International Conference of Organizational Innovation 2025
Proceedings

ICOI
2025

e-ISSN: 3064-6030
FMI, Vol 2
15-17 July 2025

Driving Sustainability Performance in Manufacturing: The Mediating Effect of Eco Innovation on Green Manufacturing in East Java

Christin Susilowati & Muchammad Zuhri Ramadhani Abanan

Department of Management, Faculty of Economic and Business, Brawijaya University

Email: christin@ub.ac.id

Abstract

As a vital contributor to Indonesia's GDP, the manufacturing industry plays a strategic economic role but also stands as a leading cause of environmental degradation, notably through carbon emissions, energy intensity, and industrial waste. In response, green manufacturing has gained global traction as a strategic approach to align industrial growth with ecological responsibility. However, existing literature remains divided on whether green manufacturing alone suffices to enhance sustainability performance, particularly in emerging economies with varying regulatory enforcement and innovation capabilities. However, existing literature remains divided on whether green manufacturing alone suffices to enhance sustainability performance, particularly in emerging economies with varying regulatory enforcement and innovation capabilities. A key issue lies in understanding whether eco-innovation is merely a byproduct of green manufacturing practices or if it plays a more strategic role as an enabling mechanism that allows firms to translate green initiatives into tangible improvements in sustainability performance. Despite its relevance, empirical investigations on this relationship remain limited, especially in the Indonesian manufacturing context, such as in East Java, a region undergoing rapid industrialization while facing persistent environmental and productivity challenges. This study aims to investigate the impact of green manufacturing on firms' sustainability performance, emphasizing the mediating role of eco-innovation. Drawing on quantitative data from manufacturing firms listed in the PROPER environmental rating program, this study employs Structural Equation Modeling with PLS (SEM-PLS) to test the proposed relationships. The results confirm that eco-innovation significantly mediates the relationship, reinforcing the idea that green manufacturing alone is not sufficient—its effectiveness depends on the firm's ability to innovate sustainably across processes, products, and business models. The findings contribute to the ongoing scholarly debate by affirming that eco-innovation is not a passive outcome but an active mediator that amplifies the benefits of green manufacturing. This study provides both theoretical insights and practical recommendations for policymakers and industry leaders to strategically integrate innovation into green manufacturing efforts to achieve long-term environmental and operational resilience.

Keywords: Green Manufacturing, Sustainability Performance, Eco Innovation.

1. Introduction

In the context of the global economy, the manufacturing industry plays a highly vital role, and Indonesia is no exception. This sector has significantly contributed to Indonesia's Gross Domestic Product (GDP). In 2023, manufacturing remained the leading sector, accounting for 18.67% of the

e-ISSN: 3064-6030
FMI, Vol 2
15-17 July 2025

total GDP. Although this figure shows a slight decline compared to 19.87% in 2020, the sector maintains its position as a key driver of the national economy. Furthermore, nearly 90% of the total manufacturing output is supported by large- and medium-scale industries, while the remainder is contributed by small-scale and household industries. With such a substantial contribution to national GDP, any dynamics occurring within the manufacturing sector particularly among large- and medium-sized enterprises have a considerable impact on the direction of Indonesia's overall economic growth.

Figure 1. Year-on-Year (y-on-y) and Quarter-on-Quarter (q-to-q) Manufacturing Production Performance in 2023. (Source: BPS, 2023)

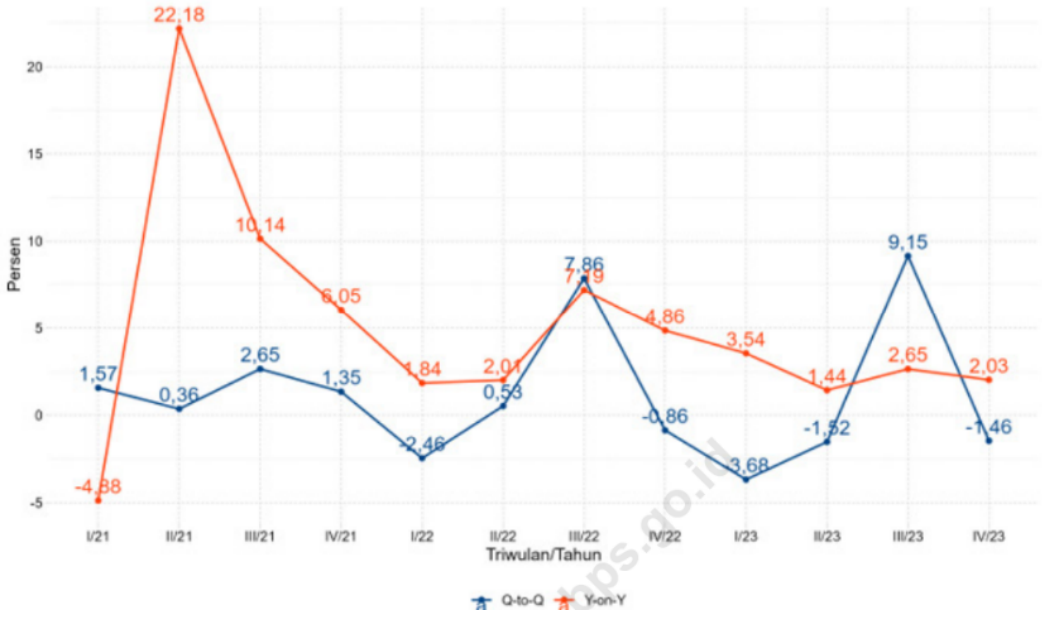


Figure 1 indicates that the year-on-year (y-on-y) growth in the manufacturing production index across the four quarters of 2023 was generally lower than in the previous years. Three years post-COVID-19 pandemic, the production index growth in 2023 lagged behind that of 2021 and 2022 and remained below the levels seen in 2019, the pre-pandemic period. This trend suggests that the performance of the manufacturing sector has yet to fully recover, despite a 19.8% increase in investment in 2023 compared to 2022. This underperformance highlights the need for innovation-driven research efforts, particularly in leveraging technology to improve industrial outcomes.

e-ISSN: 3064-6030
FMI, Vol 2
15-17 July 2025

East Java is the second-largest contributor to Indonesia's GDP after Jakarta. The province's prominent manufacturing sectors include the food and beverage industry, chemicals, petrochemicals, cement, and metallurgical activities. Rapid expansion in both manufacturing and transportation activities in East Java has significantly contributed to the increase in carbon dioxide (CO2) emissions. Major contributors to these emissions are energy-intensive and large-scale activities, such as iron, steel, ferroalloy, and cement manufacturing. East Java is home to five of the largest cement producers in Indonesia. The cement industry is a strategic target for CO2 reduction efforts in Indonesia, as it accounts for approximately 13–15% of the total greenhouse gas emissions from the manufacturing sector.

Industrial activities are a major source of environmental pollution, driven by high energy consumption, industrial waste, and greenhouse gas emissions. Growing awareness of these negative impacts has prompted many companies to adopt green manufacturing practices aimed at reducing environmental footprints without compromising business competitiveness. However, the effectiveness of green manufacturing in enhancing sustainability performance remains a topic of debate among academics and practitioners. While some studies indicate that green manufacturing can improve operational efficiency and environmental outcomes, others argue that the results are not always significant, particularly in developing countries like Indonesia. Therefore, examining the mediating roles of eco-innovation and green supply chain integration in the relationship between green manufacturing and sustainability performance is crucial, especially as both public and industrial awareness of environmental conservation intensifies.

Despite perceptions that environmentally friendly strategies may increase operational costs and weaken competitiveness, recent studies suggest that green management practices can provide competitive advantages through cost efficiency and product differentiation. Accordingly, green manufacturing emerges as a strategic approach for reducing the negative environmental impacts of industrial operations. This is achieved through environmentally friendly product design, pollution control, regulatory compliance, and waste management.

While numerous studies on green manufacturing and sustainability performance have been conducted in developed countries such as China, India, and Malaysia, research in the context of developing nations—especially Indonesia—remains scarce. Existing studies reveal that green manufacturing can enhance environmental and economic performance, yet its effect on social performance is still contested. Green manufacturing should not merely be seen as a reactive strategy to environmental pressures, but also as a catalyst for eco-innovation. Environmental challenges create the need for novel solutions, while economic opportunities and technological advancements enable the development and implementation of such solutions.

e-ISSN: 3064-6030
FMI, Vol 2
15-17 July 2025

Yang & Singhdong (2024) proposed a conceptual framework positioning ambidextrous green innovation as a key driver of environmental, social, and economic performance. Their study underscores the urgency of adopting eco-innovation approaches to achieve sustainability performance, particularly in developing countries facing institutional uncertainties. Similarly, Zhang et al. (2023) examined green product innovation adoption within the context of institutional pressures and green slack—resources allocated for green activities. Their findings suggest that firms with higher green resource commitment are more responsive to external environmental pressures through green product innovation, subsequently increasing the success rate of new products in the market.

This study explores the relationship between green manufacturing and sustainability performance by integrating the concept of eco-innovation as a mediating variable. Addressing the research gap in the Indonesian manufacturing sector, this study focuses on manufacturing industries in East Java—one of the largest industrial hubs in the country. The research aims to provide empirical evidence on the effectiveness of green manufacturing in enhancing the competitiveness of Indonesia's manufacturing sector. In light of increasing public awareness of environmental issues, this study also emphasizes that achieving sustainability performance is no longer solely a matter of regulatory compliance, but also a societal expectation for industries to fulfill. Ultimately, the study seeks to contribute to the green manufacturing literature and inform strategic decision-making within the industrial sector.

Research Problem Statements: (1) Is there an influence of green manufacturing on sustainability performance? (2) Is there an influence of green manufacturing on eco-innovation? (3) Is there an influence of eco-innovation on sustainability performance? (4) Does eco-innovation mediate the relationship between green manufacturing and sustainability performance?

Research Objectives: (1) To examine and analyze the influence of green manufacturing on sustainability performance. (2) To examine and analyze the influence of green manufacturing on eco-innovation. (3) To examine and analyze the influence of eco-innovation on sustainability performance. (4) To examine and analyze the mediating role of eco-innovation in the relationship between green manufacturing and sustainability performance.

2. Literature Review

Resource-Based View (RBV). The Resource-Based View (RBV) is a theory that describes how firms can achieve competitive advantage by leveraging their internal resources, thereby enabling sustained organizational performance (Barney, 1986). Penrose conducted an analysis on internal management processes and noted that mismanagement in combining resources could negatively affect business growth. Based on these findings, it was concluded that business growth potential

Published by: FMI FORUM MANAJEMEN INDONESIA Training & Research Institute JERAMBA ILMU SUKSES

e-ISSN: 3064-6030
FMI, Vol 2
15-17 July 2025

is constrained by the function of various productive assets owned by the company (Barney & Arikan, 2005). RBV argues that an organization can outperform its competitors by optimally allocating resources to create competitive advantage. Companies that effectively utilize their resources are more likely to achieve superior performance compared to others. Several strategic management scholars have criticized this approach for insufficiently emphasizing the importance of the interaction between strategic resources and business strategy, which is crucial for enhancing business performance. According to Barney & Arikan (2005), not all resources are profitable; they must meet four criteria: valuable, rare, imperfectly imitable, and non-substitutable. However, it is not necessary for a company to meet all these criteria simultaneously—this depends on whether the organizational goal is long-term sustainability or performance enhancement. RBV has been further developed by scholars such as (Wernerfelt (1989). It is considered an alternative approach to improve business performance by proposing that the primary source of business returns lies in the unique bundles of resources each firm possesses. The RBV approach posits that resources and strategic capabilities are the main differentiators of organizational performance. Therefore, to gain competitive advantage and improve business performance, resources must be central to corporate strategy.

Natural Resource-Based View (NRBV). Hart & Dowell (2011) introduced the Natural Resource-Based View (NRBV) to incorporate environmental resources into RBV theory. Hart argued that a firm's ability to leverage its resources to develop strategic environmental capabilities determines its future competitiveness. This advantage is not solely based on the acquisition of resources and internal capabilities but also on the use of tacit knowledge and socially complex, causally ambiguous resources. NRBV emphasizes the importance of three proactive environmental strategies—pollution prevention, product stewardship, and sustainable development—as critical factors for maintaining competitive advantage. NRBV is also recognized as a relevant framework in the context of industrial sustainability. Manufacturing firms are increasingly attentive to the environmental impacts surrounding their operations. Therefore, firms must not only acquire and develop resources but also enhance their capacity to manage environmental uncertainty. This theory, thus, focuses on specific conditions that can affect green business performance.

Green Business Performance. Recent economic and social developments require that industries evaluate their performance not only based on financial metrics but also by considering environmental and social dimensions. Companies must adopt sustainability dimensions that encompass stakeholder satisfaction and eco-friendly indicators alongside traditional financial measures such as productivity and profitability (Dwikat et al., 2023)**.** Three key dimensions of business sustainability must be considered: (1) Economic performance refers to how well a firm achieves its short, medium, and long-term financial goals. It involves adopting flexible business

e-ISSN: 3064-6030
FMI, Vol 2
15-17 July 2025

strategies to address changing market needs and improve customer quality of life. (2) Environmental performance focuses on efforts to protect the environment, such as reducing pollution, limiting energy consumption, and minimizing carbon emissions. In the manufacturing industry, this entails reducing negative environmental impacts and wisely utilizing natural resources. (3) Social performance relates to how the firm contributes to societal well-being, including employee welfare, community relations, and corporate social responsibility (Larbi-Siaw et al., 2022). Previous studies have explored factors affecting corporate profitability, yet few have investigated how manufacturing firms can develop flexible strategies to achieve business sustainability. Despite its significant role in the national economy, the manufacturing sector faces both internal and external challenges that influence economic, social, and environmental aspects. Thus, sustainability in manufacturing becomes a crucial issue, particularly in supporting the achievement of Sustainable Development Goals (SDGs).

Green Business Performance Indicators. Green business performance is measured using economic, social, and environmental indicators (Dwikat et al., 2023). This study adopts the following three indicators from Larbi-Siaw et al. (2022): (1) Economic, reflects a firm's success in enhancing profitability, a primary indicator of economic performance. (2) Social, demonstrates how the company is perceived by society in terms of social responsibility and stakeholder relations. (3) Environmental, indicates the firm's efforts to reduce environmental impact as part of its strategy and regulatory compliance.

Eco-Innovation. With increasing internal and external pressures to adopt environmentally responsible business practices, firms must develop eco-innovation capabilities (Ahmed et al., 2020). Environmentally responsible behavior is essential in addressing demands from governments, environmental advocacy groups, and stakeholders (Veleva, 2021). J. A. Zhang et al. (2020) identified research gaps and new opportunities in environmental management studies that offer insights into recent developments in sustainability theory and practice. In the long term, eco-innovation helps firms enhance environmental, economic, and social sustainability while also strengthening competitiveness. It is increasingly recognized as a key strategic tool for achieving sustainable business performance, particularly in the manufacturing industry under mounting environmental pressure. According to Kemp and Pearson (2008), eco-innovation is defined as the production, adoption, or exploitation of a product, service, production method, or management process that is new to the organization and aims to reduce environmental risks, pollution, and other negative impacts related to resource use, including energy. J. A. Zhang et al. (2020) further emphasized that eco-innovation involves introducing new or significantly improved products or services with lower environmental impacts.

e-ISSN: 3064-6030
FMI, Vol 2
15-17 July 2025

Cheng & Shiu (2012) categorized eco-innovation into three types: (1) Eco-product innovation refers to improvements in existing products or the development of new ones that are more environmentally friendly. (2) Eco-process innovation involves enhancing current production processes or introducing new ones to reduce environmental impacts. (3) Green managerial innovation pertains to implementing environmentally oriented management policies and strategies to boost efficiency and business sustainability.

Eco-Innovation Indicators. Eco-innovation, as defined by Kemp and Pearson (2008), involves the adoption or creation of new products, services, production processes, or business management methods aimed at minimizing environmental risks and resource use. This study adopts three indicators adapted from Larbi-Siaw et al. (2022): (1) Product, focuses on product features that support sustainability, such as the use of eco-friendly materials and recyclable designs. (2) Process, refers to how operations are carried out in a more efficient and environmentally friendly manner. (3) Organization, highlights managerial and strategic aspects that support environmentally oriented innovation.

Green Manufacturing. Green manufacturing emerged in the 1990s as a systemic, integrated, and economically efficient approach aimed at reducing or eliminating all forms of waste associated with product design, production, usage, and disposal. In practice, green manufacturing emphasizes the use of technologies and processes that consume resources and energy efficiently while minimizing environmental impact. Moreover, it promotes recycling efforts and waste management within production processes.

Green Manufacturing Indicators. As a systemic, integrated, and economically efficient approach, green manufacturing seeks to eliminate waste throughout the product lifecycle (Sezen & Çankaya, 2013). Dheeraj & Vishal (2012) defined it as the adoption of rapid, reliable, and energy-efficient manufacturing processes aimed at minimizing waste and improving productivity. This study adopts two indicators from Hsu et al. (2016) and Abdul-Rashid et al. (2017), as applied by Afum et al. (2020): (1) Resource and energy efficiency, focuses on how firms optimize raw materials, energy use, and eco-friendly technologies to reduce environmental impact and increase productivity (Hsu et al., 2016). **(2)** Production process sustainability, reflects how firms implement green manufacturing principles through energy efficiency, environmentally friendly technologies, and sustainable product design (Abdul-Rashid et al., 2017).

The Influence of Green Manufacturing on Green Business Performance. Green manufacturing plays a pivotal role in enhancing green business performance. Its implementation reduces environmental impacts, improves operational efficiency, and ensures compliance with increasingly stringent sustainability standards. Beyond long-term cost savings, green manufacturing also

e-ISSN: 3064-6030
FMI, Vol 2
15-17 July 2025

contributes to the improvement of environmental, social, and economic performance. Companies that adopt green manufacturing practices are more likely to attract investors, generate higher profits, and establish sustainable competitive advantages (Dubey et al., 2015; Laari et al., 2016; C. S. Yang et al., 2013). From the perspective of the Resource-Based View (RBV), companies that implement environmentally friendly practices can develop superior capabilities, which ultimately enhance their green business performance (Hami et al., 2015). Improvements in environmental and social performance through green manufacturing reflect a company's commitment to responsible business operations, which in turn strengthens overall business competitiveness (Sezen & Çankaya, 2013). Additionally, firms that successfully implement green manufacturing tend to benefit from a win-win relationship, where increased resource efficiency and green innovation generate positive outcomes for both the environment and corporate profitability (Zhan et al., 2018).

H1: Green Manufacturing has a positive influence on Green Business Performance.

The Influence of Green Manufacturing on Eco-Innovation. Green manufacturing is a systemic, integrated, and economically oriented approach aimed at reducing or eliminating all types of waste associated with product design, production, usage, and disposal (Sezen & Çankaya, 2013). This finding aligns with the study by Dheeraj & Vishal (2012), who define green manufacturing as the adoption of fast, reliable, and energy-efficient manufacturing processes and equipment designed to minimize waste and improve productivity. In the context of green manufacturing, the adoption of such production processes stimulates new innovations as a reactive response to environmental demands (Abdul-Rashid et al., 2017). F. Zhang et al. (2023), in their study on green product innovation, analyzed the role of institutional pressure and green slack—resources allocated for green activities. Their findings suggest that firms with a high commitment to green resources are better equipped to respond to external environmental pressures with eco-friendly product innovations, ultimately improving the success of new products in the market.

H2: Green Manufacturing has a positive influence on Eco-Innovation.

The Influence of Eco-Innovation on Green Business Performance. Eco-innovation is a critical factor in improving green business performance, as it enables firms to develop environmentally friendly products, processes, and business models (Larbi-Siaw et al., 2022). Product, process, and organizational eco-innovations enhance competitiveness through technological modification and operational efficiency by reducing energy consumption, waste, and carbon emissions in manufacturing processes.

e-ISSN: 3064-6030
FMI, Vol 2
15-17 July 2025

Based on this perspective, it can be concluded that the higher the level of eco-innovation implemented by a firm, the better its green business performance. Companies that adopt product, process, and organizational eco-innovation are better positioned to comply with strict environmental regulations, meet green market demands, and improve long-term profitability.

H3: Eco-Innovation has a positive influence on Green Business Performance.

The Mediating Role of Eco-Innovation in the Relationship between Green Manufacturing and Green Business Performance. Companies implementing green manufacturing practices are more likely to attract investors, improve profitability, and establish sustainable competitive advantages (Dubey et al., 2015; Laari et al., 2016; C. S. Yang et al., 2013). From an RBV perspective, environmentally responsible practices enhance firms' internal capabilities, ultimately improving green business performance (Hami et al., 2015). Enhanced environmental and social performance reflects a firm's commitment to stakeholder-oriented operations, contributing to broader business competitiveness (Sezen & Çankaya, 2013). Moreover, firms that adopt green manufacturing enjoy win-win outcomes where increased resource efficiency and green innovation benefit both environmental sustainability and profitability (Zhan et al., 2018). Green manufacturing demands fast, reliable, and efficient production processes, which often stimulate innovation as a response to environmental challenges (Abdul-Rashid et al., 2017). F. Zhang et al. (2023) found that institutional pressures and the availability of green slack are critical in driving green product innovation. Firms that invest in green resources tend to proactively address environmental pressures through eco-friendly innovations, thereby enhancing product success rates. Furthermore, green business performance can be optimized by developing green products, innovating green processes, and integrating sustainability into business operations (Singh et al., 2020). Through business model restructuring and sustainability strategies, companies can improve their environmental and social performance, reaffirming that higher levels of eco-innovation lead to improved green business performance.

H4: Eco-Innovation mediates the relationship between Green Manufacturing and Green Business Performance.

3. Research Method

This study adopts a quantitative approach, which emphasizes the testing of theories through the measurement of research variables using numerical data. Based on the nature of the investigation, this study is categorized as explanatory research. The population of this study consists of all companies in East Java that are members of PROPER (Program for Environmental Performance Rating), a government-led initiative under the Ministry of Environment and Forestry that monitors and evaluates companies environmental management performance. As such, PROPER-listed

e-ISSN: 3064-6030
FMI, Vol 2
15-17 July 2025

companies are appropriate and valid subjects for examining green manufacturing, eco-innovation, and green supply chain integration.

The sampling technique used is purposive sampling, specifically selecting manufacturing firms in East Java that are PROPER participants, with an estimated sample size of 200 respondents. The selection of the manufacturing sector is based on its significant contribution to the national Gross Domestic Product (GDP) and its major environmental impact, particularly in terms of greenhouse gas emissions. Manufacturing—especially medium- and large-scale operations—represents the largest energy consumer and CO_2 emitter, making it a critical sector for implementing green manufacturing practices. Furthermore, this sector holds great potential for adopting environmentally friendly innovations and integrating green supply chains to improve sustainability performance. Therefore, the manufacturing sector is deemed most relevant for analyzing the relationship between green manufacturing, eco-innovation, and green supply chain integration and their influence on sustainability performance.

The respondents in this study are management-level employees of PROPER-affiliated manufacturing companies in East Java. Data were collected through questionnaires using a Likert scale, and analyzed using Structural Equation Modeling (SEM) based on the Partial Least Squares (PLS) approach. The analysis was conducted in two stages: the outer model, to test instrument validity and reliability; and the inner model, to examine the relationships between variables using indicators such as R^2, Q^2, and Goodness of Fit (GoF). This study also conducts hypothesis testing and mediation analysis to identify both direct and indirect effects among the constructs. PLS was chosen for its suitability in confirming theoretical relationships within the developed conceptual model, particularly involving latent variables and scaled indicators.

Green manufacturing aims to achieve energy-efficient production, minimal emissions, and the promotion of recycling and material reuse. With increasing stakeholder pressure concerning sustainability issues, the implementation of green manufacturing has become a critical standard for modern industries. Eco-innovation is positioned as a mediating variable that strengthens the influence of green manufacturing on sustainability performance. Eco-innovation reflects the adoption of environmentally friendly innovations in both products and processes.

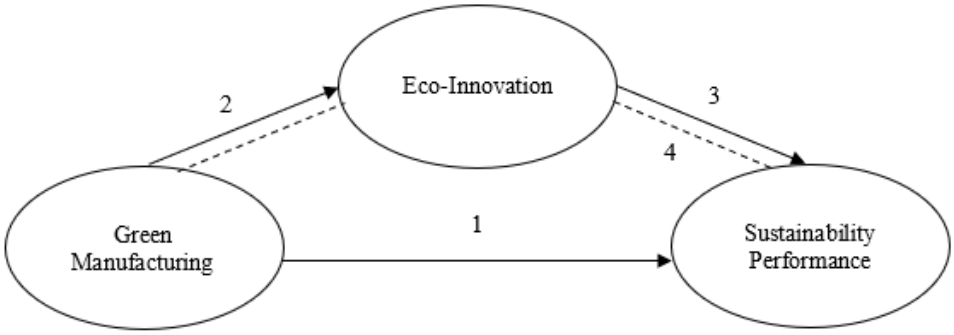
Using an observational survey and descriptive-qualitative analysis, the conceptual framework supports empirical understanding of the interrelationships among variables within the manufacturing sector in East Java, a region with a strategic role in the national economy and high industrial emission levels.

e-ISSN: 3064-6030
FMI, Vol 2
15-17 July 2025

The selection of variables in this study is grounded in robust and relevant theoretical frameworks. Green Manufacturing is the independent variable, supported by the Natural Resource-Based View (NRBV). Eco-Innovation, the mediating variable, refers to the Dynamic Capability Theory, which emphasizes a firm's ability to respond to external change through innovation and cross-supply chain integration. Sustainability Performance, the dependent variable, is grounded in the Triple Bottom Line Framework, which assesses sustainability not only from an economic standpoint but also from environmental and social perspectives. The research model refers to validated indicators from previous studies: Green Business Performance is measured across economic, social, and environmental dimensions (Larbi-Siaw et al., 2022). Eco-Innovation includes product, process, and organizational innovation (Larbi-Siaw et al., 2022). Green Manufacturing is assessed based on resource and energy efficiency and production process sustainability (Afum et al., 2020). Green Supply Chain Integration encompasses sustainable internal, supplier, and customer integration (Junaid et al., 2022).

Figure 4 presents the conceptual framework for examining the influence of Green Manufacturing on Green Business Performance, with Eco-Innovation acting as the mediating variable.

Figure 2. Conceptual Framework of the Study



4. Finding and Discussion

The respondent characteristics in this study, within the context of the population of manufacturing companies participating in the Environmental Performance Rating Program (PROPER) in East Java, comprising a total of 136 companies, are presented in Table 1.

e-ISSN: 3064-6030
FMI, Vol 2
15-17 July 2025

Table 1. Demographic Respondent

Respondent Profile		Frequency	Percentage
Duration of PROPER Membership	< 1 year	28	20.59%
	1 - 5 year	64	47.06%
	6 - 10 year	24	17.65%
	> 10 year	20	14.71%
Total		136	100%
Environmental Certification Ownership	Certified	92	67.65%
	Not Certified	44	32.35%
Total		136	100%
Export/Import	Yes	96	70.59%
	No	40	29.41%
Total		136	100%
PROPER Rating	Gold	9	6.62%
	Green	30	22.06%
	Blue	21	15.44%
	Red	76	55.88%
Total		136	100%

The majority of respondent companies have participated in the PROPER program for 1 to 5 years, representing 47.06% of the sample. Companies with less than one year of participation account for 20.59%, those with 6 to 10 years of participation make up 17.65%, and only 14.71% have been members for more than 10 years. This indicates that most companies are still in the early to intermediate stages of their engagement with PROPER, which may influence their environmental management practices.

Regarding environmental certification, 67.65% of the companies hold certifications such as ISO 14001, reflecting their commitment to standardized environmental management systems. Meanwhile, the remaining 32.35% do not yet have such certifications, indicating the need for further capacity-building efforts.

In terms of international trade activities, 70.59% of the companies are involved in export and import operations, highlighting the importance of strengthening environmental practices to meet global sustainability standards. Concerning PROPER ratings, only 6.62% of companies achieved a gold rating, 22.06% received a green rating, and 15.44% obtained a blue rating. However, 55.88% of companies fall into the red category, indicating that more than half still fail to meet

e-ISSN: 3064-6030
FMI, Vol 2
15-17 July 2025

essential environmental management requirements. This underscores the urgent need for systematic intervention, monitoring, and improvement.

Table 2 shows that the scale, magnitude, and statistical fit were acceptable. The Average Variance Extracted (AVE) values for all variables were satisfactory, with a score of 0.524 for the Eco-Innovation variable, 0.532 for Green Manufacturing, and 0.529 for Sustainability Performance. The Cronbach's alpha values indicated high reliability; the Sustainability Performance variable recorded the highest Cronbach's alpha. Overall, the Cronbach's alpha coefficients for the four variables ranged from 0.822 to 0.888 and were deemed acceptable. The Composite Reliability values were 0.885, 0.910, and 0.871 respectively (all above 0.80). Therefore, it can be concluded that all constructs are reliable based on both Composite Reliability and Cronbach's Alpha. The R-square values indicate a score of 0.652 for the Eco-Innovation variable and 0.833 for Sustainability Performance, suggesting a substantial explanatory power of the model.

Table 2. Composite Reliability, Cronbach Alpha, AVE

Variabel	Cronbach's Alpha	Composite Reliability	AVE	R-Square
Eco Innovation	0.848	0.885	0.524	0.652
Green Manufacturing	0.822	0.871	0.532	0.833
Sustainability Performance	0.888	0.910	0.529	

The results of the hypothesis testing are presented in Table 3 and indicate that the direct effect of green manufacturing on sustainability performance is significant, with a path coefficient of 0.425 and a p-value of 0.000 (below the 0.05 threshold). These findings demonstrate that green manufacturing has a significant influence on sustainability performance. Thus, Hypothesis 1 is supported. The effect of green manufacturing on eco-innovation is also found to be significant, with a path coefficient of 0.808 and a p-value of 0.000 (below 0.05). Based on these results, green manufacturing significantly influences eco-innovation. Therefore, Hypothesis 2 is supported.

The influence of eco-innovation on sustainability performance is likewise significant, with a path coefficient of 0.535 and a p-value of 0.000 (below 0.05). This indicates that eco-innovation significantly affects sustainability performance. Thus, Hypothesis 3 is supported. Regarding the indirect effect, the mediating role of eco-innovation in the relationship between green manufacturing and sustainability performance is found to be significant, with a path coefficient of 0.432 and a p-value of 0.000 (below 0.05). These findings indicate that eco-innovation mediates the relationship between green manufacturing and sustainability performance. Therefore, Hypothesis 4 is supported.

e-ISSN: 3064-6030
FMI, Vol 2
15-17 July 2025

Table 3. Results of Direct and Indirect Effect Testing

Hypothesis	Path Coefficient	t-statistic	P-Value	Result
H1: Green Manufacturing → Sustainability Performance	0.425	8.564	0.000	Significant
H2: Green Manufacturing → Eco Innovation	0.808	16.957	0.000	Significant
H3: Eco Innovation → Sustainability Performance	0.535	10.536	0.000	Significant
H4: Green Manufacturing → Eco Innvation → Sustainability Performance	0.432	9.102	0.000	Significant (Partial Mediation)

Based on the results of this study, it can be concluded that there is a direct influence of Green Manufacturing on Sustainability Performance. This finding confirms that the adoption of Green Manufacturing directly and positively affects a company's sustainability performance. The underlying rationale is that by reducing waste, conserving energy, using renewable raw materials, and minimizing pollution during production processes, companies not only comply with environmental regulations but also enhance operational efficiency. Operational cost reductions (e.g., energy costs, waste disposal costs), improved reputation among environmentally conscious consumers and investors, and environmental risk mitigation are some of the mechanisms that explain why Green Manufacturing directly improves overall sustainability performance—economically, environmentally, and socially. It can thus be concluded that sustainability is no longer a burden but rather a driver of superior performance.

In this study, the relationship between Green Manufacturing and Eco-Innovation is shown to be very strong. The findings suggest that implementing Green Manufacturing serves as a powerful catalyst for Eco-Innovation. Companies committed to Green Manufacturing will seek to innovate in their processes, products, and organizational management systems aligned with sustainability principles. The challenge of becoming “greener” fosters creativity and drives the search for new sustainable solutions. Innovation in product design may involve designing for recyclability, implementing low-carbon production technologies, and adopting environmentally oriented business models. In fact, Green Manufacturing stimulates innovative thinking that ultimately results in new forms of Eco-Innovation. A commitment to green manufacturing opens the door to more environmentally friendly discoveries. Sustainability-oriented innovation leads to the creation of products with greater value, potentially serving as a source of competitive advantage.

e-ISSN: 3064-6030
FMI, Vol 2
15-17 July 2025

The results of testing the relationship between Eco-Innovation and Sustainability Performance show that Eco-Innovation is a significant driver of sustainability performance. Environmentally focused innovations—whether in products, processes, or services—are inherently designed to reduce negative impacts and enhance positive ones. The development of energy-efficient products lowers the carbon footprint, which in turn reduces environmental pollution and operational costs for consumers. Furthermore, such innovation improves the product and corporate image. Cleaner production processes reduce environmental pollution and help avoid additional costs to the company. Moreover, Eco-Innovation can increase market share, attract environmentally conscious investors, and build a strong brand image all of which contribute to holistic sustainability performance. It can be concluded that Eco-Innovation enhances cost efficiency and becomes a source of competitive strength in an increasingly intense market environment.

This study also concludes that Eco-Innovation partially mediates the relationship between Green Manufacturing and Sustainability Performance. The findings show that Green Manufacturing has a significant direct effect on Sustainability Performance. The mediating role of Eco-Innovation can be explained by the fact that the positive impact of Green Manufacturing on sustainability occurs because such practices encourage companies to innovate, and it is this Eco-Innovation that subsequently enhances Sustainability Performance. Companies adopting Green Manufacturing are likely to discover new ways to reduce waste through material recycling—an example of process-based Eco-Innovation which in turn boosts efficiency and contributes to improved sustainability outcomes.

To maximize Sustainability Performance, companies should not only implement Green Manufacturing but also actively foster the development of Eco-Innovation as a natural consequence. Eco-Innovation acts as a lever through which the full benefits of Green Manufacturing can be realized. This indicates that the most effective sustainability strategy involves jointly advancing Green Manufacturing and simultaneously promoting Eco-Innovation.5.

5. Conclusion

Green Manufacturing not only enhances Sustainability Performance directly but also significantly stimulates Eco-Innovation. The adoption of green manufacturing practices fosters the development of sustainability-oriented product, process, and business model innovations, which in turn strengthen a firm's Sustainability Performance. Therefore, the most effective strategy for achieving optimal Sustainability Performance is to integrate Green Manufacturing as a key driver of Eco-Innovation, ensuring that investments in Eco-Innovation directly yield innovative solutions that improve long-term efficiency and competitiveness.

e-ISSN: 3064-6030
FMI, Vol 2
15-17 July 2025

Acknowledgement. This research was supported by the Department of Management, Faculty of Economics and Business, Universitas Brawijaya. The authors would like to express their sincere gratitude for the academic guidance, research resources, and institutional support provided throughout the study.

References

Abdul-Rashid, S. H., Sakundarini, N., Raja Ghazilla, R. A., & Thurasamy, R. (2017). The impact of sustainable manufacturing practices on sustainability performance: Empirical evidence from Malaysia. *International Journal of Operations and Production Management*, *37*(2), 182–204. https://doi.org/10.1108/IJOPM-04-2015-0223

Afum, E., Agyabeng-Mensah, Y., Sun, Z., Frimpong, B., Kusi, L. Y., & Acquah, I. S. K. (2020). Exploring the link between green manufacturing, operational competitiveness, firm reputation and sustainable performance dimensions: a mediated approach. *Journal of Manufacturing Technology Management*, *31*(7), 1417–1438. https://doi.org/10.1108/JMTM-02-2020-0036

Ahmed, W., Najmi, A., & Ikram, M. (2020). Steering firm performance through innovative capabilities: A contingency approach to innovation management. *Technology in Society*, *63*. https://doi.org/10.1016/j.techsoc.2020.101385

Barney, J. B., 1986. Strategic factor markets: Expectations, luck, and business strategy. *Management science*, 32(10), 1231-1241.

Barney, J. B., & Arikan, A. M. (2005). The resource-based view: origins and implications. *The Blackwell Handbook of Strategic Management*, 123–182.

Cheng, C. C., & Shiu, E. C. (2012). Validation of a proposed instrument for measuring eco-innovation: An implementation perspective. *Technovation*, *32*(6), 329–344. https://doi.org/10.1016/j.technovation.2012.02.001

Dheeraj, N., & Vishal, N. (2012). An Overview of Green Supply Chain Management in India. In *Research Journal of Recent Sciences* (Vol. 1, Issue 6). www.isca.in

Dubey, R., Gunasekaran, A., & Samar Ali, S. (2015). Exploring the relationship between leadership, operational practices, institutional pressures and environmental performance: A framework for green supply chain. *International Journal of Production Economics*, *160*, 120–132. https://doi.org/10.1016/j.ijpe.2014.10.001

e-ISSN: 3064-6030
FMI, Vol 2
15-17 July 2025

Dwikat, S. Y., Arshad, D., & Mohd Shariff, M. N. (2023). Effect of Competent Human Capital, Strategic Flexibility and Turbulent Environment on Sustainable Performance of SMEs in Manufacturing Industries in Palestine. *Sustainability (Switzerland)*, *15*(6). https://doi.org/10.3390/su15064781

Hami, N., Muhamad, M. R., & Ebrahim, Z. (2015). The impact of sustainable manufacturing practices and innovation performance on economic sustainability. *Procedia CIRP*, *26*, 190–195. https://doi.org/10.1016/j.procir.2014.07.167

Hart, S. L., & Dowell, G. (2011). A natural-resource-based view of the firm: Fifteen years after. In *Journal of Management* (Vol. 37, Issue 5, pp. 1464–1479). https://doi.org/10.1177/0149206310390219

Hsu, C. C., Tan, K. C., & Mohamad Zailani, S. H. (2016). Strategic orientations, sustainable supply chain initiatives, and reverse logistics: Empirical evidence from an emerging market. *International Journal of Operations and Production Management*, *36*(1), 86–110. https://doi.org/10.1108/IJOPM-06-2014-0252

Junaid, M., Zhang, Q., & Syed, M. W. (2022). Effects of sustainable supply chain integration on green innovation and firm performance. *Sustainable Production and Consumption*, *30*, 145–157. https://doi.org/10.1016/j.spc.2021.11.031

Laari, S., Töyli, J., Solakivi, T., & Ojala, L. (2016). Firm performance and customer-driven green supply chain management. *Journal of Cleaner Production*, *112*, 1960–1970. https://doi.org/10.1016/j.jclepro.2015.06.150

Kemp, R., Pearson, P., 2008. Final Report MEI Project about Measuring Eco innovation: Deliverable 15 of MEI project (D15). *Project Report*, available at /http://www.merit.unu.edu/MEIS.

Larbi-Siaw, O., Xuhua, H., Owusu, E., Owusu-Agyeman, A., Fulgence, B. E., & Frimpong, S. A. (2022). Eco-innovation, sustainable business performance and market turbulence moderation in emerging economies. *Technology in Society*, *68*. https://doi.org/10.1016/j.techsoc.2022.101899

Prahalad, C. K & Hamel, G., 1990. Strategic intent. *Mckinsey quarterly*, (1), 36-61

Sezen, B., & Çankaya, S. Y. (2013). Effects of Green Manufacturing and Eco-innovation on Sustainability Performance. *Procedia - Social and Behavioral Sciences*, *99*, 154–163. https://doi.org/10.1016/j.sbspro.2013.10.481

Singh, S. K., Giudice, M. Del, Chierici, R., & Graziano, D. (2020). Green innovation and environmental performance: The role of green transformational leadership and green human

e-ISSN: 3064-6030
FMI, Vol 2
15-17 July 2025

resource management. *Technological Forecasting and Social Change*, *150*. https://doi.org/10.1016/j.techfore.2019.119762

Veleva, V. (2021). The role of entrepreneurs in advancing sustainable lifestyles: Challenges, impacts, and future opportunities. *Journal of Cleaner Production*, *283*. https://doi.org/10.1016/j.jclepro.2020.124658

Wernerfelt, B. (1989). A Resource-Based View of the Firm. In *Strategic Management Journal* (Vol. 5, Issue 2).

Yang, C. S., Lu, C. S., Haider, J. J., & Marlow, P. B. (2013). The effect of green supply chain management on green performance and firm competitiveness in the context of container shipping in Taiwan. *Transportation Research Part E: Logistics and Transportation Review*, *55*, 55–73. https://doi.org/10.1016/j.tre.2013.03.005

Yang, G., & Singhdong, P. (2024). A conceptual framework of green supply chain integration toward enterprise performance through ambidextrous green innovation: an organizational capability perspective. *Journal of International Logistics and Trade*, *22*(2), 93–106. https://doi.org/10.1108/JILT-07-2023-0056

Zhan, Y., Tan, K. H., Ji, G., Chung, L., & Chiu, A. S. F. (2018). Green and lean sustainable development path in China: Guanxi, practices and performance. *Resources, Conservation and Recycling*, *128*, 240–249. https://doi.org/10.1016/j.resconrec.2016.02.006

Zhang, F., Yang, B., & Zhu, L. (2023). Digital technology usage, strategic flexibility, and business model innovation in traditional manufacturing firms: The moderating role of the institutional environment. *Technological Forecasting and Social Change*, *194*. https://doi.org/10.1016/j.techfore.2023.122726

Zhang, J. A., O'Kane, C., & Chen, G. (2020). Business ties, political ties, and innovation performance in Chinese industrial firms: The role of entrepreneurial orientation and environmental dynamism. *Journal of Business Research*, *121*, 254–267. https://doi.org/10.1016/j.jbusres.2020.08.055

Copyrights

Copyright for this article is retained by the author(s), with first publication rights granted to the journal.

This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (http://creativecommons.org/licenses/by/4.0/)