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DRIVING BUSINESS GROWTH THROUGH GREEN INNOVATION AND SUSTAINABILITY: EVIDENCE FROM INDONESIA'S WOOD PROCESSING INDUSTRY

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ABSTRACT

This study's research objective is to analyze the relationship between Green Innovation (GI), Sustainable Practices (SP), Competitive Advantage (CA), and Business Performance (BP) in Indonesia's wood processing industry. This research utilizes a quantitative explanatory technique and Partial Least Squares-Structural Equation Modeling (PLS-SEM) to analyze the hypothesis. The research population includes medium to large enterprises in Indonesia's wood processing industry, categorized under wood sawmilling (KBLI 1610) and wood preservation (KBLI 16102). The data was obtained through an online questionnaire, utilizing a purposive sampling technique, where 100 valid data was collected. The results demonstrate that GI has a significant and positive effect on CA and BP. SP has a significant effect on CA, however SP has a nonsignificant effect on BP. However, CA partially mediates the relationship between GI and BP. CA fully mediates the relationship between SP and BP. Thus, suggesting that firms in Indonesia's wood processing industry should integrate green innovation and sustainable practices to gain sustained competitive advantage and enhanced business performance.

Keywords: Green Innovation, Sustainable Practices, Competitive Advantage, Business Performance.

INTRODUCTION

Indonesia's wood industry holds a strategic position within the national economy due to tis substantial contribution to economic growth, employment, competitiveness, and generating industrial economic value (BPS-Statistics Indonesia, 2024) Indonesia possesses one of the world's largest tropical forests, with 120.4 million hectares of forest area and 29.2 million hectares of Permanent Production Forests for wood production (Ministry of Environment and Forestry Republic of Indonesia, 2024)). Indonesia's wood industry is export-oriented, actively participating in global wood trade with major export destinations in China, Russia and the United States (Prasada et al., 2022) Despite its economic value, the wood industry aced a decline in performance. The industry's contribution to Indonesia's GDP declined from 0.6% in 2020 to 0.39% in 2023 (BPS-Statistics Indonesia, 2024). The value added from wood manufacturing in Indonesia deteriorated from 3.11 billion USD in 2019 to 1.88 billion USD in 2023. Exports show market volatility, as export value declined from 4.94 billion USD in 2021 to 3.98 billion USD in 2023 (Trading Economics, 2025).

These economic turbulences are further compounded by environmental concerns. Indonesia is one of the countries with the highest primary first loss rate, where net deforestation accounted for 175,4 thousand hectares in 2024 from 104 thousand hectares in 2021-2022, primarily caused by the palm oil, timber, pulp and paper industry, and illegal logging (Ministry of Environment and Forestry Republic of Indonesia, 2024; Sari et al., 2023). Consequently, the government implemented regulations such as Government Regulation Number 23 of 2021 in forest administration and the Timber Legality Verification System (SLVK), promoting responsible forest governance (Susilawati & Kanowski, 2022). However, policy effectiveness remained inadequate due to inconsistent implementation (Sugiarto et al., 2024; Susilawati & Kanowski, 2022). The industry continues to face adversities to maintain competitiveness amid increasing global demands for sustainably sourced wood products (Prasada et al., 2022). Thus, wood industry firms in Indonesia face an urgent need to adopt green innovation and sustainable practices to mitigate deforestation, enhance competitiveness, meet international wood sustainability standards whilst ensuring industry sustainability and resilience.

Green innovation is the fundamental basis to enhance green competitiveness, sustainable growth, company performance, and enables firms to reduce waste, optimize resource efficiency and create value-added products (Guo et al., 2025; Irvan Pratama SAPUTRA & Noorlailie SOEWARNO, 2024; Ji et al., 2025; Yang et al., 2025). In Indonesia's wood industry, green innovation entails optimizing wood waste into value-added products such as wood pellets (Rimantho et al., 2023; SETIAWAN et al., 2023). However, the application of green innovation is restricted by lack of resources, technologies and knowledge (Guo et al., 2025; Lee et al., 2024).

Sustainable practices is a differentiation strategy encompassing responsible sourcing, production efficiency and waste minimization to improve business performance, ensure economic viability, and reduce environmental impacts (Chong & Kaliappen, 2025; Showkat & Nagina, 2025). For example, in the European Union, 6% of wood waste is recycled into viable products, underlining the augmenting global demand for sustainability compliant wood products (SETIAWAN et al., 2023).

Green innovation serves an integral function in enhancing a firm's competitive advantage, long-term performance and business growth (Maldonado-Guzmán et al., 2023; Novitasari & Agustia, 2023). However, few studies examine how competitive advantage concurrently links green innovation and sustainable practices to business performance within a single framework. The mediating role of competitive advantage linking both variables to business performance remains underexplored. Empirical

Competitive advantage represents how effectively a firm achieves differentiation by making strategic decisions that leverage its unique resources and capabilities (Farida & Setiawan, 2022; Wang et al., 2025). In the wood industry, sustainable production methods, innovation, and technology are crucial to attain industry competitive advantage (Rembiasz et al., 2024).

Business performance refers to the outcome of work achieved by an individual, measured through the completion of tasks within a time frame in correlation with the value or standard

of business (Farida & Setiawan, 2022). Considering Indonesia's significant role in global wood trade, it is imperative to examine whether business performance can be enhanced through the utilization of sustainable practices and green innovation.

Addressing this research gap is imperative to advance theoretical understanding of sustainability-driven strategies and insights to enhance competitiveness in resource-intensive sectors like the wood processing industry. Thus, this study was conducted to examine the impact of green innovation and sustainability practices on business performance, mediated by competitive advantage in Indonesia's wood processing industry.

LITERATURE REVIEW

Resource Based View Theory

This study incorporates the resource-based view theory (RBV), a strategic management theoretical framework introduced by Barney (1991). According to the RBV theory, a firm is capable of attaining superior business performance and sustained competitive advantage by obtaining valuable, rare, inimitable, and non-substitutable (VRIN) resources and skills to create superior business performance- aiding businesses to identify and leverage their unique resources, capabilities and core competencies to compete against industry competitors and understand resource gaps to achieve sustained competitive advantage (J. Barney, 1991; J. B. Barney, 2002; Malhotra et al., 2025; Monson, 2024). The RBV theory is commonly used in dynamic capabilities, strategic, operations, and supply chain management (Mailani et al., 2024; Monson, 2024).

Under the RBV theory, green innovation and sustainable practices are positioned as a valuable internal capability and strategic resource that enhances operational efficiency, environmental compliance, and market reputation (Hart, 1995; Xie et al., 2019). Green innovation equips firms to minimize waste, emissions and energy consumption– providing them with a sustained competitive advantage and enhanced environmental performance (Chen et al., 2006; Shahbaz & Malik, 2025; Singh et al., 2020). Green innovation enables firms to leverage internal capabilities to gain strategic advantage. Utilizing sustainable environmental technologies can also strengthen a company's innovative capacity (Hart, 1995; Veiga, 2025). Moreover, implementing new sustainable practices using resources that are inimitable aids firms to meet environmental demands and become pioneers in sustainable practices, establishing industry standards, acquiring market recognition and long-term value (Veiga, 2024).

Relationship of Green Innovation to Business Performance

Green innovation encompasses the implementation of new or improved products, processes, services and management into business activities to mitigate negative environmental impact; thereby generating economic and environmental value (Hojnik & Ruzzier, 2016; Sun et al., 2025). Its empirical implementations encompass the adoption of clean production technologies, development of eco-friendly materials, and sustainable manufacturing processes to improve resource efficiency (Singh et al., 2020). Firms are encouraged to implement green innovation due to growing regulatory pressures and stakeholder pressures from consumers and NGOs (Sun et al., 2025). Shahbaz & Malik (2025) found that green innovation

empowers the optimization of organizational resources to reduce waste, emissions, energy and attain competitive advantages.

Business performance measures a firm's success in attaining its goals, utilized by stakeholders in decision-making and reflects efforts to attain sustainable development (Tjahjadi et al., 2023). According Venkatraman & Ramanujam (1986) as cited in Ongkowijoyo et al. (2022), business performance reflects strategic managements' perspective and is vital to measure a firm's overall accomplishments and ensuring sustainability. According to Robert S. Kaplan & David P. Norton., (2003) as cited in Tjahjadi et al (2023), business performance is determined by financial conditions such as yearly net profit, revenue, and profit increase– and non-financial conditions which entails the consumers, employees and other stakeholders. Amid augmenting environmental issues and regulations, firms have begun to incorporate environmental standards to enhance business performance, competitiveness and legitimacy (Tjahjadi et al., 2023).

Empirical studies consistently highlight the positive association between green innovation and business performance. Research by Weng et al., (2015) and Tjahjadi et al. (2020) as cited in Ogiemwonyi et al. (2023) states that green product innovation significantly increases cost efficiency and profitability, whereas green innovation practices improve environmental and business performance in manufacturing and service firms. Green innovation improves key performance dimensions such as revenue growth, quality improvement, and customer satisfaction. Sudirman et al. (2024 and Tjahjadi et al. (2023) found that green innovation, encircling the development of environmentally friendly products and processes substantially impacts business performance, competitiveness, and profitability in Indonesian SMEs, as decision makers increasingly view it as a long-term strategic tool that strengthens reputation and market differentiation. SETIAWAN et al. (2023) found that the wood industry in Jepara mitigates the negative environmental impact of wood waste through green innovation, optimizing wood waste into eco-friendly crafts and furniture– aligning both environmental and financial objectives to ensure sustained business performance.

H1: Green Innovation significantly affects Business Performance

The Relationship between Sustainable Practices to Business Performance

Sustainable practices indicates a firm's deliberate efforts to enhance environmental and social performance (Fazli et al., 2023). According to Wijethilake & Ekanayake (2018) as cited in Fazli et al. (2023), firms may implement sustainable practices through reactive and proactive approaches. In a reactive approach, firms are only able to satisfy the minimum expectations of external stakeholders without fully realizing benefits in sustainability performance. In a proactive approach, firms voluntarily implement sustainable actions that exceed legal compliance by an internal commitment to promote social, environmental, and economic development (Fazli et al., 2023). Sustainable practices are classified by internal and external factors. Internal sustainable practices encompass human capital management, working environment and occupational safety, environmental impact and natural resource management. External sustainable practices include

engagement with external stakeholders such as suppliers, consumers, and communities (Fazli et al., 2023). Firms implement sustainable practices when they can merge organizational opportunities and objectives to generate simultaneous economic, social, and environmental value (Akomea et al., 2023)

Growing sustainability issues caused by greenhouse gas emissions, ecological depletion, social inequity, and external pressure from regulatory agencies, customers, and non-governmental organizations have encouraged firms to implement sustainable business practices and strategies. Businesses that adopt sustainability-oriented strategies such as minimizing resource consumption, compliance to environmental and social standards, adoption of sustainable certifications, collaborations with sustainable suppliers are more likely to attain enhanced business performance, trust, and legitimacy (Akomea, 2022; Fazli et al., 2023; Goldaraz-Salamero et al., 2024). In Indonesia's wood industry, sustainable practices such as optimizing wood waste and utilizing non-toxic materials support sustainable product development– vital to attain environmental and financial objectives (SETIAWAN et al., 2023). Prior studies found that sustainable practices positively influence SME business performance (Akomea et al., 2022). Under high competitive intensity, sustainable practices serve as a strategy to attain superior performance through lean, innovation, and ethical operations (Akomea et al., 2022) Therefore, the researcher proposed that sustainable practices have a significant effect on business performance.

H2: Sustainable Practices significantly affects Business Performance

Relationship of Green Innovation to Competitive Advantage

Competitive advantage pertains to the creation or development products that embody regional unique values, and carried out sustainably (Correia et al., 2021; Farida & Setiawan, 2022). It stems from the ability to create strategic market opportunities and deliver superior benefits to buyers (Farida & Setiawan, 2022; Sultoni & Sudarmiatin, 2021). Competitive advantage is also reflected in firm activities such as designing, producing, marketing, delivering, and supporting sales (Farida & Setiawan, 2022). Product differentiation strategies based on market orientation practices allows companies to exceed competitors by offering unique value propositions, while aligning strategies with technological advances and creative innovation also increases a company's competitive advantage (Farida & Setiawan, 2022). The RBV theory underscores that combining, developing, and restructuring internal and external competencies to overcome unpredictable or dynamic environments enables companies to attain innovative competitive advantage (Farida & Setiawan).

Green innovation equips firms to develop distinctive capabilities to respond effectively to stakeholder pressures, comply with environmental regulations, and meet sustainability objectives that yield strengthened customer loyalty, enhanced brand image, and higher profitability (El-Kassar & Singh, 2019; Rimantho et al., 2023). Judi et al. (2022) and (Novitasari & Agustia (2023) verify a positive significant relationship between green innovation and competitive advantage, emphasizing that firms that implement green innovation– encompassing green product development, green process improvement, and sustainable

management practices gain market differentiation, regulatory compliance, and meet increasing eco-conscious consumer demands. Novitasari & Agustia (2023) highlight the urgency of green innovation implementation for Indonesian businesses, as environmentally friendly products allow firms to surpass competitors and attain a more extensive market share. Therefore, the researcher proposed that green innovation has a significant effect on competitive advantage. H3: Green Innovation significantly affects Competitive Advantage

H3: Green Innovation significantly affects Competitive Advantage

Relationship of Sustainable Practices to Competitive Advantage

According to (Tarnovskaya, 2023), sustainable practices can become a vital basis of competitive advantage for various firms, especially for multinational enterprises (MNEs) with broad supply chains, innovation capabilities, and stakeholder visibility. In relation to the RBV theory, sustainability can serve as a non-substitutable and inimitable internal capability, especially when businesses implement inimitable sustainable practices (Barney, 1991; Tarnovskaya, 2023). Firms that integrate sustainable practices into business operations attain higher profitability due to added value in sustainability, thereby attaining sustained competitive and cooperative advantage (Tarnovskaya, 2023). Businesses that implement both internal sustainable practices and external collaborative efforts, particularly within the manufacturing aspect– yield improved sustainability outcomes and that contribute to superior competitive advantage (Cornejo-Cañamares et al., 2021; Elg & Hånell, 2023).

SETIAWAN et al. (2023) found that sustainable practices through wood waste optimization helped businesses attain environmental objectives and competitive advantage. Goldaraz-Salamero et al. (2024) stated that cascading systems, product repurposing, and forests under sustainable management certified under PEFC (Programme for the Endorsement of Forest Certification Chain) show direct contribution to competitive advantage. Implementing sustainable practices that comply with environmental regulations and standards reap benefits beyond mere compliance, enhancing market positioning and differentiation (Goldaraz-Salamero et al., 2024). Therefore, the researcher proposed that sustainability practice has a significant effect on competitive advantage.

H4: Sustainable Practices significantly affects Competitive Advantage

Relationship of Competitive Advantage to Business Performance

The RBV theory emphasizes the importance to obtain unique, difficult to imitate resources to attain sustained competitive advantage (Barney, 1991; Veiga, 2024). Competitive advantage is vital in evaluating a company's performance, reflected in factors including financial results, market share, and return on investment. Competitive advantage shapes organizational strategies and innovation, which consequently affects business performance (Irawan & Sudarmiatin, 2024). Competitive advantage allows companies within an industry to attain superior business performance, including profit, sales, and customer growth (Patrisia et al., 2022). Studies by Novitasari & Agustia (2023) in PROPER companies and Patrisia et al (2022) in banking companies show that

competitive advantage has a significant effect on business performance. The greater the company's ability to generate competitive advantage, the greater the business performance (Patrisia et al., 2022). Maintaining competitive advantage is crucial to ensure long-term business performance and sustainability (Irawan & Sudarmiatin, 2024). Therefore, the researcher proposed that competitive advantage has a significant effect on business performance.

H5: Competitive Advantage significantly affects Business Performance

Relationship of Green Innovation to Business Performance with Competitive Advantage as the mediator

Beyond environmental benefits, green innovation drives an increase in corporate value through product differentiation, improved reputation and cost efficiency. In contrast, competitive advantage yields increased market share, expands market reach, increases sales, and gains customer trust– thus, resulting in enhanced business performance (Novitasari & Agustia, 2023). According to Michael E. Porter (1985) as cited in Novitasari & Agustia (2023) Competitive advantage is a vital strategy within operational and strategic management, equipping businesses to attain superior performance metrics such as profitability, customer satisfaction, and brand equity. Empirical evidence illustrates this linkage, demonstrating that the application of green innovation within Jepara's wood industry helped the businesses attain both environmental objectives, improved competitive advantage against competitors, enhanced business performance and continuity (SETIAWAN et al., 2023).

However, prior research mainly evaluated green innovation and sustainability practices as independent constructs, with limited research that integrates both variables within a single framework (Farida & Setiawan, 2022; Patrisia et al., 2022). Furthermore, despite how numerous firms have implemented green innovation practices, the collective extent of change within those firms remains insufficient– as they are still accountable for significant environmental damage (Rahmani et al., 2024). Therefore, the researcher proposed that competitive advantage mediates the relationship between green innovation and business performance.

H6: Competitive Advantage mediates the relationship between Green Innovation and Business Performance

Relationship between Sustainable Practices to Business Performance with Competitive Advantage as the mediator

Fazli et al. (2023), emphasized the relevance of the RBV theory for businesses to attain competitive advantage in sustainability-oriented contexts. Firms that create and implement unique, new and inimitable sustainable practices enables them to achieve environmental demands, gain competitive advantage, and become industry pioneers (Veiga, 2024). Due to increasing environmental issues, sustainable practices have become a strategic priority for businesses, as it is deemed as a crucial basis of competitive advantage (Barney 1991; Tarnovskaya, 2023) A study by Wright et al. (1995) as cited in Patrisia et al. (2022) also substantiated the role of competitive advantage in helping businesses attain superior business performance.

Akomea et al. (2022) and Goldaraz-Salamero et al. (2024) demonstrates how implementing

sustianable practices directly enhances competitive advantage and business performance within the wood industry. SETIAWAN et al. (2023) also substantiated the vitality of sustainable practices within the wood industry, including wood waste optimization in yielding competitive advantage, reducing environmental impact, and enhancing business performance. Nevertheless, most prior studies are centred on manufacturing industries, automotive industries, or SMEs in non-resource-based economics, with limited empirical research on Indonesia's wood processing industry despite the sector's vitality to the economy (Irvan Pratama SAPUTRA & Noorlailie SOEWARNO, 2024; Judi et al., 2022). This unveils a research gap, particularly in understanding how green innovation, sustainable practices through competitive advantage simultaneously influence business performance in resource-intensive sectors (Farida & Setiawan, 2022; Patrisia et al., 2022). Therefore, the researcher proposed that competitive advantage mediates the relationship between sustainable practices and business performance.

H7: Competitive Advantage mediates the relationship between Sustainable Practices and Business Performance.

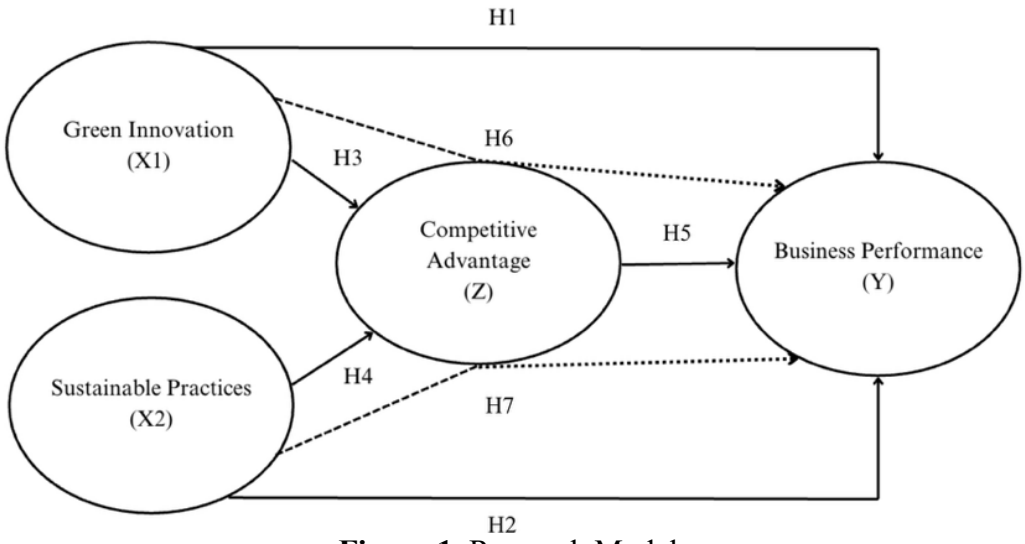


Figure 1. Research Model

Source: Akomea et al. (2022), Goldaraz-Salamero et al. (2024), Judi et al. (2022), Novitasari & Agustia (2023), Patrisia et al. (2022), SETIAWAN et al. (2023), Sudirman et al. (2024)

METHOD

This study uses a quantitative explanatory method and partial least squares-based structural equation modeling (PLS-SEM) to analyze the model of the relationships between green innovation, sustainable practices, competitive advantage, and business performance (Hair & Alamer, 2022). The data for this research was obtained through an online questionnaire. The study population consists of employees in Indonesia's wood processing industry (KBLI 1610 and KBLI 16102) in medium and large-scale enterprises. Purposive sampling was utilized, targeting employees with managerial, operational or executive positions in order to ensure that the data represented real business practices and expertise to provide reliable insights. This study

deployed a five-point Likert scale (Heo et al., 2022).

The total population of medium-large firms in Indonesia's wood processing industry in wood sawmilling (KBLI 1610) and wood preservation (KBLI 16102) is unknown. The minimum sample size was identified using G*Power, utilizing an effect size of 0.15, significance level (α) of 0.05, power of 0.80, and 5 predictors. The required minimum sample size is 92 respondents. The data is analyzed using outer model, inner model, and mediation test.

The indicators to green innovation are "green process innovation, green product innovation, and green management innovation" (Chiou et al., 2011; Sun et al., 2023) There are 7 questions adopted from Chiou et al. (2011) as cited in Sun et al. (2023). Sustainable practices were operationalized using indicators such as "economic sustainability, and social sustainability" (Sarango-Lalangui et al., 2018). There are 7 questions adopted from (Sarango-Lalangui et al., 2018). The indicators to business performance are "increase in sales, increase in cost efficiency, increase in profit, sell high-quality products at an affordable price, sell high-quality products at an affordable price, decrease in customer complaints, build good image and reputation, improve production and service quality, gain new customers and retain old customers, improvement in products and services innovation, improvement in employees' skills, improvement in information processing using computers, and improvement in employees' teamwork" (Robert S. Kaplan & David P. Norton, 2004; Tjahjadi et al., 2023). There are 15 questions adopted from Tjahjadi et al (2023). The indicators to competitive advantage are "innovation, quality, price, delivery dependability, and time to market". (Correira et al., 2020; Farida & Setiawan., 2022). There are 7 questions adopted from Farida & Setiawan (2022).

RESULT AND DISCUSSION

Respondents Characteristics

Table 1. Respondent Characteristics

Parameter		Frequenc	%
Gender	Male	52	51.5
	Female	49	48.5
Position	CEO/Owner	12	11.9
	COO	15	14.9
	General Manager	15	14.9
	Operational Manager	13	12.9
	Production Manager	31	30.7
	Sustainability Manager	13	12.9
	Other	2	2
Business Size	Medium	58	58
	Large	42	42
Business Age	<1 year	0	0
	1-3 years	12	11.9
	4-6 years	25	24.8
	7-10 years	26	25.7
	>10 years	38	37.6
	Wood Sawmilling (KBLI 16101)	76	75.2

Wood Processing	Wood Preservation (KBLI 16102)	25	24.8
Location	East Java	37	37
	Central Java	7	7
	West Java	6	6
	DKI Jakarta	3	3
	Banten	2	2
	North Sumatera	4	4
	South Sumatera	2	2
	West Sumatera	1	1
	Riau	1	1
	Lampung	1	1
	Jambi	1	1
	East Kalimantan	14	14
	South Kalimantan	4	4
	West Kalimantan	3	3
	Central Kalimantan	2	2
	North Kalimantan	3	3
	Bali	1	1
	Papua	8	8

Source: Processed Data, 2025

There is a total of 101 data obtained from the questionnaire. 100 valid responses were analyzed. Based on Table 1, most respondents were male (51.5%). Most respondents were production managers (30.7%), COOs (14.9%), and general managers (14.9%), implying that the responses were mainly obtained from individuals with substantial managerial experience. The majority of respondents represented medium-sized enterprises (58%) and large enterprises (42%), exhibiting a balanced firm scale representation. Most firms have been established for 10 years (37.6%) and 7-10 years (25.7%), indicating that most respondents represent well-established firms with significant operational experience and market resilience. Respondents were primarily from the Wood Sawmilling Industry (KBLI 1610) (75.2%), followed by Wood Preservation Industry (KBLI 16102) (24.8%). Geographically, a substantial number of respondents were located in East Java (37%), East Kalimantan (14%), and Papua (8%), regions well-known for their abundant natural resources and processing facilities. Smaller concentrations are evident in Central Java, West Java, and South Kalimantan, exhibiting the diverse distribution of Indonesia's wood processing firms.

Validity and Reliability Test

Table 2. Outer Loadings

Construct	Indicator	Outer Loading	Cronbach's Alpha	Rho_A	Composite Reliability	AVE
Green Innovation	GI1	0.668	0.893	0.911	0.916	0.611
	GI2	0.813				
	GI3	0.883				
	GI4	0.812				
	GI5	0.817				
	GI6	0.785				
	GI7	0.670				
Sustainable Practices	SP1	0.819	0.815	0.844	0.869	0.573
	SP2	0.852				
	SP3	0.706				
	SP5	0.742				
	SP6	0.648				
Business Performance	BP1	0.694	0.930	0.934	0.939	0.510
	BP2	0.732				
	BP3	0.707				
	BP4	0.778				
	BP5	0.758				
	BP6	0.750				
	BP7	0.736				
	BP8	0.723				
	BP9	0.700				
	BP10	0.767				
	BP11	0.736				
	BP12	0.759				
	BP13	0.709				
	BP14	0.596				
	BP15	0.522				
Competitive Advantage	CA1	0.760	0.805	0.814	0.860	0.506
	CA2	0.636				
	CA3	0.701				
	CA4	0.733				
	CA5	0.736				
	CA7	0.696				

Source: Processed Data, 2025

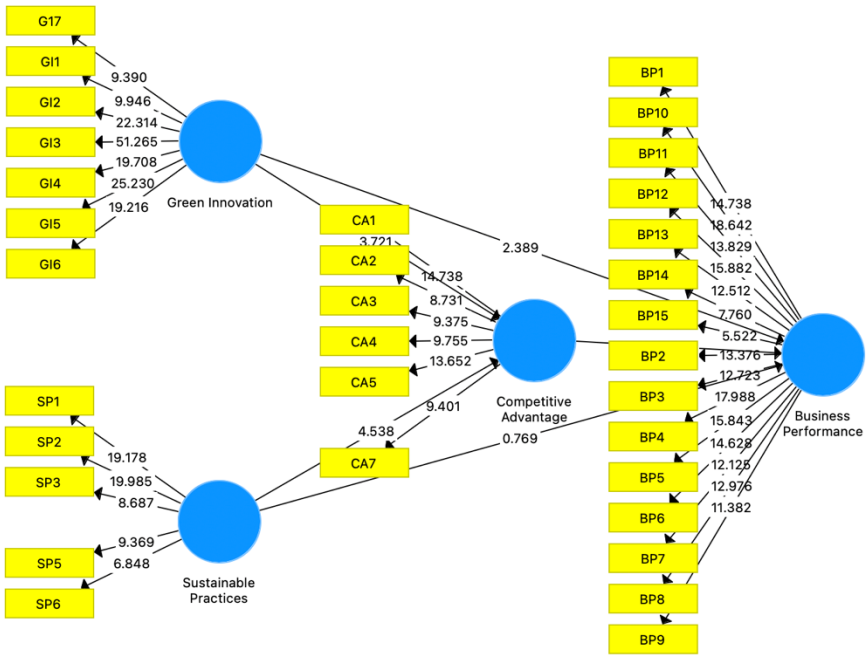
Table 3. Heterotrait-Monotrait

	BP	CA	GI	SP
Business Performance				
Competitive Advantage	0.532			
Green Innovation	0.390	0.470		
Sustainable Practices	0.209	0.542	0.342	

Source: Processed Data, 2025

2 out of 35 indicators with the lowest outer loading (0.555-0.592) were removed. There are several indicators with a weaker value of outer loadings. However, according to Hair et al., (2022), indicators exhibiting outer loadings between 0.40 and 0.70 are still acceptable and may be maintained. Discriminant validity was measured through the Average Variance Extracted (AVE), Cronbach's Alpha, Rho_a and composite reliability of each construct. Table 2 illustrates a complete result overview of the AVE and reliability tests, displaying the reliability and validity of the research model, as all internal consistency reliability values are above 0.7 and all convergent validity values are above 0.5. Furthermore, the values of the hetero-trait-monotrait (HTMT) are collectively below 0.9.

Structural Model (Inner Model)



Source: Processed Data, 2025

Table 4. Path Coefficient

Hypothesis	Path	Path Coefficients	T Statistics	P Values	Notes
H1	GI → BP	0.231	2.389	0.017	Hypothesis Accepted
H2	SP → BP	-0.092	0.769	0.442	Hypothesis Rejected
H3	GI → CA	0.282	3.721	0.000	Hypothesis Accepted
H4	SP → CA	0.389	4.538	0.000	Hypothesis Accepted
H5	CA → BP	0.431	4.497	0.000	Hypothesis Accepted
H6	GI → CA→ BP	0.121	2.542	0.011	Hypothesis Accepted
H7	SP → CA → BP	0.167	3.035	0.003	Hypothesis Accepted

Source: Processed Data, 2025

According to Figure 2 and Table 4, H1 exhibits a T-statistic of 2.389, a P-value of 0.017 and path coefficient of 0.231, demonstrating a positive path direction. Indicating that the hypothesis is acceptable, H1: “Green Innovation significantly affects Business Performance”. However, H2 records a T-statistic of 0.769 with a P-value of 0.442 and path coefficient of -0.092, which indicates a negative path direction and the absence of a correlation between the independent and dependent variable. Thus, the hypothesis H2: “Sustainable Practices significantly affects Business Performance” is rejected. Furthermore, H3 has a T-statistic of 3.721, a P -value of 0.000 and a path coefficient of 0.282, demonstrating a positive path direction. Therefore, the hypothesis H3: “Green Innovation significantly affects Competitive advantage’ is accepted. H4 exhibits a T-statistic of 4.538, a P-value of 0.389 and a path coefficient of 0.000, which exhibits a positive path direction. Thus, H 4: “Sustainable Practices significantly affects Competitive advantage” is accepted. Moreover, H5 shows a significant T-statistic of 4.497 and P-value of 0.000, and a path coefficient of 0.431 demonstrating a positive path direction, showing that the mediating variable strongly affects the dependent variable. Thus, the hypothesis H5: "Competitive Advantage significantly affects Business Performance” is accepted. Conversely, H6 displays a T-statistic of 2.542, a P-value of 0.011 and path coefficient of 0.121, showing a positive path direction and indicating that competitive advantage partially mediates the relationship between green innovation and business performance– as the direct effect of green innovation to business performance is significant. Moreover, H7 shows a T-statistic of 3.035, p-value of 0.003, and path coefficient of 0.003, exhibiting a positive direction and indicating that competitive advantage fully mediates the relationship between sustainable practices and business performance– as the direct effect of sustainable practices to business performance is nonsignificant. Thus, both H6: “Competitive advantage mediates the relationship between Green Innovation and Business Performance” and H7: “Competitive advantage mediates the relationship between Sustainable Practices and Business Performance” are accepted.

Goodness of Fit

Coefficient of Determination (R2)

Table 5. R Square Test

	R^2
BP	0.276
CA	0.298

Source: Processed Data, 2025

The value of R^2 demonstrates that the dependent variable business performance accounts for 27.6%, indicating a weak level of predictive accuracy (0.276). Conversely, the mediation variable, competitive advantage accounts for 29.8%, indicating a weak level of predictive accuracy (0.298).

F Square

Table 6. F-Square Test

	BP	CA	GI	SP
BP				
CA	0.180			
GI	0.060	0.102		
SP	0.009	0.194		

Source: Processed Data, 2025

The relationship between CA and BP has a medium effect size of (f^2 = 0.180). The relationship between GI and BP has a small effect size (f^2 = 0.060, meanwhile the relationship between SP and BP also exhibits a small effect size (f^2 = 0.009). Furthermore, the relationship between GI and CA demonstrates a small effect size (f^2=0.102). Conversely, the relationship between SP and CA shows a medium effect size (f^2=0.194).

Q Square

Table 7. Q-Square Test

	Q^2 (=1-SSE/SSO)
BP	0.127
CA	0.127

Source: Processed Data, 2025

With a Q2 value of 0.127 for competitive advantage and 1.127 for business performance, the model demonstrates a small yet acceptable predictive relevance for both constructs. Despite how the predictive relevance is small, the results indicate the model has sufficient explanatory capability and predictive relevance within this study. Thus, the findings substantiate the general validity of the structural model, demonstrating its effectiveness to predict both constructs.

Discussion

The Effect of Green Innovation and Sustainable Practices on Business Performance

There is a significant and positive relationship between green innovation and business performance. Therefore, H1 is accepted. This demonstrates that firms in Indonesia's wood processing industry that implement green innovation are more likely to attain superior business performance. This finding supports the RBV theory, indicating that green innovation serves as a distinctive and valuable strategic resource, thereby enhancing overall business performance through improved operational efficiency, environmental compliance, and market reputation (Barney, 1991; Hart, 1995; et al., 2019; Sudirman et al., 2024). This result is validated through prior studies that confirm green innovation's direct association with business performance for MSMEs in the manufacturing industry in East Java (Tjahjadi et al., 2020; Osarodion Ogiemwonyi et al., 2023), and SMEs that have implemented at least one form of green innovation in Indonesia (Sudirman et al., 2024).

This study does not show a significant relationship between sustainable practices and business performance. Hence, H2 is rejected. This finding does not align with prior studies that emphasize that sustainability-

oriented strategies are more likely to result in enhanced business performance (Akomea et al., 2023). The contrast in results may be caused by the contextual nature of Indonesia's wood processing industry, where sustainable practices are still developing and may not yield immediate economic benefits– especially for middle-sized firms that took account of 58% of this study's respondents. The nonsignificant direct relationship may also be attributed to the financial volatility in Indonesia's wood processing industry, where high costs of implementing sustainable technologies and certifications may hinder the extent of sustainable practices implementation. For example, Prasada et al. (2022) found that obtaining the FLEGT (Forest Law Enforcement, Governance and Trade) license added additional compliance costs for Indonesian plywood businesses, causing the price to increase– lessening competitiveness in the European market. Hoang et al. (2015) as cited in Zanchini et al. (2022) revealed that managing forests according to sustainable standards in accordance with certification schemes can lead to 5-25% higher costs than that of non-certified forests. Consequently, the benefits of sustainable practices are realized through the enhancement of competitive advantage as opposed to immediate financial performance.

The Effect of Green Innovation and Sustainable Practices on Competitive Advantage

The results reveal that green innovation and sustainable practices have a positive and significant effect on competitive advantage, thereby implying that H3 and H4 are accepted. This implies that businesses in Indonesia's wood processing industry that actively implement green innovation and sustainable practices are more likely to attain sustained and superior competitive advantage, strengthen internal capabilities, improve cost efficiency and create market differentiation. This finding is in alignment with the RBV theory, which posits that sustained competitive advantage is attained through the effective use of internal capabilities that demonstrate has value and uniqueness (Barney, 1991; Hart, 1995). The positive relationship between green innovation and competitive advantage has been corroborated by prior studies (Novitasari & Agustia, 2023; Judi et al., 2022). Likewise, prior studies have confirmed the positive relationship between sustainable practices and competitive advantage, implying that implementing sustainable practices result in improved sustainability outcomes that contribute to superior competitive advantage (Cornejo-Cañamares et al., 2021; Elg & Hånell, 2023

The Effect of Competitive Advantage on Business Performance

The relationship between competitive advantage and business performance shows a significant and positive correlation. Thereby, H5 is accepted. This suggests that firms in Indonesia's wood industry with stronger competitive positioning from innovation, efficiency and differentiation helps firms enhance financial and non-financial outcomes. This is aligned with prior studies that verify the positive significant correlation between competitive advantage and business performance (Anwar et al., 2018; Chan et al., 2004; Ferreira et al., 2021; Patrisia et al., 2022). This result is parallel with prior studies that assert that competitive advantage affects business strategies and innovation, improving business performance through enhanced profitability, sales and customer growth

(Edi Irawan & Sudarmiatin, 2024; Farida & Setiawan, 2022; Patrisia et al., 2022).

The Mediation Effect of Competitive Advantage on Green Innovation and Sustainable Practices towards Business Performance

This study exhibits an indirect, positive and significant relationship between green innovation and business performance through competitive advantage, showing a partial mediation. Therefore, H6 is accepted. This implies that green innovation increases corporate value through product differentiation, improved reputation and cost efficiency which in turn strengthens competitive advantage, collectively improving business performance (ARENHARDT et al., 2016; Novitasari & Agustia, 2023). This suggests that firms in Indonesia's wood processing industry that implements green innovation can optimize waste, improve cost efficiency, and build differentiation against competitors. Thus, providing firms with a greater ability to convert innovation efforts into tangible performance gains. This finding aids in addressing the existing research gap, as preceding research have mainly analyzed green innovation and sustainability practices as separate constructs, with limited integrations of competitive advantage as a mediating variable (Farida & Setiawan, 2022; Patrisia et al., 2022). Therefore, the results of this research extend current research by unveiling empirical evidence that green innovation indirectly enhances business performance through competitive advantage.

This result demonstrates an indirect, positive and significant relationship between sustainable practices and business performance through competitive advantage, showing a full mediation. Thus, H7 is accepted. This indicates that sustainable practices primarily contribute to business performance through its ability to strengthen competitiveness, as opposed to direct performance gains– as firms may still face financial constraints to fully optimize large-scale sustainability efforts. Firms that effectively integrate sustainability efforts such as ethical sourcing, wood waste optimization, and sustainable production processes into unique capabilities are more likely to attain enhanced business performance (SETIAWAN, 2023; Goldaraz-Salamero et al., 2024).

Implications

The results unveils that green innovation (GI) has a significant effect on business performance (BP). The highest outer loading indicator is "In product design, we will choose materials with the least environmental pollution and resource consumption", highlighting that firms need to source sustainable raw materials such as FSC (forest stewardship council), PEFC (programme for the endorsement of forest certification) SFI (Sustainable Forestry Initiative) certified wood and production technologies to minimize negative environmental impact (Prasada et al. (2022; Zanchini et al., 2022). Sustainable practice (SP) has a nonsignificant direct effect on business performance but demonstrates influence through competitive advantage (CA) as a meditation variable. The strongest outer loading indicator is "Our company's employees are paid better than our competitors" suggests the importance of employee welfare as a strategic factor of sustainability– as it fosters commitment and indirectly enhances performance through higher productivity. Competitive advantage exhibits a significant effect on business performance, reinforcing that market differentiation such as sustainability

certifications, renewable production technologies, utilizing biofuels derived from wood waste for production processes, and origin labelling (Zanchini et al., 2022) is vital in Indonesia's wood processing industry. The highest indicator loading "Compared to competitors, our company consistently excels in using innovative promotional strategies" suggests that firms can integrate innovation not only in production, but also in marketing efforts to sustain competitiveness. The strongest outer loading indicator for business performance is, "In the past three years, we have been able to acquire new customers", highlighting the need for continuous improvement for market expansion and customer acquisition.

CONCLUSION

Based on this study, green innovation (GI) directly affects business performance (BP), whereas sustainability practices (SP) indirectly affect BP through competitive advantage (CA). These findings reflect the RBV theory, emphasizing that valuable and inimitable internal capabilities such as green innovation and sustainable practices are primary determinants for sustained competitiveness and enhanced business performance. This study highlights the importance for environmental initiatives to be aligned with strategic differentiation to sustain growth in Indonesia's wood processing industry. The limitations include the concentration of respondents in East Java and the concentration of respondents in KBLI 1610 (Sawmilling). Future research should include a larger scope of respondents and utilize various data collection methods to improve result accuracy.

These findings suggest the need for stronger indicators that can fully represent sustainable practices and provide accurate results. The questionnaire-based data collection may have led the findings to be subject to bias or misinterpretation, where complex vocabularies may affect the accuracy of the results. Furthermore, 37% of respondents are geographically concentrated in East Java, which may limit regional diversity and applicability to other regions. Moreover, 75.2% of respondents are derived from companies in the Wood Sawmilling Industry (KBLI 1610), whereas only 24.8% respondents are derived from companies in the Wood Preservation Industry (KBLI 16102). Therefore, these findings may may limit applicability to the wood preservation industry. Future studies should include a larger scope of respondents and balanced respondents from both industries to represent Indonesia's wood industry in its entirety more accurately and comprehensively. Future studies should use other methods such as structured interviews to avoid misinterpretation and ensure accuracy.

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