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

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Dąbrowa Górnicza 2025

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1. JUSTIFICATION FOR CHOOSING THE TOPIC OF THE DISSERTATION

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[1]. 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[2]. 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[3], 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[4]. The effective management of these green innovation practices is crucial for business success[5] [6]. Effective integration of this green innovation concept in the management practices of SMEs is both an interesting adventure and a significant challenge that requires keen evaluation[7]. 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. From another perspective, Ebrahimi and Mirbargkar[8] argue that these challenges should not be considered barriers but opportunities where SMEs could demonstrate their agility and creativity in the demanding business environment.

2. THE GOALS OF THE DISSERTATION AND RESEARCH HYPOTHESES

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[9]. This kind of

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[1]M.H. Weng, and C.Y. Lin, "Determinants of green innovation adoption for small and medium-size enterprises (SMES)." *African Journal of Business Management*, *5*,22, 2011, 9154.

[2]M.R.H. Polas, M.I. Tabash, A. Bhattacharjee, and G.A. Dávila, "Knowledge management practices and green innovation in SMEs: The role of environmental awareness towards environmental sustainability. International Journal of Organizational Analysis, 31,5, 1601-1622.

[3]M.C. Cuerva, A. Triguero-Cano, and D. Córcoles, "Drivers of green and non-green innovation: empirical evidence in Low-Tech SMEs." *Journal of Cleaner Production*, 68, 2014, 104-113.

[4]Y. Bilan, H.I. Hussain, M. Haseeb, and S. Kot, "Sustainability and economic performance: Role of organizational learning and innovation." Inzinerine Ekonomika-Engineering Economics 2020.

[5] C.C. Cheng, and E.C. Shiu, "How to enhance SMEs customer involvement using social media: The role of Social CRM." International Small Business Journal, 2018. https://doi.org/10.1177/0266242618774831

[6]J. Kurowska-Pysz, "Selected conditions of developing inter-organizational cooperation in innovation processes on the Polish capital market. Challenges in Economic Policy". Business and Management in the COVID-19 Era, 165, 2021.

[7] T. Azam, W. Songjiang, K. Jamil, S. Naseem, and M. Mohsin, "Measuring green innovation through total quality management and corporate social responsibility within SMEs: Green theory under the lens." *The TQM Journal*, 35(7), 2023, 1935-1959.

[8]P. Ebrahimi, and S.M. Mirbargkar, "Green entrepreneurship and green innovation for SME development in market turbulence." Eurasian Business Review, 7(2), 2017, 203-228.

[9]M. Yurdakul, and H. Kazan, "Effects of eco-innovation on economic and environmental performance: Evidence from Turkey's manufacturing companies." *Sustainability*, 12(8), 2020, 3167.

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. An increasing body of literature is geared toward deeply understanding green innovation practices in business[10].

From the critical literature review, there is an unexplored aspect of SMEs' adoption of green innovation management in Thailand and Poland. Few studies have investigated the aspect of green innovation among SMEs in Thailand[11], while others have been carried out under the case of Poland[12]. 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 gaps, led by the previously stated research questions. 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?

The main objective of this research is to investigate and determine the drivers that influence green innovation management in small and medium enterprises (SMEs) in Poland and Thailand.

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

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[10]S. Bani-Melhem, M.A. Al-Hawari, and F. Mohd. Shamsudin, "Green innovation performance: a multi-level analysis in the hotel sector." *Journal of Sustainable Tourism*, 30(8), 2022, 1878–1896. https://doi.org/10.1080/09669582.2021.1991935

[11]A. Tariq, Y. Badir, and S. Chonglerttham, "Green innovation and performance: moderation analyses from Thailand." *European Journal of Innovation Management*, 22(3), 2019, 446-467; C. Muangmee, Z. Dacko-Pikiewicz, N. Meekaewkunchorn, N. Kassakorn, and B. Khalid, "Green entrepreneurial orientation and green innovation in small and medium-sized enterprises (SMEs)." Social Sciences, 10(4), 2021, 136; M. Tantayanubutr, and V. Panjakajornsak, "Impact of green innovation on the sustainable performance of Thai food industry." *Business and Economic Horizons*, 13(2), 2017, 192-209.

[12]J. Wysocki, "Innovative green initiatives in the manufacturing SME sector in Poland." *Sustainability*, 13(4), 2021, 2386.

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 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.

Based on the research problem and identified gap from the discussion, the following hypotheses 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 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.

3. THE COURSE OF RESEARCH AND THE STRUCTURE OF THE DISERTATION

The study comprises five main chapters and an introduction section. The introduction section justifies the study, research problem, gap, objectives, and questions. It justifies the study.

Chapter 1 discusses the principles of green innovation management in SMEs, including the development, strategies and benefits of green innovation management in SMEs. More particularly, it provides insight into the development of green processes and technologies, proposes a few feasible means of embedding green processes in the organization's core operations, forecasts advantages including improved competitiveness, cost savings, and regulatory compliance.

Chapter 2 outlines the green research policies and theories for SMEs. The aspects covered include green innovation management policies, theories, and literature-supported hypotheses. It provides a theoretical model which ties in organizational practices to those objectives in keeping with green innovation, as well as policy approaches to serve the basis of academic synthesis theories. Thus,

this section is geared toward producing a theoretical underpinning for putting an understanding on how SMEs might operationally and strategically incorporate environmental stewardship considerations into their management decision-making processes. The conceptual framework is also presented in this section.

Chapter 3 explores the study methods and descriptions. This comprises the research design, population and sample, data collection instruments and techniques, and data analysis methods. It defines the population of interest, i.e. SMEs in different sectors whereas the sample criterion was stratified random sampling which gave rise to subjects participating. Data was collected through validated questionnaires ensures reliability and ethics compliance. A detailed account of the analytical methods namely: structural equation modeling (SEM) was presented indicating the rigor and in validating the findings.

Chapter 4 includes the data analysis & results description on green innovation management in SMEs in Poland and Thailand. The analysis was done independently for both countries. The data analysis is conducted to evaluate the suitability and reliability of the adopted models, variables, and data, and then the proposed hypotheses are evaluated. Appropriate techniques, such as CFA, SEM, and multi-group SEM, are applied in the data analysis process.

Chapter 5 discusses the findings of the study, addressing each objective and hypothesis, with the objective of addressing the study problem. Study results (e.g., SEM path coefficients, *p*-values) reveal key patterns: hypotheses like GTC→AGM are strongly supported (β = .739**), while GER→AGM is rejected (p* > .05). Multigroup comparisons (Poland vs. Thailand) expose contextual drivers (e.g., GSC's dominance in Poland vs. GHRM in Thailand).

The Conclusion brings the study to its conclusion by summarizing the major findings, and proposing limitations of the study. It also offers policy recommendations, specifically targeting the obstacles SMEs encounter in implementing green innovation management. The research provided extensive knowledge of the interactions among numerous factors influencing SMEs' adoption of green innovation across many industries, yielding significant insights for the creation of green policies and decision-making processes. The thesis offers an extensive study and practical insights into fostering the adoption of green innovation for development and enduring progress across several markets in Poland and Thailand.

4. METHODOLOGY

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 analyzing using appropriate techniques to develop

results and insights. The study adopted the quantitative research methodology. The quantitative methodology involves collecting primary data and applying appropriate statistical techniques to analyze the data. For this study, primary data was collected from a representative sample of SMEs. The data was then analyzed 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 explained the relationship between selected study latent variables.

Step 3: Formulation of the study methods – 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 Natural Resource-Based View and Triple Bottom Line. Additional 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.

Step 4: Data analysis was the next step, testing the model's fitness using confirmatory factor analysis (CFA). The reliability and validity status and hypothesis of the study was analyzed using the structural equation model (SEM). 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[13]. Poland recorded around 2.16 million SMEs[14], giving a combined population of 5.36 million SMEs between both countries. The target representative sample were the SME Owner, managers, and supervisors of registered SMEs in Poland and Thailand. The sample size was estimated using the Cochran[15] sample size formula with 95% confidence level. The formula is given as:

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[13]Statista Research Department "Number of micro, small, and medium enterprises in Thailand from 2019 to 2022." *Statista*, 2024. https://www.statista.com/statistics/1337417/thailand-number-of-msmes/#:~:text=In%202022%2C%20the%20number%20of,an%20increase%20in%20recent%20years.

[14] A. Sas, "Number of small medium-enterprises (SMEs) in Poland 2017-2022, by size. Statista." 2023. https://www.statista.com/statistics/818716/small-and-medium-sized-enterprises-poland/#:~:text=Number%20of%20small%20medium%2Denterprises,Poland%202017%2D2022%2C%20by%20size&text=In%202022%2C%20Poland%20recorded%20approximately,companies%20amounted%20to%203.2%20thousand

[15]W.G. Cochran, Sampling techniques (3rd Ed.). Wiley, 1991.

$$n = \frac{Z^2(p)(q)}{e^2}$$ 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 Poland's population was estimated at 2.16 million, while Thailand's population was put at 3.2 million SMEs based on the literature. Thus, the sample size for both aspects of the study become:

Poland/Thailand: $= n = \frac{(1.96)^2(0.5)(1-0.5)}{(0.05)^2} = 384.16$

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

$n = \frac{n_0}{1 \pm \frac{n0-1}{N}}$

Substituting similarly for Poland, it becomes:

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

Substituting similarly for Thailand, it becomes:

$n = \frac{384.16}{1 \pm \frac{384.16-1}{3200000}}$ = 383.79, 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. 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 hosted online, and the sample respondents were asked to answer and submit it. The data was collected between 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 – this section 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: Latent variable questions – This part 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 data was collected via an online questionnaire constructed using the 5-point Likert Scale. These questions were formulated based on the existing literature and input from other scholars.

5. RESEARCH RESULTS

The results contribute to the study objectives by presenting the findings of the analysis on the drivers of green innovation management adoption in SMEs using Poland and Thailand as case studies. The study was developed following several sub-sections. The study is divided into two major sections – Presentation of Findings for Poland SMEs adoption of GIM and Presentation of Findings for Thailand SMEs adoption of GIM. 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)), hypothesis evaluation (structural equation modelling (SEM)), and multigroup analysis. The study targeted a minimum sample size of 400 respondents. More respondents were sampled for responding to the questions to ensure this minimum is met. The study ended up with a sample of 428 respondents from Poland and 413 from Thailand.

Presentation of Findings for Poland SMEs GIM Adoption

Demographic Statistics Analysis – Poland

This section presents the descriptive statistics findings for the respondents' demographics for Poland. The results are presented and summarized in Table 1, followed by discussions.

Table 1: Demographic Statistics Analysis – Poland

Demographic Character		Frequency (n)	Percent (%)
Gender	Males	258	60.3
	Females	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 Owners	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%).

Second Order Confirmatory Factor Analysis (SO-CFA)

The second-order CFA was conducted to evaluate the fitness of the proposed conceptual model. Figure 1 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 2.

Table 2: Model Fit Indices - Poland

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
Conclusion		**Model Fit**

Source: author's own calculations

The results indicated that the chi-square statistic for the model was significant χ^2/df ratio = 4.444 (considered acceptable since it was below 5 and was being influenced by sample size)[16]. 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. Additionally, the RMSEA is 0.090 (slightly above the threshold of 0.80), while the RMR = 0.040 below 0.08[16] [17]. Considering that almost all the fit indices met the required threshold, the data was considered to fit well into the adopted model. In addition to the model fitness indices, the relationship between the latent variables and their observed variables was evaluated.

[16]R.E. Schumacker, and R.G. Lomax*, "A beginner's guide to structural equation modeling."* Psychology press, 2004; L.T. Hu, and P.M. Bentler, "Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives." *Structural Equation Modeling: A Multidisciplinary Journal*, 6(1), 1999, 1-55

[17]M.W. Browne, and R. Cudeck, "Single sample cross-validation indices for covariance structures." *Multivariate Behavioral Research*, 24(4), 1989, 445-455.

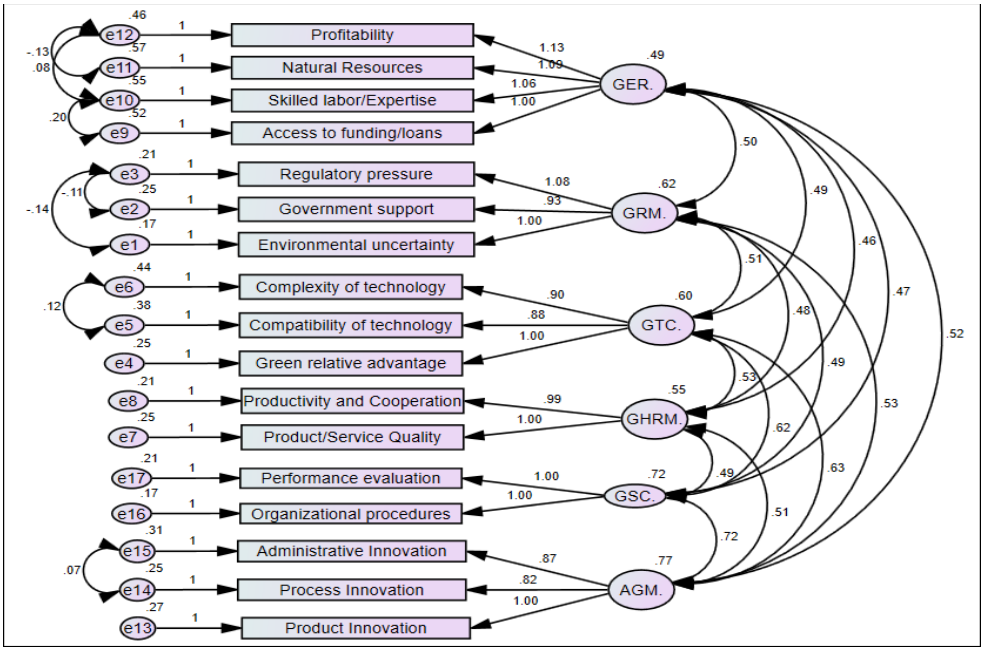

Figure 1: Second Order Confirmatory Factor Analysis (SO-CFA)
Source: author's own calculations

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 showed 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 findings revealed 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 showed 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 3.

Table 3: Reliability and Validity Analysis - Poland

. **Latent V.**	**Observed V.**	**Beta Weight**	**Estimate**	**S.E.**	**t-values**	**Sqd. multiple Correlations**
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

Hypothesis Analysis – Direct Effects

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.

Table 4: Hypothesis Analysis – Direct Effects - Poland

Hypothesis	Path relationship			Estimate	S.E.	C.R.	P
H1	GRM	→	AGM	.041	.078	0.529	.597
H2	GTC	→	AGM	.266	.069	3.847	***
H3	GER	→	AGM	.277	.102	2.719	.007
H5	GHRM	→	AGM	-.053	.060	-.887	.375
H6	GSC	→	AGM	.726	.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 = 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) (β = 0.041, p = 0.597). Green technical capabilities (GTC) have a positive and significant influence on the adoption of green innovation management (AGM) (β = 0.266, p = 0.000). Green economic resources (GER) have a positive and significant influence on the adoption of green innovation management (AGM) (β = 0.277, p = 0.007). Green human resources management (GHRM) has a negative and insignificant influence on the adoption of green innovation management (AGM) (β = -0.053, p = 0.375). Green standards compliance (GSC) has a positive and significant influence on the adoption of green innovation management (AGM) (β = 0.726, p = 0.000).

For Hypothesis # 4: The mediation analysis was conducted using the bootstrapping method. The results indicated that the indirect path GRM → GER → AGM was significant (β = 0.219, p = 0.045), suggesting that green economic resources were a significant mediator. For Hypothesis # 7:

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 (β = 0.469, p=0.000). This meant 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 (β = 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 (β = 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 (β = 0.259, p=0.000). This meant that GSC moderates the effect of GER on AGM.

Presentation of Findings for Thailand SMEs GIM Adoption

Demographic Statistics Analysis -Thailand

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 5, 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 rest of the data are on Table 5.

Table 5: Demographic Statistics Analysis -Thailand

Demographic Character		**Frequency (n)**	**Percent (%)**
Gender	Male	186	45
	Female	227	55
	Others	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

Second Order Confirmatory Factor Analysis (SO-CFA)

In this section, the second-order CFA was conducted to evaluate the fitness of the proposed conceptual model. Figure 2 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 6.

Table 6: Fit Indices Results - Thailand

Fit Indices	**Required threshold**	**Statistics Value**
CMIN/DF	<5	2.287
GFI	≥0.80	0.939
NFI	≥0.90	0.959
TLI	≥0.90	0.968
IFI	≥0.90	0.976
CFI	≥0.90	0.976
RMR	<0.08	0.022
RMSEA	<0.08	0.056

Conclusion	Model Fit

Source: author's own calculations

The results indicated that the chi-square statistic for the model was significant χ^2/df ratio = 2.287, which was considered acceptable since it was below 5 and was being influenced by sample size [18] [19]. 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 0.80[16] [17]. 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. 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.

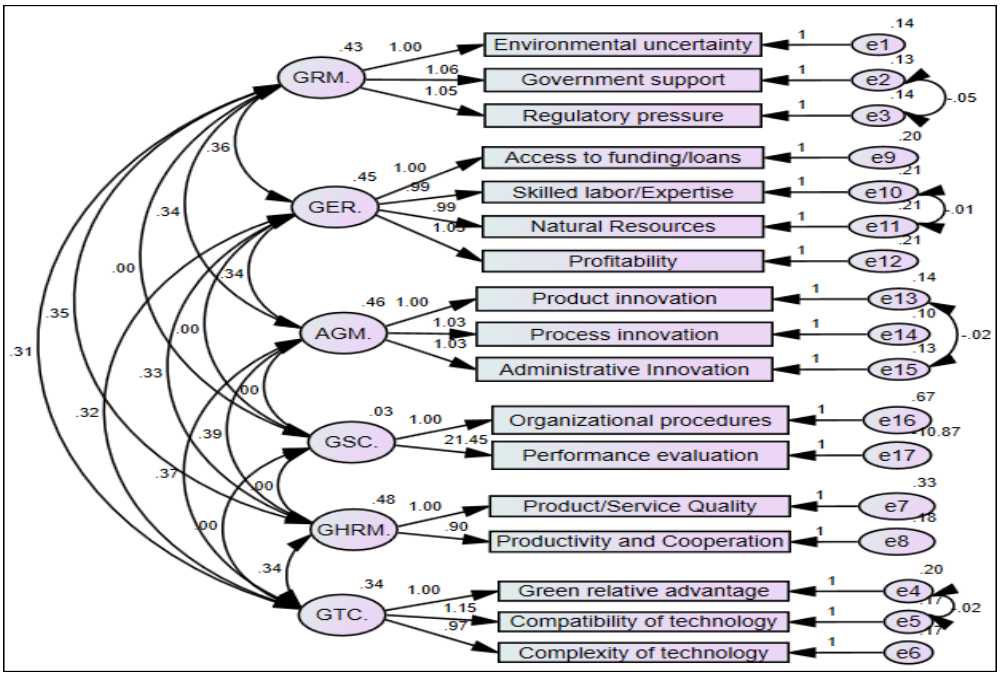

Figure 2: Second-Order Confirmatory Factor Analysis (SO-CFA)
Source: author's own calculations

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.

[18] R.E. Schumacker, and R.G. Lomax, *"A beginner's guide to structural equation modeling."* Psychology press, 2004.

[19] L.T. Hu, and P.M. Bentler, "Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives." *Structural Equation Modeling: A Multidisciplinary Journal*, 6(1), 1999, 1-55.

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 0.782. These results are summarized in Table 7.

Table 7: Reliability and Validity Analysis Results -Thailand

Latent V.	**Observed V.**	**Beta Weights**	**Estimate**	**S.E.**	**t-values**	**Std. Multiple correlations**
AGM	CR= 0.920; AVE = 0.792; Cronbach's Alpha = 0.921					
	Product Innovation	0.885	1.03	0.044	23.523***	0.769
	Process Innovation	0.908	1.028	0.04	25.821***	0.824
	Administrative Innovation	0.877	1			0.783
GER	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***	0.680
	Access to Fund	0.835	1.032	0.051	20.091***	0.697
	Profitability	0.835	0.989	0.05	19.739***	0.697
GHRM	CR= 0.778; AVE = 0.637; Cronbach's Alpha = 0.783					
	Product/Service Quality	0.828	0.899	0.057	15.704***	0.685

	Productivity & Cooperation	0.767	1			0.588
GRM	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 ***	0.789
	Regulatory Pressure	0.879	1.052	0.048	21.906 ***	0.773
GSC	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
GTC	CR= 0.859; AVE = 0.671; Cronbach's Alpha = 0.863					
	Green Relative Advantage	0.807	0.971	0.054	17.891 ***	0.631
	Compatibility of Technology	0.855	1.148	0.061	18.724 ***	0.731
	Complexity of Technology	0.794	1			0.652

Source: author's own calculations

Hypothesis Analysis – Direct Effects

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 8.

Table 8: Hypothesis Analysis – Direct Effects

Hypothesis	Relationship			Estimate	S.E.	C.R.	P
H1	GRM	→	AGM	0.092	0.06	1.534	0.125
H2	GTC	→	AGM	0.690	0.066	10.496	***
H3	GER	→	AGM	0.125	0.057	2.205	0.027
H5	GHRM	→	AGM	0.195	0.044	4.468	***
H6	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 2). 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) (β = 0.195, p = 0.000). Green standards compliance (GSC) has a positive and insignificant influence on the adoption of green innovation management (AGM) (β = 0.035, p = 0.208). For Hypothesis # 4: The mediation analysis was conducted using the bootstrapping method. The results indicated that the indirect path GRM → GER → AGM was insignificant (β = 0.106, p = 0.075), suggesting that green economic resources were not a significant mediator. For Hypothesis # 7: 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 (β = 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 (β = 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 (β = 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 (β = 0.036, p=0.376). This meant that GSC does not moderate the effect of GER on AGM.

Multi-Group SEM Analysis

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 9.

Table 9: 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

Table 9 shows that 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 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.

6. RESEARCH CONCLUSIONS

The focus of this study was to investigate the drivers of green innovation management adoption in small and medium enterprises (SMEs) under a case study of two countries – Poland and Thailand. The study was guided by a conceptual framework developed from the Natural Resource Based View (NRBV) and Triple Bottom Line (TBL) models. The results for Poland and Thailand are discussed in the following sub-sections.

The Case for Poland

Influence of Green Regulation Management on Adoption of Green Innovation Management

The results revealed that, in Poland, green regulation management does not significantly influence the SMEs' adoption of green innovation management. This implies that green regulation policies, acts, and standards in Poland are minimal in determining the adoption and incorporation of green innovation management practices among SMEs.

Influence of Green Technical Capabilities on Adoption of Green Innovation Management

The results indicated that green technical capabilities positively and significantly influence the SMEs' adoption of green innovation management practices ($\beta = 0.266$, $p = 0.000$). These results suggest that the aspects of technical capabilities, such as the complexity of the technology adopted, the technology compatibility, and associated green relative advantage are critical considerations for adopting green innovation.

Influence of Green Economic Resources Adoption Green Management Innovation

The findings 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.

Influence of Green Human Resource Management on Adoption of Green Management Innovation

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, product and cooperation, and product/service quality and management support do not yield sufficient support to drive a significant change in SMEs' green innovation agenda.

Influence of Green Standards Compliance on Adoption of Green Management Innovation

The results indicated that compliance with green standards positively and significantly influences SMEs adopting 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.

The Case for Thailand

Influence of Green Regulation Management on Adoption of Green Innovation Management

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.

Influence of Green Technical Capabilities on Adoption of Green Innovation Management

The results indicated that green technical capabilities positively and significantly influence the SMEs' adoption of green innovation management ($\beta = 0.69$, $p = 0.000$). This implied that a unit improvement in Thailand SMEs' technical capabilities would boost the green innovation adoption practices by 0.69 units.

Influence of Green Economic Resources Adoption Green Management Innovation

The results indicated that green economic resources significantly and positively influence SMEs' adoption of green innovation management in Thailand. It implies that it would positively enhance adoption if resources were available and channelled to green innovation practices.

Influence of Green Human Resource Management on Adoption of Green Management Innovation

The results indicated that green human resource management has a significant and positive influence on adopting green innovation management. 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

The results revealed that green standards compliance (ISO 14001 compliance) did not significantly influence Thailand SMEs' green innovation practices. These results imply that the green standards, particularly the ISO 14001 compliance, may not have been fully developed in Thailand's landscape, and therefore its effects are not evidently pronounced.

7. FURTHER DIRECTIONS OF THE RESEARCH

The researcher has been able to make a number of policy recommendations based on the findings that will enhance the operational efficiency and drive towards the adoption of green innovation management by SMEs in Poland and Thailand, and by extension, other emerging economies. The first policy recommendation is to enhance technical capabilities. SMEs should consider investing in enhanced technical capabilities and capacity building related to green innovations. Secondly, this study recommends the importance of financial support and investment in driving green initiatives within SMEs. This research also recommends the importance of integrating human resources and green standards. 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.

8. ADDED VALUE OF THE DISSERTATION

This dissertation adds significant value by providing a comprehensive comparative analysis of the drivers of green innovation management (GIM) in SMEs across Poland and Thailand. By adopting the Natural Resource-Based View (NRBV) and Triple Bottom Line (TBL) frameworks and extending it with additional variables such as Green Human Resource Management (GHRM) and Green Standards Compliance (GSC), the study fills theoretical gaps in understanding how SMEs navigate green innovation in distinct cultural and economic contexts. The study’s dual-country approach is a key strength, enabling a balanced understanding of how contextual factors influence GIM adoption. A major contribution lies in its empirical analysis using robust methods like Structural Equation Modeling (SEM) and Multigroup Analysis. The research validates the influence of key drivers, such as Green Technical Capabilities and Green Economic Resources, on GIM adoption. This dissertation has practical value in formulating strategic recommendations for SME managers and policymakers. By identifying the significance of GSC in Poland and GHRM in Thailand, the research offers actionable guidance for enhancing green innovation adoption.

9. DISSERTATION – TABLE OF CONTENTS