ความสัมพันธ์ระหว่างนวัตกรรมผลิตภัณฑ์เพื่อสิ่งแวดล้อมและผลการดำเนินงานที่เติบโตด้านสิ่งแวดล้อม: การทดสอบความสามารถการแข่งขันของผลิตภัณฑ์เป็นตัวแปรคั่นกลาง

RELATIONSHIP BETWEEN GREEN PRODUCT INNOVATION AND GREEN GROWTH PERFORMANCE: TEST PRODUCT COMPETITIVENESS AS MEDIATOR

ฉัตรชัย อินทสังข์[1] และ ฐิติมนต์ ธนกิติเอื้ออังกูร[2*]
Chatchai Inthasang[1] and Titimont Tanakitiaueaungkur[2*]

(Received: June 6, 2025; Revised: October 3, 2025; Accepted: November 17, 2025)

บทคัดย่อ

การศึกษานี้มีวัตถุประสงค์เพื่อตรวจสอบอิทธิพลของนวัตกรรมผลิตภัณฑ์เพื่อสิ่งแวดล้อมที่มีต่อความสามารถการแข่งขันของผลิตภัณฑ์และนำไปสู่ผลการดำเนินงานที่เติบโตด้านสิ่งแวดล้อมของธุรกิจ กลุ่มตัวอย่างที่ใช้ศึกษา คือ ผู้บริหารอุตสาหกรรมพลาสติกประเทศไทย จำนวน 214 ราย โดยใช้แบบสอบถามเป็นเครื่องมือในการวิจัย ซึ่งผ่านการตรวจสอบคุณภาพด้วยการทดสอบความเที่ยงตรงเชิงเนื้อหาด้วยผู้เชี่ยวชาญและการทดสอบทางสถิติด้วยค่าอำนาจจำแนก มีค่าระหว่าง 0.790 - 0.911 และมีค่าความเชื่อมั่นระหว่าง 0.887 - 0.914 ทดสอบด้วยค่าสัมประสิทธิ์แอลฟาของครอนบาค การวิจัยนี้ใช้การวิเคราะห์สถิติเชิงอนุมานด้วยแบบจำลองสมการโครงสร้าง ผลการวิจัย พบว่า แบบจำลองสมการโครงสร้างที่พัฒนาขึ้นมามีความสอดคล้องกับข้อมูลเชิงประจักษ์และผ่านเกณฑ์มาตรฐานด้วยสถิติ x^2= 289.607, df = 151, p-value = 0.001, GFI = 0.911, RMSEA = 0.035, SRMR = 0.033 และ CFI = 0.921 ผลการทดสอบสมมติฐาน พบว่า นวัตกรรมผลิตภัณฑ์เพื่อสิ่งแวดล้อมมีความสำคัญและมีอิทธิพลเชิงบวกต่อความสามารถการแข่งขันของผลิตภัณฑ์และผลการดำเนินงานที่เติบโตด้านสิ่งแวดล้อม ทำนองเดียวกัน ความสามารถการแข่งขันของผลิตภัณฑ์มีความสัมพันธ์เชิงบวกกับผลการดำเนินงานที่เติบโตด้านสิ่งแวดล้อม นอกจากนี้ การศึกษาแสดงว่าความสามารถการแข่งขันของผลิตภัณฑ์เป็นสื่อกลางในความสัมพันธ์ระหว่างนวัตกรรมผลิตภัณฑ์เพื่อสิ่งแวดล้อมและผลการดำเนินงานที่เติบโตด้านสิ่งแวดล้อม

คำสำคัญ: นวัตกรรมผลิตภัณฑ์เพื่อสิ่งแวดล้อม ความสามารถการแข่งขันของผลิตภัณฑ์ ผลการดำเนินงานที่เติบโตด้านสิ่งแวดล้อม

[1] ผู้ช่วยศาสตราจารย์ คณะบริหารธุรกิจ มหาวิทยาลัยเทคโนโลยีราชมงคลอีสาน
Assistant Professor, Faculty of Business Administration, Rajamangala University of Technology Isan
[2] อาจารย์ คณะบริหารธุรกิจ มหาวิทยาลัยเทคโนโลยีราชมงคลอีสาน
Lecturer, Faculty of Business Administration, Rajamangala University of Technology Isan
* Corresponding author, e-mail: titimont.ta@rmuti.ac.th

Abstract

This study aims to examine the effects of green product innovation on product competitiveness and its subsequent impact on green growth performance. Data were collected from 214 executives in the plastic industry in Thailand using a structured questionnaire as the research instrument. The measurement quality was rigorously assessed through content validity evaluation by experts and statistical testing. Discriminant validity values ranged from 0.790 to 0.911, while reliability analysis using Cronbach's alpha yielded coefficients between 0.887 and 0.914, indicating satisfactory reliability. Structural equation modeling (SEM) was employed for inferential statistical analysis. The results indicate that the proposed structural equation model demonstrates a good fit with the empirical data and meets established goodness-of-fit criteria (x^2= 289.607, df = 151, p-value = 0.001, GFI = 0.911, RMSEA = 0.035, SRMR = 0.033, and CFI = 0.921). Hypothesis testing reveals that green product innovation has a significant and positive effect on both product competitiveness and green growth performance. Similarly, product competitiveness is positively associated with green growth performance. Moreover, the findings confirm that product competitiveness serves as a mediating variable in the relationship between green product innovation and green growth performance.

Keywords: Green Product Innovation, Product Competitiveness, Green Growth Performance

1. Introduction

The sustainability of companies that concentrate on eco-friendly operations has become an intriguing area of competitive advantage research discussion. In a rapidly changing business environment, the organization's role in the development of novel products is crucial. Therefore, companies need to focus on exceeding client expectations by developing eco-friendly, inventive, and distinctive products (green product innovation) to establish a distinct brand and gain a competitive edge (Wang, 2019). Nowadays, it is evident that strategy formulation and management planning are instruments that may be used to enhance operational procedures and so increase the operational efficiency of a business. Green resource management strategies, for instance, may generate a competitive edge, enhance customer happiness, and influence long-term marketing profitability (Chen et al., 2016).

In recent years, green product innovation has been identified as one of the most important indicators of operational efficiency, growth, and environmental sustainability (Soewarno, Tjahjadi, & Fithrianti, 2018). In addition, investments in green product innovation can assist with public relations efforts to safeguard natural resources and lessen the likelihood of environmental complaints and legal fines. Also, new market potential for environmentally friendly items can be created (Lavrinenko et al., 2019). These days, the plastic industries is one of the businesses that generates the revenue for Thailand's

economic growth. Yet, agencies are affected by and must adapt to a continually changing environment, which includes technical improvements, product innovation, product quality, and environmental consciousness (Thiumsak, 2025). The Thai plastics industry can look forward to ongoing growth over 2024-2026 thanks to continuing domestic and global economic expansion, which will then support stronger demand from downstream manufacturers, including players in the packaging, autos and auto parts, electronics and electrical appliances, construction, and medical devices industries. Furthermore, government schemes to promote investment in the 'new S-curve' industries will benefit plastics manufacturers embedded in these supply chains. However, these tailwinds will be met by a number of challenges, including stiff competition and the move by many countries (including Thailand) to restrict or ban single-use plastics, and instead to promote greater consumption of low-carbon biodegradable products (Thiumsak, 2023). In addition, the spread of COVID-19 and the country's lockdown resulted in decreased consumer purchasing power and fluctuating demand among target customers. This necessitates that corporate management adapt to dynamic needs and concentrate on real-world issue perception to boost production efficiency and develop distinctive, market-driven goods.

The researcher is interested in analyzing the impact of green product innovation on the green growth performance of plastic industries in Thailand based on the preceding information. Compared to conventional innovation and new product development, the study of green product innovation is a relative newcomer to the academia. Majority of the early studies on green product innovation focussed primarily on definitional issues, theoretical explanations for the emergence of green product innovation and the link between marketing performance and financial performance. To address this research gap, researchers extend their studies beyond the business level and look to explore the implications of product competitiveness as a mediator variable between green product innovation and the green growth performance of enterprises. The study results are utilized to create awareness of innovation in order to assist these businesses in taking use of it and incorporating it into their operations in order to achieve sustainable business development and enhance Regional and international competitiveness.

2. Objective

1. To study how green product innovation affects the competitiveness of products and green growth performance of Thailand's plastic industry.

2. To study the influence of product competitiveness on the green growth performance of enterprises.

3. To study product competitiveness as a mediator variable between green product innovation and the green growth performance of enterprises.

3. Literature Review

The Resource-Based View (RBV) theory is an important theory to explain how firms achieve better financial performance than their competitors through a sustainable competitive advantage in the market (Hunt & Morgan, 1995). According to the premises of the resource advantage theory, all firms cannot be superior at the same time. The financial performance of each firm relies on an assortment of their resources (Hunt & Morgan, 1995). The Resource-Based View theory explains the importance of resources, characteristics, and adaptation to continuously in fast-changing green markets for achieving the sustainable competitive advantage (Jaeresukon, 2024; Nuryakin & Maryati, 2020).

For the research framework, the researcher conducted a literature review and conducted pertinent research on the effect of green product innovation on green growth performance of Thailand's plastics industry. As indicated in Figure 1, the research framework was designed based on Nuryakin and Maryati (2020) discussion of the development and deployment of green product innovation to build competitive advantages and bring value to company growth.

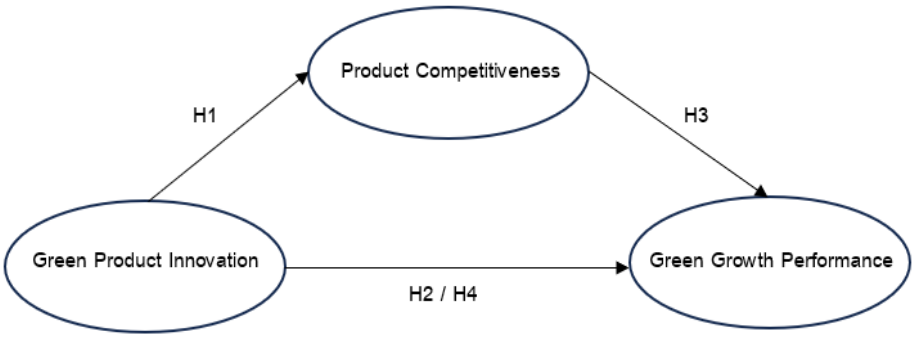


Figure 1 Conceptual Framework

Green Product Innovation: GPI

Khan et al. (2021) state that green product innovation is a technique for improving environmental management procedures. It refers to any technical, organizational, social, or institutional modifications that lessen the environmental load. This study defines "green product innovation" as an organization's efforts to incorporate environmental factors (design, packaging, material usage, energy consumption, etc.) into the development, modification, and improvement of manufacturing processes for new products in order to save production resources, raw materials, and energy for maximum benefit without long-term impacts, dangers, and risks to humans, communities, and society (Chan et al., 2016; Nuryakin & Maryati, 2020). Literature analysis reveals that product innovation capabilities is an important aspect that produces a sustained competitive advantage, which may be communicated to marketing operations that are effective (Kuncoro & Suriani, 2018; Sukanthasirikul & Phornlaphatrachakorn, 2021). The invention of the eco-friendly product boosts its competitiveness. This may result in new goods and boost the

company's productivity and income (Li et al., 2017). According to the findings of Huang, Yang, and Wong (2016); Nuryakin and Maryati (2020) adopting green product innovation as a driving force is essential for product innovation, gaining a competitive advantage, and the organization's performance in market competition. This leads to the following hypotheses in research:

Hypothesis 1 Green product innovation has a statistically significant positive influence on product competitiveness.

Hypothesis 2 Green product innovation has a statistically significant positive influence on green growth performance.

Product Competitiveness: PRC

Long-term corporate operations rely heavily on competitiveness to increase profits. This is the fundamental theory based on the notion that an organization's performance depends on its resources and capabilities to create a unique and imitable identity, such as quality capability, product innovation, and after-sales service (Sobirovna & O'rinboyevich, 2019; Tani et al., 2013). Product competitiveness is described as an integrated structure based on product quality perception, cost advantage, market competitiveness, product uniqueness, technology use, and the timing of new product launches (Lau et al., 2013; Liu, Qin, & Zhang, 2021). The competitiveness of a product increases the competitiveness of the product. It is an option to addressing environmental concerns to fulfill fluctuating demand (Shpak et al., 2019). This is in accordance with the results of Nuryakin and Maryati (2020), who determined that companies must develop their identity via goods that offer value and attract customers. Among these is the creation of eco-friendly products. It is evident that green product innovation has a substantial effect on an organization's operational advantage and productivity. In addition, product competitiveness was found to be a mediator between green product innovation and new product success (Ardyan & Sugiyarti, 2018; Wong, 2012). The hypothesis for this study is as follows:

Hypothesis 3 Product competitiveness has a positive correlation with the green growth performance of enterprises.

Hypothesis 4 Product competitiveness influences a mediator variable between green product innovation and green growth performance.

Green Growth Performance: GGP

In this process, green innovation plays a key role in improving green growth performance by saving resources and reducing environmental pollution by increasing production efficiency, saving energy, and reducing emissions. Exploratory empirical research has also showed that green innovation, as an important way to realize industrial green growth, can realize the "win–win" of reducing pollution and increasing production efficiency (Kunapatarawong & Martínez-Ros, 2016). In this research green growth performance refers to a run that focuses on reducing pollution in the water, air, and environment and increasing the cost-effective use of resources (Song et al., 2022).

Consequently, green growth performance is the operation of an organization that focuses on reducing water, air, and environmental pollution; increasing resource efficiency to achieve cost savings; and developing eco-friendly products, recyclable and biodegradable packaging, efficient waste management, and reducing gas and liquid emissions that are harmful to life, society, and the environment (Armstrong et al., 2018; Garg, 2015; Song et al., 2022). Additionally, the organization's long-term success depends on developing ties with the community and society to grow sales and reduce operational expenditures (Abbas & Dogan, 2022; Sianturi et al., 2022).

4. Research Methodology

This study passed the institution review board's evaluation of the project's adherence to ethical standards for human research, as documented by Document No. HEC-01-67-008, dated March 29, 2024. That was the research that agreed with the Declaration of Helsinki and did not breach international ethical principles. This quantitative study examined the effect of green product innovation on product competitiveness, which influenced the green growth performance of plastic product businesses.

Procedures and Sample Selection Method

The study's population consisted of 3,120 executives of the plastic industries operating in Thailand. Data collected from the Thai Plastic Industries Association (Plastics Intelligence Unit, 2023). The Thai plastic market is experiencing a notable surge, poised to generate an estimated revenue nearing USD 25,000 million within the forecast period. This growth can be attributed to the escalating demand for plastic in various sectors, including packaging, construction, and automotive. The packaging sector, in particular, is witnessing a substantial rise in plastic usage due to its diverse applications in food and beverage, healthcare, and consumer goods sectors. The construction industry is also contributing significantly to the market expansion, with plastic materials increasingly being used for insulation, piping, and window frames. The automotive industry’s growing reliance on lightweight, durable plastic components to enhance fuel efficiency and reduce greenhouse gas emissions is another driving force. However, environmental concerns related to plastic waste are posing challenges to the market, urging players to adopt sustainable practices and develop bio-based alternatives (Thiumsak, 2025).

This research has determined the sample size according to the concept of Hair et al. (2010), which has determined the appropriate sample size is 10 - 20 people per 1 variable. This study had a total of 16 observable variables. The sample size should not be less than 160 - 320 people, as well as to prevent the low rate of returning incomplete or missing questionnaires (Aaker et al., 2001).

A sample size calculation method suggested by Yamane (1973) provides a simplified formula to calculate sample sizes. A 95% confidence level and P = .5 are assumed for equation. Where n is the sample size, N is the population size, and e is the level of precision. When this formula is applied to the above sample.

This formula was used to calculate the sample sizes for a population. The calculation sample size is proposed as follows:

$$n = \frac{N}{1 + N(e)^2}$$

$$\text{Thus, } n = \frac{3{,}120}{1 + 3{,}120(0.05)^2}$$

$$n = 355$$

Preventing errors, researcher collected 400 members. This study applies the purposive sampling technique to verify the hypotheses.

Data Collection

The following techniques and approaches were used to collect data for the study. The questionnaire was addressed to plastic firm owners in Thailand, with crucial information responses coming from corporate executives or marketing directors.

Questionnaires were self-administered to ensure accuracy. The questionnaire contained questions covering elements of green product innovation, product competitiveness, and green growth performance and respondents were asked to indicate their agreement or otherwise relating to each statement using five-point Likert scale. Out of the 400 questionnaires administered, 226 representing 56.5%. The filled questionnaires were screened and the badly filled ones were discarded from the analysis. Finally, 214 questionnaires were found suitable for the analysis (Hair et al., 2010).

Non-Response Bias

Subsequently cleaning the data, the number of questionnaires used for the analysis was 214. Finally, to test a non-response bias has followed the recommendation of Armstrong and Overton (1977) to ensure that no statistically significant difference between early and late respondents. To test potential non-response bias, a comparison of the first and the second wave data such as gender, age, educational level, and work experience were considered the variables, as recommended by (Armstrong & Overton, 1977). Also, t-test statistic was utilized to verify the differences of the variables. The results indicated that a non-response bias is not a problem with this research.

Reliability and Validity

Results of factor loading, Cronbach's Alpha, CR, and AVE all constructs were shown in Table 1.

Table 1 Results of Factor Loading, Cronbach's Alpha, CR and AVE

Variables	Factor Loadings	Alpha Coefficient	CR	AVE
GPI	.790 - .911	.887	.874	.711
PRC	.835 - .910	.899	.876	.718
GGP	.824 - .877	.914	.863	.718

Table 1 demonstrations the results of factor loading and Cronbach's alpha. The constructs have a construct reliability range of factor loading as 0.790 - 0.911, which exceeds 0.7 for good reliability and validity (Hair et al., 2010). In the same vein, the findings reveal that Cronbach's alpha is between .887 to .914, which exceeds 0.70, to indicate high reliability.

Following, AMOS was used to run the confirmatory factor analysis. The results of the confirmatory factor analysis were shown in Table 1. With regard to reliability, the composite reliability (CR) of each construct was above 0.7. Therefore, it indicated good reliability. Additionally, there are two measurements to confirm the validity of the constructs. First, if the average variance extracted (AVE) of a construct was greater than 0.5, then it meant that there is convergent validity for the construct. As shown in Table 1, the AVE of all constructs were greater than 0.5. Therefore, these results supported the convergent validity of the measurement (Fornell & Larcker, 1981). Second, this study applied Fornell and Larcker's measure of AVE to access discriminative validity of the measurement (Fornell & Larcker, 1981). To satisfy the condition of discriminative validity, the square root of a construct's AVE must be greater than the correlations between the construct and other constructs in the model. The square root of the AVE for three construct, green product innovation, product competitiveness, and green growth performance, were .711, .687, and .718 in Table 1.

Variable Measurement

Using a 5-point rating scale, relevant theory, literature, and research were used to apply and adapt variable measurement, questionnaire design and development, and research data collection. In ascending order, level 1 represented the lowest rating, while level 5 represented the highest rating. The meanings of variables and measurements were defined as follows:

Green product innovation is the use of environmental factors (like design, packaging, material use, energy use, etc.) to come up with, change, and improve production processes that save resources and use less energy. These processes also do not harm people, communities, or society (Nuryakin & Maryati, 2020). It involves making products and packaging that are good for the environment by using raw materials without chemicals and focusing on natural ingredients. It also involves making good use of resources and energy, using biodegradable packaging materials that can be recycled and reused, and using clean production innovations.

Product competitiveness refers to the perception of product quality, product uniqueness, cost advantage, market competitiveness, and the technology adoption process (Lau et al., 2013; Liu, Qin, & Zhang, 2021). This perception includes product qualification, which must be higher than that of competitors in terms of product uniqueness, product quality, product benefit, and technical performance.

Green Growth Performance is the operation of an organization that focuses on reducing water, air, and environmental pollution; increasing resource efficiency to achieve cost savings; and developing eco-friendly products, recyclable and biodegradable packaging, efficient waste management, and reducing gas and liquid emissions that are harmful to life, society, and the environment (Armstrong et al., 2018;

Garg, 2015; Song et al., 2022). This construct is measured by the degree of proud of the business receives satisfaction from the company's stakeholders, business is trusted for safety in the production process and products, business has received praise and acceptance from the community and society, business has a good image for participating in sustainable development for society, helping to conserve resources and nature, and business meets national and international environmental standards.

Research Statistics

Data analysis was conducted using quantitative research methods; general information about executives and plastic product enterprises was presented using descriptive statistics by percentage and mean; and hypothesis testing was conducted using structural equation modeling.

5. Results

Correlation Matrix

This research uses the Pearson correlation for verifying a multicollinearity problem and explores the relationship between any pair of the variables.

Table 2 Correlation Matrix of Green Product Innovation and Consequents

Variable	GPI	PRC	GGP
Mean	4.37	4.22	4.30
S.D.	.574	.613	.588
GPI	1		
PRC	.402**	1	
GGP	.533**	.490**	1

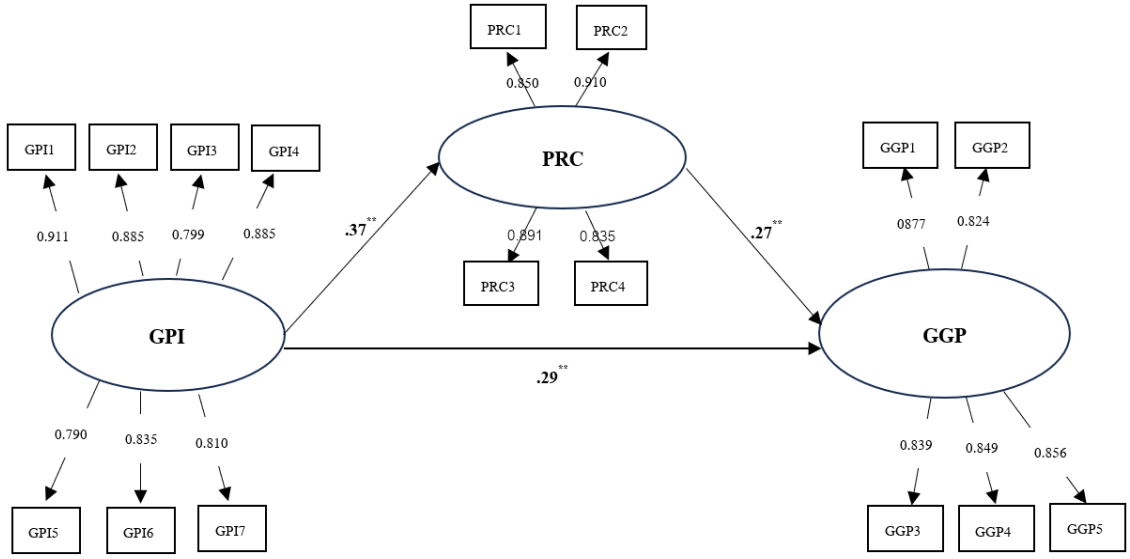
Note: ** p<0.01, * p<0.05, Beta coefficients with standard errors in parenthesis

For correlation analysis, the empirical evidence suggests that there are relationships between of green product innovation, product competitiveness, and green growth performance ($r = .402 - .533$, $p < .01$). Accordingly, the results of correlation between the same level of variables indicate that all concerned bivariate correlation values do not exceed .8 (Hair et al., 2010). In other words, no problem with multicollinearity was found.

Results of Structural Model

The effects of the green product innovation on green growth performance are based on hypotheses 1 to 4. All relationships between the green product innovation and green growth performance were hypothesized to be positively correlated. These hypotheses were analyzed from the structural equation modeling.

The results of the structural equation model analysis found that every level of compliance index passed the specified criteria. Considering x^2= 289.607, df = 151, p-value = 0.001, GFI = 0.911, RMSEA = 0.035, SRMR = 0.033, and CFI = 0.921. It can be described that the model is consistent with empirical data. The harmony index value passes the acceptance criteria as follows. The relative chi-square statistic is equal to 1.640, which is less than 3. The overall model goodness of Fit Index (GFI) was equal to 0.911, which is greater than 0.90, indicating that the model has good empirical consistency and the root mean square error approximation index (RMSEA) has a value. was equal to 0.035 and the standardized root mean square residual index (SRMR) was equal to 0.033, both of which were less than 0.05, and the comparative fit index (CFI) was equal to 0.921, meaning that the model had consistency and fit with empirical data. As shown in figure 2.



Note: ** p < 0.01, * p < 0.05 (GFI = 0.911; RMSEA = 0.035; SRMR = 0.033; and CFI = 0.921)

Figure 2 The Results of Structural Model

Results of data analysis to test hypotheses based on the concept of green product innovation and product competitiveness with green growth performance to determine the direct effect and indirect effect as shown in Table 3.

Table 3 Results of Data Analysis to Test Hypotheses

Hypotheses	Direct Effect	Indirect Effect	Results
H1: Green product innovation has a statistically significant positive influence on product competitiveness.	.377**	-	Supported
H2: Green product innovation has a statistically significant positive influence on green growth performance.	.297**	-	Supported
H3: Product competitiveness has a positive influence on green growth performance.	.271**	-	Supported
H4: Product competitiveness as the mediate variable between green product innovation and green growth performance.	-	.212**	Supported

** P<0.01, * P<0.05, a Beta coefficients with standard errors in parenthesis, (N=214)

The results of data analysis to test hypotheses based on the concept of green product innovation and product competitiveness with green growth performance to determine the direct effect and indirect effect. The fit of model in Table 4.5 provides a x^2 value of 289.607 (df = 151, p = .001). In addition, other indexes are within ranges for accepting the model (GFI = .911, RMSEA = 0.035, SRMR = 0.033, and CFI = 0.921) based on recommendation level (Hair et al., 2010).

Firstly, the results demonstrate that green product innovation has a significant and positive effect on product competitiveness (β = .377, p < .01). Further, the results demonstrate that green product innovation has a significant and positive effect on green growth performance (β = .297, p < .01). Thus, hypothesis 1and 2 are supported. Secondly, the results point out that green product innovation has a significant and positive effect on green growth performance (β = .271, p < .01). Thus, hypothesis 3 is supported. For mediating effects, this research findings show that product competitiveness was found to play a significant, but partial mediating role on the green product innovation and green growth performance (mediating effect = 0.212; p < 0.001). Thus, hypothesis 4 is supported.

6. Conclusion and Discussion

The finding that green product innovation influences product competitiveness and green growth performance is consistent with scholars describe product innovation that product innovation capabilities is an important aspect that produces a sustained competitive advantage, which may be communicated to marketing operations that are effective (Kuncoro & Suriani, 2018; Sukanthasirikul & Phornlaphatrachakorn, 2021). Congruence with the study of Huang, Yang, and Wong (2016); Nuryakin and Maryati (2020) who reveal adopting green product innovation as a driving force is essential for product innovation, gaining a competitive advantage, and the organization's performance in market competition. In addition, green

product innovation had a significant positive influence on sustainable enterprise development, which was consistent with research by Garg (2015); Huang, Yang, and Wong (2016); Li et al. (2017); Palmer and Truong (2017) showing that green product innovation had a positive influence on green growth performance and sustainable development.

Regarding product competitiveness, the results are similar to the study of Nuryakin and Maryati (2020); Sarkar, Qian, and Peau (2020); Shpak et al. (2019), which stated that organizations must establish their identity through their products. This demonstrated that producing an environmentally friendly product can offer a competitive advantage by impacting the performance of an enterprise. Congruence with the study of Nuryakin and Maryati (2020), who determined that companies must develop their identity via goods that offer value and attract customers. Among these is the creation of eco-friendly products. It is evident that green product innovation has a substantial effect on an organization's operational advantage and productivity. A major area of contribution to the literature is the evaluation of product competitiveness as determinants of green growth performance. Quite obviously, several findings found that the competitiveness of a product increases the competitiveness of the product. It is an option to addressing environmental concerns to fulfill fluctuating demand (Shpak et al., 2019).

The confirmation of product competitiveness as a mediator is consistent with Nuryakin and Maryati (2020), who determined that companies must develop their identity via goods that offer value and attract customers. Among these is the creation of eco-friendly products. It is evident that green product innovation has a substantial effect on an organization's operational advantage and productivity. In addition, product competitiveness was found to be a mediator between green product innovation and new product success (Ardyan & Sugiyarti, 2018; Wong, 2012). The result is similar to Pono and Munizu (2021), who found that company competitiveness as mediation variable the impact of supply chain practices on operational performance.

7. Suggestions

Theoretical and Managerial Contributions

This research's findings provide important information for entrepreneurs that can be used to determine corporate sustainability guidelines as a paradigm in modern organizational management, in keeping with the current trend of the 'Save the World Innovation Project' by striving to create customer value that leads to the goals of the enterprise. Empirical testing to confirm the relationship can help to expand our understanding of how green product innovation influences product competitiveness, thus contributing to green performance of plastic product enterprises in Thailand. Marketing executives can utilize the findings to plan the development of products that meet the needs of all dimensions, including economic, social, and environmental dimensions, to have positive outcomes and efficient connections with each other. In addition, the study found that environmental product innovation has a positive

influence on the sustainable development of plastic product enterprises. Product competitiveness is the mediator variable, which has suggestions for executives. Thus, executives of plastic product enterprises should be aware of green product innovations that can have a positive influence on business performance by enhancing corporate image and public righteousness, thereby helping to fulfill the requirements of new market segments, increasing market competitiveness, and creating new market opportunities, ultimately leading to sustainable growth and profitability. Key strategies include using biodegradable and recycled materials, minimizing energy consumption in production, and minimizing waste through reverse logistics and sustainable supply chain practices.

Environmental research issue remains an interesting research topic which rises in early 1990s, stimulated by customers' awareness to choose environmentally friendly product. Consequently, green product innovation becomes an important strategy for company to reach its customers. To enhance reputation and access to customers and more wider new market, green product innovation is developed in corporate strategy, particularly by adopting environmentally friendly technology and resources.

Recommendations for Future Research

The study's scope should be expanded to include other industrial operators, such as the automobile parts manufacturing industry, because it is a specialized manufacturing industry that is directly related to product development. To strengthen the reliability and validate the generalizability, it is necessary to compare the obtained results to those of previous research to determine if they differ or are comparable. In addition, an antecedent factor that causes green product innovation affects marketing results that can assist in driving the organization's efficient growth and sustainable business success.

This research used questionnaires to collect the data and explored through cross-sectional survey. Therefore, future research should consider the longitudinal designs in the scale development, both to facilitate greater understanding of the analyzed variables and to assess the predictive validity. A follow-up study using qualitative methods can be conducted to address this problem and to gain additional insights.

8. References

Aaker, D. A., Kumar, V., Day, G. S., & Leone, R. (2001). *Marketing Research*. New York: John Wiley & Sons.

Abbas, J., & Dogan, E. (2022). The impacts of organizational green culture and corporate social responsibility on employees' responsible behavior towards the society. *Environmental Science and Pollution Research, 29*(40), 60024-60034. https://doi.org/10.1007/s11356-022-20072-w

Ardyan, E., & Sugiyarti, G. (2018). The influence of e-CRM capability and co-information sharing activity on product competitiveness and marketing performance of small and medium-sized enterprises. *International Journal of Electronic Customer Relationship Management*, *11*(2), 158-178. https://www.inderscienceonline.com/doi/abs/10.1504/IJECRM.2018.090208

Armstrong, G. M., Kotler, P., Harker, M., & Brennan, R. (2018). *Marketing: An introduction.* London: Pearson.

Armstrong, J. S., & Overton, T. S. (1977). Estimating nonresponse bias in mail surveys. *Journal of Marketing Research, 14*(3), 396-402. https://doi.org/10.2307/3150783

Chan, H. K., Yee, R. W., Dai, J., & Lim, M. K. (2016). The moderating effect of environmental dynamism on green product innovation and performance. *International Journal of Production Economics, 181*, 384-391. https://doi.org/10.1016/j.ijpe.2015.12.006

Chen, Y. S., Chang, T. W., Lin, C. Y., Lai, P. Y., & Wang, K. H. (2016). The influence of proactive green innovation and reactive green innovation on green product development performance: The mediation role of green creativity. *Sustainability, 8*(10), 966. https://doi.org/10.3390/su8100966

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research, 18*(1), 39-50. https://doi.org/10.2307/3151312

Garg, A. (2015). Green marketing for sustainable development: an industry perspective. *Sustainable Development, 23*(5), 301-316. https://doi.org/10.1002/sd.1592

Hair, J . F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). *Multivariate data analysis: A global perspective* (7th ed.). New Jersey: Pearson.

Huang, Y. C., Yang, M. L., & Wong, Y. J. (2016). The effect of internal factors and family influence on firms' adoption of green product innovation. *Management Research Review, 39*(10), 1167-1198. https://doi.org/10.1108/MRR-02-2015-0031

Hunt, S. D., & Morgan, R. M. (1995). The comparative advantage theory of competition. *Journal of Marketing, 59*(2), 1-15. https://doi.org/10.2307/1252069

Jaeresukon, P. (2024). The causal relationship model of environmental, social, and governance (ESG) disclosure and firm value of companies listed on the stock exchange of Thailand. *Journal of Liberal Arts and Management Science Kasetsart University, 11*(1)*,* 36-56. https://so14.tci-thaijo.org/index.php/jlams/article/view/747

Khan, S. J., Dhir, A., Parida, V., & Papa, A. (2021). Past, present, and future of green product innovation. *Business Strategy and the Environment, 30*(8), 4081-4106. https://doi.org/10.1002/bse.2858

Kunapatarawong, R., & Martínez-Ros, E. (2016). Towards green growth: How does green innovation affect employment?. *Research Policy, 45*(6), 1218-1232. https://doi.org/10.1016/j.respol.2016.03.013

Kuncoro, W., & Suriani, W. O. (2018). Achieving sustainable competitive advantage through product innovation and market driving. *Asia Pacific Management Review, 23*(3), 186-192. https://doi.org/10.1016/j.apmrv.2017.07.006

Lau, A. K., Baark, E., Lo, W. L., & Sharif, N. (2013). The effects of innovation sources and capabilities on product competitiveness in Hong Kong and the Pearl River Delta. *Asian Journal of Technology Innovation, 21*(2), 220-236. https://doi.org/10.1080/19761597.2013.866313

Lavrinenko, O., Ignatjeva, S., Ohotina, A., Rybalkin, O., & Lazdans, D. (2019). The Role of Green Economy in Sustainable Development (Case Study: The EU States). *Entrepreneurship and Sustainability Issues, 6*(3), 1113-1126. https://doi.org/10.9770/jesi.2019.6.3(4)

Li, D., Zheng, M., Cao, C., Chen, X., Ren, S., & Huang, M. (2017). The impact of legitimacy pressure and corporate profitability on green innovation: Evidence from China top 100. *Journal of Cleaner Production, 141,* 41–49. https://doi.org/10.1016/j.jclepro.2016.08.123

Liu, Z., Qin, C. X., & Zhang, Y. J. (2021). Mining product competitiveness by fusing multisource online information. *Decision Support Systems, 143*, 113477. https://doi.org/10.1016/j.dss.2020.113477

Nuryakin, N., & Maryati, T. (2020). Green product competitiveness and green product success. Why and how does mediating affect green innovation performance?. *Entrepreneurship and Sustainability Issues, 7*(4), 3061. https://doi.org/10.9770/jesi.2020.7.4(33)

Palmer, M., & Truong, Y. (2017). The impact of technological green new product introductions on firm profitability. *Ecological Economics*, *136*, 86-93. https://doi.org/10.1016/j.ecolecon.2017.01.025

Plastics Intelligence Unit. (2023). *Entrepreneurship Category/Plastic product manufacturers.* Retrieved 10 January 2025, from https://plastic.oie.go.th/CompanyList.aspx?tid=1&id=2

Pono, M., & Munizu, M. (2021). The role of company competitiveness as mediation variable the impact of supply chain practices on operational performance. *Uncertain Supply Chain Management*, *9*(1), 125-132. https://doi.org/10.5267/j.uscm.2020.11.002

Sarkar, A., Qian, L., & Peau, A. K. (2020). Overview of green business practices within the Bangladeshi RMG industry: competitiveness and sustainable development perspective. *Environmental Science and Pollution Research, 27*, 22888-22901. https://doi.org/10.1007/s11356-020-08816-y

Shpak, N., Seliuchenko, N., Kharchuk, V., Kosar, N., & Sroka, W. (2019). Evaluation of product competitiveness: A case study analysis. *Organizacija, 52*(2), 107-125. https://doi.org/10.2478/orga-2019-0008

Sianturi, N. M., Nofirman, N., Yulianti, E. B., Fatmawati, E., & Hendriarto, P. (2022). Relevancy technological innovation and community economic development in Indonesia. *Linguistics and Culture Review, 6*(S3), 117-130. https://doi.org/10.21744/lingcure.v6nS3.2091

Sobirovna, D. K., & O'rinboyevich, A. A. (2019). Directions for increasing product competitiveness in industrial enterprises. *Asian Journal of Multidimensional Research, 8*(7), 29-35. https://doi.org/10.5958/2278-4853.2019.00258.1

Soewarno, N., Tjahjadi, B., & Fithrianti, F. (2018). Green innovation strategy and green innovation: The roles of green organizational identity and environmental organizational legitimacy. *Management Decision, 57*(11), 3061-3078. https://doi.org/10.1108/MD-05-2018-0563

Song, M., Peng, L., Shang, Y., & Zhao, X. (2022). Green technology progress and total factor productivity of resource-based enterprises. *Technological Forecasting and Social Change, 174*, 121276. https://doi.org/10.1016/j.techfore.2021.121276

Sukanthasirikul, K., & Phornlaphatrachakorn, K. (2021). Product Innovation Accounting, Customer Response Capability and Market Success: An Empirical Investigation in Thailand. *The Journal of Asian Finance, Economics and Business, 8*(10), 65–76. https://doi.org/10.13106/jafeb.2021.vol8.no10.0065

Tani, L. H., Zain, D., Wirjodirjo, B., & Djumahir, D. (2013). The role of competitiveness as mediator for the relation between supply chain flexibility and firm performance. *Journal of Management Research, 5*(1), 269-290. https://doi.org/10.5296/jmr.v5i1.2904

Thiumsak, T. (2023). *Industry Outlook 2024-2026: Plastics*. Retrieved 9 January 2025, from https://www.krungsri.com/en/research/industry/industry-outlook/petrochemicals/plastics/io/io-plastics-2024-2026

Thiumsak, T. (2025). *Industry Outlook 2025-2027: Plastics*. Retrieved 28 June 2025, from https://www.krungsri.com/en/research/industry/industry-outlook/petrochemicals/plastics/io/io-plastics-2025-2027

Wang, C. H. (2019). How organizational green culture influences green performance and competitive advantage. *Journal of Manufacturing Technology Management, 30*(4), 666-683. https://doi.org/10.1108/JMTM-09-2018-0314

Wong, S. K. S. (2012). The influence of green product competitiveness on the success of green product innovation: Empirical evidence from the Chinese electrical and electronics industry. *European Journal of Innovation Management*, *15*(4), 468-490. https://doi.org/10.1108/14601061211272385

Yamane, T. (1973). *Statistics: an introductory analysis.* New York: Harper & Row.