies are supportive of green innovation implementation.                                                                                                                                     | 1                                            | 1                                | 1                                  | 1                                      | 1                          | 1                                  | 6     | 1.0       |
| 2                                  | Regulatory agencies regularly conduct inspections to ensure compliance with rules.                                                                                                                         | 1                                            | 1                                | 1                                  | 1                                      | 1                          | 1                                  | 6     | 1.0       |
| 3                                  | Regulatory agencies enforce green innovation guidelines through incentives and penalties.                                                                                                                  | 0                                            | 1                                | 1                                  | 0                                      | 1                          | 1                                  | 4     | 0.7       |
| 4                                  | Tax/subsidy incentives for renewable energy investments have significantly lowered our financial barriers to introducing renewable solutions, e.g., installing solar panels on industrial roofs, LNG, etc. | 1                                            | 1                                | 1                                  | 1                                      | 1                          | 1                                  | 6     | 1.0       |

|                                     |                                                                                                                                                                          |   |   |   |   |    |   |   |     |
|-------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---|---|----|---|---|-----|
|                                     |                                                                                                                                                                          |   |   |   |   |    |   |   |     |
| 5                                   | We are aware of and actively engage with government programs or initiatives designed to enhance green regulations within our industry, like the Green Investment Scheme. | 1 | 1 | 1 | 1 | 1  | 1 | 6 | 1.0 |
| 6                                   | Green regulations influence our strategic decisions, prompting us to invest in resource efficiency and create new green product lines.                                   | 1 | 1 | 1 | 1 | -1 | 1 | 4 | 0.7 |
| 7                                   | Green policies and regulations have accelerated the progress and adoption of green technologies.                                                                         | 1 | 0 | 1 | 1 | 1  | 1 | 5 | 0.8 |
| 8                                   | Policies supporting green innovation regulations subsidies have assisted SMEs in acquiring the necessary resources to compete with large enterprises.                    | 1 | 1 | 1 | 1 | 1  | 0 | 5 | 0.8 |
| 9                                   | We have developed new eco-friendly products and services due to the government's focus on green technology, encouraging its adoption.                                    | 1 | 1 | 1 | 1 | 1  | 1 | 6 | 1.0 |
| <b>Green Technical Capabilities</b> |                                                                                                                                                                          |   |   |   |   |    |   |   |     |
| 10                                  | The advancement of green technology necessitates the development of new skills in innovation management due to its complexity.                                           | 1 | 1 | 1 | 1 | 1  | 1 | 6 | 1.0 |
| 11                                  | Our organization created a user-friendly green innovation knowledge base for employees to access materials and best practices.                                           | 0 | 1 | 1 | 1 | 1  | 1 | 5 | 0.8 |
| 12                                  | We have employed successful strategies to                                                                                                                                | 1 | 1 | 1 | 1 | 0  | 1 | 5 | 0.8 |

|                                 |                                                                                                                                                  |   |   |   |   |   |   |   |     |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---|---|---|---|---|-----|
|                                 | manage/overcome technological complexity challenges in adopting and integrating green technologies within our technical capability.              |   |   |   |   |   |   |   |     |
| 13                              | Our company successfully ensured the compatibility of green initiatives with our environmental responsibility and operational excellence values. | 1 | 1 | 1 | 1 | 1 | 1 | 6 | 1.0 |
| 14                              | We have reduced energy usage and exceeded our environmental performance targets by adopting renewable energy sources.                            | 1 | 0 | 1 | 1 | 1 | 1 | 5 | 0.8 |
| 15                              | We have measures in place to continuously improve our technical capability in managing and optimizing the compatibility of green technologies.   | 1 | 0 | 1 | 1 | 0 | 1 | 4 | 0.7 |
| 16                              | Implementing green innovation management has improved our corporate image.                                                                       | 1 | 1 | 1 | 1 | 1 | 1 | 6 | 1.0 |
| 17                              | Implementing green innovation management leads to better economic benefits.                                                                      | 1 | 1 | 1 | 1 | 0 | 1 | 5 | 0.8 |
| 18                              | Transparency about our green activities and measurable environmental progress have improved our brand, credibility, and customer loyalty.        | 1 | 1 | 1 | 0 | 1 | 1 | 5 | 0.8 |
| <b>Green Economic Resources</b> |                                                                                                                                                  |   |   |   |   |   |   |   |     |
| 19                              | Government funding is available to implement green innovation.                                                                                   | 1 | 1 | 1 | 1 | 1 | 1 | 6 | 1.0 |
| 20                              | Our company dedicates specific funds to green innovation.                                                                                        | 1 | 1 | 1 | 1 | 1 | 1 | 6 | 1.0 |
| 21                              | Our company partnered with the local university to train our employees                                                                           | 1 | 1 | 1 | 1 | 1 | 1 | 6 | 1.0 |

|                                         |                                                                                                                                                           |   |   |   |   |    |   |   |     |
|-----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---|---|----|---|---|-----|
|                                         | on green innovation best practices.                                                                                                                       |   |   |   |   |    |   |   |     |
| 22                                      | Our company is able to attract highly skilled employees who specialize in green innovation management.                                                    | 1 | 1 | 0 | 1 | 1  | 1 | 5 | 0.8 |
| 23                                      | We optimize resource management by partnering with local green suppliers to minimize negative environmental impacts such as pollutions.                   | 1 | 1 | 1 | 1 | 1  | 1 | 6 | 1.0 |
| 24                                      | We have invested in resource-saving technologies like waste recycling, biomass, etc.                                                                      | 1 | 1 | 1 | 1 | -1 | 1 | 4 | 0.7 |
| 25                                      | Balancing profitability with the integration of green economic resources is a key priority for our company's development strategy.                        | 1 | 1 | 1 | 1 | 1  | 1 | 6 | 1.0 |
| 26                                      | We are implementing green innovation management because it is profitable for our business.                                                                | 1 | 1 | 1 | 1 | 1  | 1 | 6 | 1.0 |
| <b>Green Human Resources Management</b> |                                                                                                                                                           |   |   |   |   |    |   |   |     |
| 27                                      | We encourage employees to suggest and implement green initiatives through company-wide competitions and idea boards.                                      | 0 | 0 | 1 | 1 | 1  | 1 | 4 | 0.7 |
| 28                                      | Our performance reviews include green metrics, such as energy consumption reduction and waste minimization, alongside traditional performance indicators. | 1 | 1 | 1 | 1 | 1  | 1 | 6 | 1.0 |
| 29                                      | There is a high level of cooperation among employees in implementing green practices to improve productivity.                                             | 1 | 1 | 1 | 0 | 1  | 1 | 5 | 0.8 |
| 30                                      | We offer dedicated training programs on green innovation                                                                                                  | 1 | 1 | 1 | 1 | 1  | 1 | 6 | 1.0 |

|                                   |                                                                                                                                                                                   |    |    |   |   |   |   |   |     |
|-----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|---|---|---|---|---|-----|
|                                   | concepts, like life cycle assessment and eco-design, etc. for all employees.                                                                                                      |    |    |   |   |   |   |   |     |
| 31                                | We provide resources and support to ensure the proper implementation of green practices for enhancing product/service quality.                                                    | 1  | -1 | 1 | 1 | 1 | 1 | 4 | 0.7 |
| 32                                | We recognize and reward employees for their contributions to improving green innovation product/service quality.                                                                  | -1 | 1  | 1 | 1 | 1 | 1 | 4 | 0.7 |
| <b>Green Standards Compliance</b> |                                                                                                                                                                                   |    |    |   |   |   |   |   |     |
| 33                                | We have implemented planning and control measures with regard to green standards in our practices.                                                                                | 1  | 1  | 1 | 1 | 1 | 1 | 6 | 1.0 |
| 34                                | We have put in place organizational procedures to integrate green standards and compliance requirements into our daily operations.                                                | 1  | 1  | 1 | 1 | 0 | 1 | 5 | 0.8 |
| 35                                | The implementation of green standard-compliant, i.e. (ISO14001) organizational procedures has facilitated improvements in our resource efficiency and waste management practices. | 1  | 1  | 0 | 1 | 1 | 1 | 5 | 0.8 |
| 36                                | Our real-time environmental information is linked to green standards compliance metrics and tracks energy consumption, waste generation, and resource utilization.                | 1  | 0  | 1 | 1 | 1 | 1 | 5 | 0.8 |
| 37                                | Our performance tracking system encompasses not only green product lifecycle but also employee green engagement and skills development.                                           | 1  | 1  | 1 | 1 | 1 | 1 | 6 | 1.0 |

|                                                |                                                                                                                                                                                               |   |   |   |   |   |   |   |     |
|------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---|---|---|---|---|-----|
| 38                                             | We conduct periodic analyses and evaluations to measure green innovation compliance with green standards.                                                                                     | 1 | 1 | 1 | 1 | 1 | 1 | 6 | 1.0 |
| <b>Adoption of Green Innovation Management</b> |                                                                                                                                                                                               |   |   |   |   |   |   |   |     |
| 39                                             | We prioritizes the development of environmentally friendly products/services as part of our business strategy                                                                                 | 1 | 0 | 1 | 1 | 0 | 1 | 4 | 0.7 |
| 40                                             | We regularly integrate eco-friendly materials into our product/service innovation efforts.                                                                                                    | 1 | 1 | 1 | 1 | 1 | 1 | 6 | 1.0 |
| 41                                             | We launch innovative green products/services using eco-labeling to demonstrate our commitment to green product design and marketing.                                                          | 0 | 1 | 1 | 1 | 1 | 1 | 5 | 0.8 |
| 42                                             | We actively seeks to optimize production processes to minimize environmental impact as part of our innovation strategy.                                                                       | 0 | 1 | 1 | 1 | 1 | 1 | 5 | 0.8 |
| 43                                             | We have implemented green practices and technologies to reduce energy consumption and waste generation in our operational processes.                                                          | 1 | 1 | 1 | 1 | 1 | 1 | 6 | 1.0 |
| 44                                             | We have successfully implemented eco-friendly practices and technologies to reduce our carbon footprint and environmental impact across operational processes.                                | 1 | 1 | 1 | 1 | 1 | 1 | 6 | 1.0 |
| 45                                             | We implemented a flexible remote work policy and virtual collaboration tools to allow employees to work from home whenever possible to reduce our carbon footprint from commuting and travel. | 1 | 1 | 0 | 1 | 1 | 1 | 5 | 0.8 |
| 46                                             | Implementing administrative innovations like printing                                                                                                                                         | 1 | 0 | 1 | 1 | 1 | 1 | 5 | 0.8 |

|    |                                                                                                                                                          |   |   |   |   |   |   |   |     |
|----|----------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---|---|---|---|---|-----|
|    | only essential communication and signing digital documents instead of paper to enhance environmental protection.                                         |   |   |   |   |   |   |   |     |
| 47 | Our managers and supervisors are trained on green leadership principles and encouraged to incorporate green concepts in their decision-making processes. | 1 | 1 | 1 | 1 | 1 | 1 | 6 | 1.0 |

Source: Author's own elaboration

## Appendix C: Confirmatory Factor Analysis (CFA) Results for Poland SMEs Respondents

### Model Fit Summary

#### CMIN

| Model              | NPAR | CMIN     | DF  | P    | CMIN/DF |
|--------------------|------|----------|-----|------|---------|
| Default model      | 56   | 430.670  | 97  | .000 | 4.440   |
| Saturated model    | 153  | .000     | 0   |      |         |
| Independence model | 17   | 5952.450 | 136 | .000 | 43.768  |

Source: author's own calculations

#### RMR, GFI

| Model              | RMR  | GFI   | AGFI | PGFI |
|--------------------|------|-------|------|------|
| Default model      | .040 | .895  | .835 | .568 |
| Saturated model    | .000 | 1.000 |      |      |
| Independence model | .496 | .157  | .051 | .139 |

Source: author's own calculations

#### Baseline Comparisons

| Model              | NFI<br>Delta1 | RFI<br>rho1 | IFI<br>Delta2 | TLI<br>rho2 | CFI   |
|--------------------|---------------|-------------|---------------|-------------|-------|
| Default model      | .928          | .899        | .943          | .920        | .943  |
| Saturated model    | 1.000         |             | 1.000         |             | 1.000 |
| Independence model | .000          | .000        | .000          | .000        | .000  |

Source: author's own calculations

#### Parsimony-Adjusted Measures

| Model              | PRATIO | PNFI | PCFI |
|--------------------|--------|------|------|
| Default model      | .713   | .662 | .672 |
| Saturated model    | .000   | .000 | .000 |
| Independence model | 1.000  | .000 | .000 |

Source: author's own calculations

#### NCP

| Model              | NCP      | LO 90    | HI 90    |
|--------------------|----------|----------|----------|
| Default model      | 333.670  | 273.089  | 401.796  |
| Saturated model    | .000     | .000     | .000     |
| Independence model | 5816.450 | 5567.271 | 6071.956 |

Source: author's own calculations

### FMIN

| Model              | FMIN   | F0     | LO 90  | HI 90  |
|--------------------|--------|--------|--------|--------|
| Default model      | 1.009  | .781   | .640   | .941   |
| Saturated model    | .000   | .000   | .000   | .000   |
| Independence model | 13.940 | 13.622 | 13.038 | 14.220 |

Source: author's own calculations

### RMSEA

| Model              | RMSEA | LO 90 | HI 90 | PCLOSE |
|--------------------|-------|-------|-------|--------|
| Default model      | .090  | .081  | .098  | .000   |
| Independence model | .316  | .310  | .323  | .000   |

Source: author's own calculations

### AIC

| Model              | AIC      | BCC      | BIC            | CAIC     |
|--------------------|----------|----------|----------------|----------|
| Default model      | 542.670  | 547.599  | 769.981        | 825.981  |
| Saturated model    | 306.000  | 319.467  | <u>927.046</u> | 1080.046 |
| Independence model | 5986.450 | 5987.947 | 6055.456       | 6072.456 |

Source: author's own calculations

### ECVI

| Model              | ECVI   | LO 90  | HI 90  | MECVI  |
|--------------------|--------|--------|--------|--------|
| Default model      | 1.271  | 1.129  | 1.430  | 1.282  |
| Saturated model    | .717   | .717   | .717   | .748   |
| Independence model | 14.020 | 13.436 | 14.618 | 14.023 |

Source: author's own calculations

### HOELTER

| Model              | HOELTER<br>.05 | HOELTER<br>.01 |
|--------------------|----------------|----------------|
| Default model      | 120            | 132            |
| Independence model | 12             | 13             |

Source: author's own calculations

|                       |       |
|-----------------------|-------|
| <b>Minimization:</b>  | .049  |
| <b>Miscellaneous:</b> | .977  |
| <b>Bootstrap:</b>     | .000  |
| <b>Total:</b>         | 1.026 |

## Appendix D: Structural Equation Modelling (SEM) Results for Poland SMEs Respondents

Estimates (Group number 1 - Default model)

Scalar Estimates (Group number 1 - Default model)

Maximum Likelihood Estimates

### Regression Weights: (Group number 1 - Default model)

|               |      |      | Estimate | S.E. | C.R.   | P    | Label |
|---------------|------|------|----------|------|--------|------|-------|
| GER           | <--- | GRM  | .789     | .058 | 13.529 | ***  |       |
| AGM           | <--- | GER  | .277     | .102 | 2.719  | .007 |       |
| AGM           | <--- | GTC  | .266     | .069 | 3.847  | ***  |       |
| AGM           | <--- | GHRM | -.053    | .060 | -.887  | .375 |       |
| AGM           | <--- | GSC  | .726     | .061 | 11.821 | ***  |       |
| AGM           | <--- | GRM  | .041     | .078 | .529   | .597 |       |
| E_uncertainty | <--- | GRM  | 1.000    |      |        |      |       |
| G_support     | <--- | GRM  | .959     | .050 | 19.169 | ***  |       |
| R_pressure    | <--- | GRM  | 1.153    | .069 | 16.804 | ***  |       |
| G_advant      | <--- | GTC  | 1.000    |      |        |      |       |
| Compat_tech   | <--- | GTC  | 1.075    | .156 | 6.882  | ***  |       |
| Cmplx_tech    | <--- | GTC  | 1.085    | .158 | 6.877  | ***  |       |
| Q_mgt         | <--- | GHRM | 1.000    |      |        |      |       |
| Prod_coop     | <--- | GHRM | 1.340    | .999 | 1.341  | .180 |       |
| S_labour      | <--- | GER  | 1.061    | .064 | 16.669 | ***  |       |
| N_resource    | <--- | GER  | 1.060    | .085 | 12.545 | ***  |       |
| Product_Inn   | <--- | AGM  | 1.000    |      |        |      |       |
| Process_Inn   | <--- | AGM  | .816     | .039 | 21.130 | ***  |       |
| Adm_Inn       | <--- | AGM  | .862     | .042 | 20.385 | ***  |       |
| O_proced      | <--- | GSC  | 1.000    |      |        |      |       |
| P_evaluat     | <--- | GSC  | 1.124    | .051 | 22.027 | ***  |       |
| AFund         | <--- | GER  | 1.000    |      |        |      |       |
| Profit        | <--- | GER  | 1.194    | .082 | 14.554 | ***  |       |

Source: author's own calculations  
Covariances: (Group number 1 - Default model)

|     |      |     | Estimate | S.E. | C.R.   | P    | Label |
|-----|------|-----|----------|------|--------|------|-------|
| e1  | <--> | e3  | -.159    | .034 | -4.707 | ***  |       |
| e11 | <--> | e12 | -.142    | .032 | -4.416 | ***  |       |
| e9  | <--> | e10 | .207     | .032 | 6.469  | ***  |       |
| e10 | <--> | e12 | .062     | .029 | 2.119  | .034 |       |
| e5  | <--> | e6  | .015     | .080 | .194   | .846 |       |
| e2  | <--> | e3  | -.155    | .032 | -4.771 | ***  |       |
| e14 | <--> | e15 | .071     | .019 | 3.745  | ***  |       |

Source: author's own calculations

**Variances: (Group number 1 - Default model)**

|             | <b>Estimate</b> | <b>S.E.</b> | <b>C.R.</b>  | <b>P</b> | <b>Label</b> |
|-------------|-----------------|-------------|--------------|----------|--------------|
| <b>GRM</b>  | .598            | .057        | 10.582       | ***      |              |
| <b>GTC</b>  | .496            | .085        | 5.807        | ***      |              |
| <b>GHRM</b> | .407            | .307        | 1.328        | .184     |              |
| <b>GSC</b>  | .639            | .061        | 10.390       | ***      |              |
| <b>e18</b>  | .119            | .026        | 4.598        | ***      |              |
| <b>e19</b>  | .042            | .019        | 2.245        | .025     |              |
| <b>e1</b>   | .188            | .025        | 7.466        | ***      |              |
| <b>e2</b>   | .233            | .025        | 9.142        | ***      |              |
| <b>e3</b>   | .130            | .054        | 2.392        | .017     |              |
| <b>e4</b>   | .353            | .071        | 4.939        | ***      |              |
| <b>e5</b>   | .274            | .083        | 3.305        | ***      |              |
| <b>e6</b>   | .344            | .085        | 4.021        | ***      |              |
| <b>e7</b>   | .396            | .304        | 1.302        | .193     |              |
| <b>e8</b>   | .021            | .544        | .039         | .969     |              |
| <b>e9</b>   | .524            | .041        | 12.881       | ***      |              |
| <b>e10</b>  | .561            | .045        | 12.483       | ***      |              |
| <b>e11</b>  | .611            | .051        | 12.053       | ***      |              |
| <b>e12</b>  | .386            | .043        | <u>8.907</u> | ***      |              |
| <b>e13</b>  | .261            | .025        | 10.252       | ***      |              |
| <b>e14</b>  | .253            | .022        | 11.367       | ***      |              |
| <b>e15</b>  | .318            | .027        | 11.962       | ***      |              |
| <b>e16</b>  | .248            | .026        | 9.558        | ***      |              |
| <b>e17</b>  | .118            | .026        | 4.508        | ***      |              |

Source: author's own calculations

## Appendix E: Confirmatory Factor Analysis (CFA) Results for Thailand SMEs Respondents

### Model Fit Summary

#### CMIN

| Model              | NPAR | CMIN     | DF  | P    | CMIN/DF |
|--------------------|------|----------|-----|------|---------|
| Default model      | 53   | 228.688  | 100 | .000 | 2.287   |
| Saturated model    | 153  | .000     | 0   |      |         |
| Independence model | 17   | 5539.621 | 136 | .000 | 40.733  |

Source: author's own calculations

#### RMR, GFI

| Model              | RMR  | GFI   | AGFI | PGFI |
|--------------------|------|-------|------|------|
| Default model      | .022 | .939  | .906 | .614 |
| Saturated model    | .000 | 1.000 |      |      |
| Independence model | .309 | .182  | .079 | .162 |

Source: author's own calculations

#### Baseline Comparisons

| Model              | NFI<br>Delta1 | RFI<br>rho1 | IFI<br>Delta2 | TLI<br>rho2 | CFI   |
|--------------------|---------------|-------------|---------------|-------------|-------|
| Default model      | .959          | .944        | .976          | .968        | .976  |
| Saturated model    | 1.000         |             | 1.000         |             | 1.000 |
| Independence model | .000          | .000        | .000          | .000        | .000  |

Source: author's own calculations

#### Parsimony-Adjusted Measures

| Model              | PRATIO | PNFI | PCFI |
|--------------------|--------|------|------|
| Default model      | .735   | .705 | .718 |
| Saturated model    | .000   | .000 | .000 |
| Independence model | 1.000  | .000 | .000 |

Source: author's own calculations

#### NCP

| Model              | NCP      | LO 90    | HI 90    |
|--------------------|----------|----------|----------|
| Default model      | 128.688  | 88.521   | 176.577  |
| Saturated model    | .000     | .000     | .000     |
| Independence model | 5403.621 | 5163.457 | 5650.115 |

Source: author's own calculations

### FMIN

| Model              | FMIN   | F0     | LO 90  | HI 90  |
|--------------------|--------|--------|--------|--------|
| Default model      | .555   | .312   | .215   | .429   |
| Saturated model    | .000   | .000   | .000   | .000   |
| Independence model | 13.446 | 13.116 | 12.533 | 13.714 |

Source: author's own calculations

### RMSEA

| Model              | RMSEA | LO 90 | HI 90 | PCLOSE |
|--------------------|-------|-------|-------|--------|
| Default model      | .056  | .046  | .065  | .150   |
| Independence model | .311  | .304  | .318  | .000   |

Source: author's own calculations

### AIC

| Model              | AIC      | BCC      | BIC      | CAIC     |
|--------------------|----------|----------|----------|----------|
| Default model      | 334.688  | 339.530  | 547.930  | 600.930  |
| Saturated model    | 306.000  | 319.980  | 921.587  | 1074.587 |
| Independence model | 5573.621 | 5575.174 | 5642.019 | 5659.019 |

Source: author's own calculations

### ECVI

| Model              | ECVI   | LO 90  | HI 90  | MECVI  |
|--------------------|--------|--------|--------|--------|
| Default model      | .812   | .715   | .929   | .824   |
| Saturated model    | .743   | .743   | .743   | .777   |
| Independence model | 13.528 | 12.945 | 14.126 | 13.532 |

Source: author's own calculations

### HOELTER

| Model              | HOELTER<br>.05 | HOELTER<br>.01 |
|--------------------|----------------|----------------|
| Default model      | 225            | 245            |
| Independence model | 13             | 14             |

Source: author's own calculations

|                       |       |
|-----------------------|-------|
| <b>Minimization:</b>  | 1.223 |
| <b>Miscellaneous:</b> | .748  |
| <b>Bootstrap:</b>     | .000  |
| <b>Total:</b>         | 1.971 |

## Appendix F: Structural Equation Modelling (SEM) Results for Thailand SMEs Respondents

Estimates (Group number 1 - Default model)

Scalar Estimates (Group number 1 - Default model)

Maximum Likelihood Estimates

### Regression Weights: (Group number 1 - Default model)

|               |      |      | Estimate | S.E.  | C.R.   | P    | Label  |
|---------------|------|------|----------|-------|--------|------|--------|
| GER           | <--- | GRM  | .844     | .051  | 16.610 | ***  | par_11 |
| AGM           | <--- | GER  | .125     | .057  | 2.205  | .027 | par_12 |
| AGM           | <--- | GTC  | .690     | .066  | 10.496 | ***  | par_13 |
| AGM           | <--- | GHRM | .195     | .044  | 4.468  | ***  | par_14 |
| AGM           | <--- | GSC  | .035     | .028  | 1.260  | .208 | par_15 |
| AGM           | <--- | GRM  | .092     | .060  | 1.534  | .125 | par_17 |
| E_uncertainty | <--- | GRM  | 1.000    |       |        |      |        |
| G_support     | <--- | GRM  | 1.076    | .050  | 21.640 | ***  | par_1  |
| R_pressure    | <--- | GRM  | 1.066    | .053  | 20.248 | ***  | par_2  |
| G_advant      | <--- | GTC  | 1.000    |       |        |      |        |
| Compat_tech   | <--- | GTC  | 1.166    | .065  | 17.812 | ***  | par_3  |
| Cmplx_tech    | <--- | GTC  | .906     | .060  | 15.156 | ***  | par_4  |
| Q_mgt         | <--- | GHRM | 1.000    |       |        |      |        |
| Prod_coop     | <--- | GHRM | .705     | .098  | 7.185  | ***  | par_5  |
| S_labour      | <--- | GER  | .994     | .050  | 19.712 | ***  | par_6  |
| N_resource    | <--- | GER  | .991     | .052  | 19.209 | ***  | par_7  |
| Product_Inn   | <--- | AGM  | 1.000    |       |        |      |        |
| Process_Inn   | <--- | AGM  | 1.027    | .040  | 25.816 | ***  | par_8  |
| Adm_Inn       | <--- | AGM  | 1.032    | .044  | 23.549 | ***  | par_9  |
| O_proced      | <--- | GSC  | 1.000    |       |        |      |        |
| P_evaluat     | <--- | GSC  | 3.045    | 5.458 | .558   | .577 | par_10 |
| AFund         | <--- | GER  | 1.000    |       |        |      |        |
| Profit        | <--- | GER  | 1.035    | .052  | 19.960 | ***  | par_16 |

Source: author's own calculations

### Standardized Regression Weights: (Group number 1 - Default model)

|               |      |      | Estimate |
|---------------|------|------|----------|
| GER           | <--- | GRM  | .819     |
| AGM           | <--- | GER  | .159     |
| AGM           | <--- | GTC  | .788     |
| AGM           | <--- | GHRM | .288     |
| AGM           | <--- | GSC  | .028     |
| AGM           | <--- | GRM  | .114     |
| E_uncertainty | <--- | GRM  | .860     |

|             |           |  | Estimate |
|-------------|-----------|--|----------|
| G_support   | <--- GRM  |  | .898     |
| R_pressure  | <--- GRM  |  | .884     |
| G_advant    | <--- GTC  |  | .818     |
| Compat_tech | <--- GTC  |  | .895     |
| Cmplx_tech  | <--- GTC  |  | .776     |
| Q_mgt       | <--- GHRM |  | .866     |
| Prod_coop   | <--- GHRM |  | .733     |
| S_labour    | <--- GER  |  | .828     |
| N_resource  | <--- GER  |  | .822     |
| Product_Inn | <--- AGM  |  | .819     |
| Process_Inn | <--- AGM  |  | .860     |
| Adm_Inn     | <--- AGM  |  | .832     |
| O_proced    | <--- GSC  |  | .505     |
| P_evaluat   | <--- GSC  |  | 1.461    |
| AFund       | <--- GER  |  | .834     |
| Profit      | <--- GER  |  | .836     |

Source: author's own calculations

#### Covariances: (Group number 1 - Default model)

|              | Estimate | S.E. | C.R.   | P    | Label  |
|--------------|----------|------|--------|------|--------|
| e2 <--> e3   | -.057    | .015 | -3.833 | ***  | par_18 |
| e13 <--> e15 | -.022    | .010 | -2.186 | .029 | par_19 |
| e4 <--> e5   | -.051    | .018 | -2.833 | .005 | par_20 |
| e10 <--> e11 | -.008    | .014 | -.571  | .568 | par_21 |

Source: author's own calculations

#### Correlations: (Group number 1 - Default model)

|              | Estimate |
|--------------|----------|
| e2 <--> e3   | -.453    |
| e13 <--> e15 | -.163    |
| e4 <--> e5   | -.341    |
| e10 <--> e11 | -.040    |

Source: author's own calculations

#### Variances: (Group number 1 - Default model)

|             | Estimate | S.E. | C.R.   | P    | Label  |
|-------------|----------|------|--------|------|--------|
| <b>GRM</b>  | .425     | .040 | 10.516 | ***  | par_22 |
| <b>GTC</b>  | .366     | .040 | 9.056  | ***  | par_23 |
| <b>GHRM</b> | .610     | .097 | 6.293  | ***  | par_24 |
| <b>GSC</b>  | .178     | .321 | .556   | .578 | par_25 |
| <b>e18</b>  | .149     | .019 | 7.946  | ***  | par_26 |
| <b>e19</b>  | .064     | .011 | 5.779  | ***  | par_27 |
| <b>e1</b>   | .150     | .016 | 9.523  | ***  | par_28 |

|            | <b>Estimate</b> | <b>S.E.</b> | <b>C.R.</b> | <b>P</b> | <b>Label</b> |
|------------|-----------------|-------------|-------------|----------|--------------|
| <b>e2</b>  | .118            | .018        | 6.533       | ***      | par_29       |
| <b>e3</b>  | .135            | .020        | 6.787       | ***      | par_30       |
| <b>e4</b>  | .180            | .022        | 8.070       | ***      | par_31       |
| <b>e5</b>  | .123            | .023        | 5.324       | ***      | par_32       |
| <b>e6</b>  | .198            | .018        | 11.124      | ***      | par_33       |
| <b>e7</b>  | .203            | .081        | 2.498       | .013     | par_34       |
| <b>e8</b>  | .261            | .044        | 5.977       | ***      | par_35       |
| <b>e9</b>  | .198            | .018        | 11.131      | ***      | par_36       |
| <b>e10</b> | .204            | .020        | 10.446      | ***      | par_37       |
| <b>e11</b> | .213            | .020        | 10.663      | ***      | par_38       |
| <b>e12</b> | .209            | .019        | 11.031      | ***      | par_39       |
| <b>e13</b> | .138            | .014        | 10.091      | ***      | par_40       |
| <b>e14</b> | .104            | .011        | 9.851       | ***      | par_41       |
| <b>e15</b> | .133            | .014        | 9.739       | ***      | par_42       |
| <b>e16</b> | .522            | .321        | 1.624       | .104     | par_43       |
| <b>e17</b> | -.879           | 2.961       | -.297       | .767     | par_44       |

Source: author's own calculations

#### **Squared Multiple Correlations: (Group number 1 - Default model)**

|                      | <b>Estimate</b> |
|----------------------|-----------------|
| <b>GER</b>           | .670            |
| <b>AGM</b>           | .773            |
| <b>P_evaluat</b>     | 2.135           |
| <b>O_proced</b>      | .255            |
| <b>Adm_Inn</b>       | .693            |
| <b>Process_Inn</b>   | .740            |
| <b>Product_Inn</b>   | .670            |
| <b>Profit</b>        | .698            |
| <b>N_resource</b>    | .675            |
| <b>S_labour</b>      | .686            |
| <b>AFund</b>         | .695            |
| <b>Prod_coop</b>     | .537            |
| <b>Q_mgt</b>         | .751            |
| <b>Cmplx_tech</b>    | .603            |
| <b>Compat_tech</b>   | .801            |
| <b>G_advant</b>      | .670            |
| <b>R_pressure</b>    | .782            |
| <b>G_support</b>     | .807            |
| <b>E_uncertainty</b> | .739            |

Source: author's own calculations

## SUMMARY IN POLISH

Niniejsza praca doktorska miała na celu empiryczne zbadanie czynników napędzających wdrażanie zarządzania zielonymi innowacjami w małych i średnich przedsiębiorstwach (MŚP), w Polsce i Tajlandii. Badanie zostało przeprowadzone ze względu na rosnące globalne zainteresowanie „zielonymi innowacjami” jako krytyczną kwestią biznesową i środowiskową. Skuteczne integrowanie zarządzania zielonymi innowacjami w MŚP, jest istotne dla długoterminowego sukcesu biznesowego. Pomimo rosnącego zainteresowania i dużego potencjału zielonych innowacji w sektorze biznesowym, tylko nieliczne z nich odnoszą się do praktyk zarządzania w MŚP. Warto zauważyć, że MŚP stanowią podstawę wielu gospodarek i są w wyjątkowej pozycji, aby skorzystać z zielonych innowacji; jednak czynniki, które zachęcają lub utrudniają ich wdrażanie, pozostają niedostatecznie zbadane. Dlatego też niniejsze badanie ma na celu zbadanie czynników napędzających praktyki zarządzania zielonymi innowacjami w MŚP w środowisku biznesowym w Polsce i Tajlandii.

W badaniu empirycznym przyjęto model NRBV (ang. Natural Resource Based View) i model potrójnej linii przewodniej. Na podstawie tego modelu, opracowane ramy koncepcyjne obejmowały sześć zmiennych: zielone regulacje, zielone możliwości techniczne, zielone zarządzanie zasobami ludzkimi, zielone zasoby gospodarcze, zgodność z zielonymi normami i wdrażanie zielonego zarządzania innowacjami. Dane pierwotne zebrano od 428 respondentów w Polsce i 413 w Tajlandii, w szczególności od zarządzających MŚP – prezesów i menedżerów. Dane oceniono pod kątem wiarygodności i ważności, a przydatność metody oceniono przy użyciu konfirmacyjnej analizy czynnikowej (CFA). Analizę przeprowadzono przy użyciu modelowania równań strukturalnych (SEM) w celu oceny związku między zmiennymi badania. Analiza wielogrupowa SEM została przyjęta zgodnie z techniką testu chi-kwadrat w celu porównania czynników determinujących zarządzanie zieloną innowacją w Polsce i Tajlandii.

Wyniki wykazały, że dwie zmienne – zielone zdolności techniczne i zielone zasoby ekonomiczne znacząco wpływają na zarządzanie innowacjami w MŚP w Polsce i Tajlandii. Zarządzanie zielonymi regulacjami ma nieistotny wpływ na oba kraje. Zielone zarządzanie zasobami ludzkimi było znaczącym czynnikiem w Tajlandii,

podczas gdy zgodność z zielonymi standardami była ważna w Polsce. Badanie wykazało również, że zgodność z zielonymi standardami (zgodność z normą ISO 14001) była istotnym czynnikiem wpływającym na zielone innowacje w zarządzaniu MŚP zarówno w Polsce, jak i w Tajlandii. Dzieje się tak, ponieważ moderuje to wpływ wszystkich zmiennych na przyjęcie przez MŚP zarządzania zielonymi innowacjami w Polsce. Ponadto w przypadku Tajlandii zgodność z zielonymi standardami moderowała wpływ (i) zarządzania zielonymi regulacjami, (ii) zielonego zarządzania zasobami ludzkimi i (iii) zielonych zasobów gospodarczych na przyjęcie zarządzania zielonymi innowacjami.

Porównanie Polski i Tajlandii ujawniło znaczną różnicę w czynnikach napędzających zarządzanie zielonymi innowacjami. Zaobserwowano rozbieżność w trzech czynnikach napędzających – zielone zdolności techniczne, zielone zarządzanie zasobami ludzkimi i zgodność z zielonymi standardami.

Rezultaty badań wskazują, iż MŚP powinny rozważyć inwestycje w ulepszone zdolności techniczne i podkreślać znaczenie wsparcia finansowego inwestycji w napędzaniu zielonych inicjatyw. W Tajlandii badanie to wskazuje na poprawę zielonego zarządzania zasobami ludzkimi, podczas gdy w Polsce badanie wskazuje na znaczenie wykorzystania zgodności z zielonymi standardami. Rezultaty badań wskazują, aby MŚP rozważyły kontekstowe środowisko biznesowe podczas przyjmowania i wdrażania inicjatyw zarządzania zielonymi innowacjami.

## SUMMARY IN ENGLISH

This research aimed to empirically study the drivers of green innovations management adoption in Small and Medium Enterprises (SMEs), with a case study of Poland and Thailand. The study was driven by the increasing global interest in ‘green innovations’ as a critical business and environmental issue. Effectively integrating green innovation management in the SMEs relevant for business long term success, particularly for the SMEs. Despite the increasing interest and great potential for green innovations in the business sector, little has been researched regarding its management practices in SMEs. SMEs, which form the backbone of many economies, are uniquely positioned to benefit from green innovation; however, the factors that encourage or hinder its implementation remain underexplored. Therefore, this research aims to explore the drivers of SMEs' green innovations management practices in Poland and Thailand's business environment.

An empirical study adopted the Natural Resource Based View (NRBV) and Triple Bottom Line (TBL) models. From the model, a conceptual framework comprised of six variables – green regulations management, green technical capabilities, green human resource management, green economic resources, green standards compliance, and adoption of green innovations management. Primary data was collected from 428 in Poland and 413 from Thailand, specifically from business operators of SMEs – CEOs and managers. The data was evaluated for reliability and validity, and the model fitness was evaluated using Confirmatory Factor Analysis (CFA). The analysis was conducted using structural equation modelling (SEM) to evaluate the relationship between the study variables. The multi-group-SEM analysis was adopted following the Chi-square test technique to compare the drivers of green innovations management in Poland and Thailand.

The results revealed that two variables – green technical capabilities and green economic resources significantly influence green innovation management in SMEs in Poland and Thailand. Green regulation management has an insignificant influence on both countries. Green human resource management was a significant driver in Thailand, while compliance with green standards was important in Poland. The study also observed that green standards compliance (ISO 14001 compliance) was a relevant influencer of green innovations in SMEs management in both Poland

and Thailand. This is because it moderates the effect of all the variables on SMEs' adoption of green innovation management in Poland. As well, in the case of Thailand, green standards compliance moderated the effect of (i) green regulation management, (ii) green human resource management, and (iii) green economic resources on the adoption of green innovation management.

A comparison of Poland and Thailand revealed a considerable difference in drivers of green innovation management. The variance was observed in three drivers – green technical capabilities, green human resource management, and green standard compliance.

The study recommended that SMEs should consider investing in enhanced technical capabilities and emphasized the importance of financial support and investment in driving green initiatives. In Thailand, this study recommends improving green human resource management, while in Poland, the study recommends the importance of leveraging green standards compliance. Lastly, the study recommends that SMEs should consider a contextual business environment when adopting and implementing green innovations management initiatives.