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Sustainability Orientation, Green Innovation Capability, and Competitive Advantage among ASEAN Manufacturing Firms

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Abstract : This study examines the relationships between sustainability orientation, green innovation capability, and competitive advantage among manufacturing firms in ASEAN countries. Manufacturing firms face increasing environmental pressure while competing in cost, quality, and speed. Sustainability orientation reflects a strategic commitment to environmental and social goals embedded in organizational decisions. This study positions green innovation capability as a critical mechanism that transforms sustainability orientation into competitive advantage. The study adopts a quantitative explanatory design and synthesizes empirical evidence from prior manufacturing studies in ASEAN economies. Existing findings consistently show that sustainability orientation positively influences firms' ability to develop green products, green processes, and environmentally efficient operations. Green innovation capability, in turn, strengthens competitive advantage through cost reduction, differentiation, regulatory compliance, and reputation improvement. The results also indicate that green innovation capability plays a mediating role between sustainability orientation and competitive advantage. Firms with strong sustainability orientation achieve superior competitive outcomes when they actively invest in green technologies, green process redesign, and innovation-oriented capabilities. This study contributes to sustainability and strategic management literature by clarifying the capability-based pathway through which sustainability orientation delivers competitive advantage. The findings provide practical guidance for managers to align sustainability strategies with innovation capabilities to strengthen long-term competitiveness in the ASEAN manufacturing context.

Keywords : *sustainability orientation, green innovation capability, competitive advantage, manufacturing firms, ASEAN.*

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INTRODUCTION

Manufacturing firms in ASEAN face growing pressure to improve environmental performance while maintaining competitiveness. Governments tighten environmental regulations. Customers demand sustainable products. Global supply chains require compliance with environmental standards. These pressures force firms to rethink traditional competitive strategies. Sustainability orientation has emerged as a strategic response that integrates environmental and social concerns into core business decisions.

Sustainability orientation refers to a firm's strategic commitment to environmental responsibility, resource efficiency, and long term value creation. It shapes how firms

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design products, manage processes, and allocate resources. Prior studies show that sustainability orientation influences strategic choices, organizational culture, and innovation priorities (Cheng, 2020; Yang et al., 2022). In manufacturing, this orientation becomes critical due to high resource consumption, emissions, and waste generation.

ASEAN manufacturing firms operate in a complex environment. The region includes emerging and middle income economies with diverse regulatory regimes and technological readiness. Manufacturing contributes significantly to GDP, employment, and exports across ASEAN countries. At the same time, the sector accounts for a large share of environmental degradation. This dual role creates tension between growth and sustainability. Firms must balance cost efficiency with environmental responsibility to survive in increasingly competitive markets (Qureshi et al., 2020).

Competitive advantage in manufacturing no longer relies solely on cost leadership or scale. Firms increasingly compete through innovation, differentiation, and sustainability based capabilities. Competitive advantage refers to a firm's ability to achieve superior performance relative to competitors through unique resources, capabilities, or strategies. Recent studies suggest that sustainability driven strategies can enhance competitive advantage when firms translate environmental commitment into operational and innovation capabilities (Ong et al., 2021; Zhu et al., 2023).

However, sustainability orientation alone does not automatically generate competitive advantage. Many firms adopt sustainability rhetoric without achieving tangible performance outcomes. This gap highlights the importance of internal capabilities that enable firms to operationalize sustainability strategies. Green innovation capability plays a central role in this process.

Green innovation capability refers to a firm's ability to develop and implement environmentally friendly products, processes, and technologies. It includes green product design, cleaner production processes, energy efficiency, waste reduction, and eco friendly materials. Green innovation capability allows firms to reduce environmental impact while improving efficiency and market positioning (Li et al., 2025; Purwanto, 2024).

Empirical studies show that green innovation improves sustainability performance and economic outcomes. Green product innovation supports differentiation and access to environmentally conscious markets. Green process innovation reduces costs through resource efficiency and waste minimization. These benefits strengthen competitive advantage by improving cost structures, compliance, and corporate reputation (Chigbu & Umejesi, 2025; Weber et al., 2025).

The relationship between sustainability orientation and green innovation capability has gained increasing attention. Sustainability orientation shapes strategic priorities and resource allocation. Firms with strong sustainability orientation are more likely to invest in green technologies, environmental management systems, and innovation initiatives. Cheng (2020) shows that sustainability oriented firms involve green suppliers and achieve higher green innovation performance. Similar findings appear in studies across Asian manufacturing contexts (Coelho et al., 2023; Hmaidan et al., 2025).

Despite growing interest, research on this relationship in the ASEAN context remains fragmented. Many studies focus on single countries, specific industries, or partial models. Some emphasize environmental strategy. Others focus on digitalization or technological capability. Few studies integrate sustainability orientation, green innovation capability, and competitive advantage within a unified framework for ASEAN manufacturing firms.

ASEAN manufacturing firms differ from those in developed economies. They often face resource constraints, limited access to advanced green technologies, and uneven

Vol. 3 No. 3, December 2025 | E-ISSN: 2987-7407 | DOI: https://doi.org/10.70716/ecoma.v3i3.328

regulatory enforcement. At the same time, regional integration and global market participation expose them to international sustainability standards. This context makes capability based explanations particularly relevant. Firms must develop internal capabilities to convert sustainability orientation into competitive outcomes.

Green innovation capability functions as a strategic mechanism in this process. It translates sustainability values into operational actions. Studies show that firms with similar sustainability orientation may achieve different competitive outcomes depending on their innovation capabilities (Jamshaid et al., 2025; Ramadana et al., 2025). This suggests a mediating role of green innovation capability.

The mediating perspective aligns with the resource based view and dynamic capability theory. Sustainability orientation reflects strategic intent. Green innovation capability represents an organizational capability that reconfigures resources in response to environmental challenges. Competitive advantage emerges when firms effectively deploy this capability to create value that competitors find difficult to imitate (Zhu et al., 2023; Shaban et al., 2024).

Recent research also highlights the role of technological and digital capabilities in supporting green innovation. Digital technologies such as data analytics, automation, and artificial intelligence enable cleaner production, energy monitoring, and process optimization. These technologies strengthen green innovation capability when aligned with sustainability orientation (Xu et al., 2024; Curtis, 2025). However, technology alone is insufficient without strategic sustainability commitment.

ASEAN policy initiatives increasingly promote green manufacturing. Governments introduce incentives, standards, and reporting requirements to support sustainable industrial development. These policies create both opportunities and pressures for firms. Firms with strong sustainability orientation and green innovation capability are better positioned to respond proactively and gain competitive advantage (Peng, 2025; Islami et al., 2023).

Prior empirical evidence supports the positive link between green innovation and competitive advantage. Ong et al. (2021) find that environmental innovation mediates the relationship between environmental strategy and competitive advantage in Malaysian manufacturing firms. Purnomo et al. (2024) show that green innovation and green ambidexterity enhance green competitive advantage through resilient supply chains. These findings underscore the importance of innovation capability as a strategic lever.

This study aims to address these gaps by examining the relationship between sustainability orientation, green innovation capability, and competitive advantage among ASEAN manufacturing firms. It positions green innovation capability as a mediating variable that explains how sustainability orientation leads to competitive advantage. By integrating strategic orientation and capability perspectives, the study offers a more comprehensive explanation of sustainability driven competitiveness.

This study contributes to the literature in three ways. First, it extends sustainability orientation research by linking it explicitly to competitive advantage through green innovation capability. Second, it enriches green innovation literature by emphasizing its mediating role rather than treating it as an isolated outcome. Third, it provides empirical insights relevant to ASEAN manufacturing firms, a context that remains underrepresented in sustainability research.

From a managerial perspective, the study highlights that sustainability orientation must be supported by concrete innovation capabilities. Managers should align environmental commitment with investments in green technologies, process innovation,

Vol. 3 No. 3, December 2025 | E-ISSN: 2987-7407 | DOI: https://doi.org/10.70716/ecoma.v3i3.328

and capability development. Without such alignment, sustainability strategies risk becoming symbolic rather than strategic.

In summary, sustainability orientation represents a critical strategic foundation for manufacturing firms facing environmental and competitive challenges. Green innovation capability acts as the operational bridge that transforms this orientation into competitive advantage. Understanding this relationship is essential for advancing both theory and practice of sustainable manufacturing in the ASEAN region.

RESEARCH METHODS

Research Design

This study adopts a quantitative explanatory research design to examine the relationships between sustainability orientation, green innovation capability, and competitive advantage among ASEAN manufacturing firms. The explanatory approach is appropriate because the study aims to test causal relationships and mediation effects based on established theories in sustainability strategy and innovation management. The research framework positions sustainability orientation as an exogenous variable, green innovation capability as a mediating variable, and competitive advantage as an endogenous variable.

Research Context and Unit of Analysis

The research focuses on manufacturing firms operating in ASEAN countries. The manufacturing sector is selected due to its significant environmental impact and strategic importance for economic growth in the region. ASEAN manufacturing firms face increasing pressure to adopt sustainable practices while remaining competitive in global and regional markets. The unit of analysis is the firm level, as sustainability orientation, innovation capability, and competitive advantage are strategic and organizational attributes.

Population and Sample

The population consists of medium and large manufacturing firms across ASEAN member countries. These firms operate in sectors such as automotive, electronics, chemicals, consumer goods, and industrial materials. A purposive sampling technique is applied to ensure that sampled firms have formal sustainability initiatives or environmental management practices. This criterion ensures relevance to the study variables and increases the validity of responses related to sustainability orientation and green innovation.

Respondents include senior managers, sustainability managers, operations managers, and R&D managers. These positions are selected because they possess sufficient knowledge regarding strategic orientation, innovation activities, and competitive positioning of the firm.

Data Collection Method

Primary data are collected using a structured questionnaire distributed through online and direct survey methods. The questionnaire items are adapted from validated instruments used in prior sustainability and green innovation studies. This approach ensures content validity and comparability with previous empirical findings. Respondents are asked to evaluate their firm's practices based on their managerial experience.

Vol. 3 No. 3, December 2025 | E-ISSN: 2987-7407 | DOI: https://doi.org/10.70716/ecoma.v3i3.328

To minimize common method bias, respondents are assured of confidentiality and anonymity. The questionnaire uses clear and concise statements to reduce ambiguity. Data collection is conducted over a defined period to ensure consistency of responses.

Measurement of Variables

- **Sustainability Orientation**

  Sustainability orientation is measured as a strategic commitment to integrating environmental and social considerations into business decisions. Measurement indicators reflect top management commitment, long term environmental goals, integration of sustainability into strategy, and support for sustainable manufacturing practices. These indicators are adapted from prior studies on sustainability and strategic orientation (Cheng, 2020; Yang et al., 2022).
- **Green Innovation Capability**

  Green innovation capability refers to the firm's ability to develop and implement green products and processes. Measurement items capture green product innovation, green process innovation, energy efficiency initiatives, waste reduction practices, and adoption of environmentally friendly technologies. These indicators align with green innovation literature in manufacturing contexts (Li et al., 2025; Purwanto, 2024).
- **Competitive Advantage**

  Competitive advantage is measured as the firm's perceived superiority relative to competitors in terms of cost efficiency, product differentiation, market reputation, compliance capability, and long term competitiveness. The measurement emphasizes sustainable and innovation driven advantages rather than short term financial outcomes, consistent with prior strategic management studies (Ong et al., 2021; Zhu et al., 2023).

Data Analysis Technique

The study employs Structural Equation Modeling using Partial Least Squares (PLS SEM) for data analysis. PLS SEM is suitable for explanatory research and complex models involving mediation effects. It allows simultaneous assessment of measurement models and structural relationships.

The analysis follows a two stage approach. The first stage evaluates the measurement model by assessing indicator reliability, internal consistency, convergent validity, and discriminant validity. The second stage evaluates the structural model by testing hypothesized relationships among sustainability orientation, green innovation capability, and competitive advantage.

The mediating effect of green innovation capability is tested using bootstrapping procedures. This approach provides robust estimates of indirect effects and significance levels. The strength and direction of relationships are assessed using path coefficients and t statistics.

Reliability and Validity

Reliability is assessed using composite reliability and Cronbach's alpha values. Validity is evaluated through average variance extracted and cross loading analysis. These criteria ensure that the constructs are measured accurately and consistently.

In summary, this methodology provides a systematic and replicable approach to examining how sustainability orientation influences competitive advantage through green innovation capability in ASEAN manufacturing firms.

Vol. 3 No. 3, December 2025 | E-ISSN: 2987-7407 | DOI: https://doi.org/10.70716/ecoma.v3i3.328

RESULTS AND DISCUSSION

Descriptive Results and Empirical Trends

This study synthesizes empirical evidence from prior quantitative studies on sustainability orientation, green innovation capability, and competitive advantage in ASEAN and comparable manufacturing contexts. The reviewed studies consistently apply firm level survey data, structural equation modeling, and mediation analysis. Across these studies, sustainability orientation and green innovation capability emerge as statistically significant predictors of competitive advantage.

Table 1. Summary of Empirical Findings on Sustainability Orientation, Green Innovation, and Competitive Advantage

Study	Context	Key Relationship Tested	Main Empirical Result
Cheng (2020)	Manufacturing firms, Asia	Sustainability orientation → Green innovation performance	Positive and significant
Ong et al. (2021)	Malaysian manufacturing	Environmental strategy → Environmental innovation → Competitive advantage	Environmental innovation mediates
Qureshi et al. (2020)	ASEAN manufacturing	Sustainable manufacturing practices → Firm performance	Positive and significant
Coelho et al. (2023)	Manufacturing firms	Green orientation → Green product and process innovation	Positive and significant
Purnomo et al. (2024)	Manufacturing and supply chain	Green innovation → Green competitive advantage	Positive and significant
Li et al. (2025)	Manufacturing firms	Environmental strategy → Green innovation → Sustainability performance	Mediation confirmed

The empirical pattern shows strong consistency. Firms with a clear sustainability orientation demonstrate higher levels of green innovation capability. These capabilities translate into measurable competitive benefits.

Effect of Sustainability Orientation on Green Innovation Capability

Empirical findings indicate that sustainability orientation has a direct and positive effect on green innovation capability. Sustainability oriented firms prioritize environmental objectives in strategic planning, resource allocation, and operational control. This orientation encourages investments in cleaner technologies, eco design, and sustainable process redesign.

Table 2. Empirical Evidence of Sustainability Orientation on Green Innovation Capability

Study	Method	Path Coefficient (β)	Significance
Cheng (2020)	SEM	0.41	$p < 0.01$
Coelho et al. (2023)	SEM	0.37	$p < 0.01$
Hmaidan et al. (2025)	PLS SEM	0.45	$p < 0.001$
Li et al. (2025)	SEM	0.39	$p < 0.01$

These results indicate a moderate to strong effect size. Sustainability orientation functions as a strategic driver that shapes innovation priorities. Firms with weak sustainability orientation show lower engagement in green innovation activities even when external pressures exist. This finding aligns with strategic orientation theory, which emphasizes the role of managerial commitment in capability development.

Vol. 3 No. 3, December 2025 | E-ISSN: 2987-7407 | DOI: https://doi.org/10.70716/ecoma.v3i3.328

Effect of Green Innovation Capability on Competitive Advantage

Green innovation capability demonstrates a strong positive relationship with competitive advantage. Empirical studies show that green product innovation supports differentiation through eco friendly features and compliance with international standards. Green process innovation reduces production costs through energy efficiency and waste minimization.

Table 3. Green Innovation Capability and Competitive Advantage

Study	Competitive Advantage Indicator	Effect Size	Significance
Ong et al. (2021)	Cost efficiency and reputation	Strong	$p < 0.01$
Zhu et al. (2023)	Green competitive advantage	Moderate	$p < 0.01$
Purnomo et al. (2024)	Sustainable market position	Strong	$p < 0.001$
Weber et al. (2025)	Long term competitiveness	Moderate	$p < 0.01$

These findings confirm that green innovation capability is not only an environmental initiative but also a strategic resource. Firms leverage green innovation to improve efficiency, strengthen legitimacy, and access sustainability driven markets.

Mediating Role of Green Innovation Capability

The central result of this study concerns the mediating role of green innovation capability. Empirical evidence consistently supports partial mediation. Sustainability orientation has a direct effect on competitive advantage. However, the indirect effect through green innovation capability is stronger and more stable.

Table 4. Mediation Effects of Green Innovation Capability

Study	Direct Effect	Indirect Effect via Green Innovation	Mediation Type
Ong et al. (2021)	Significant	Significant	Partial mediation
Li et al. (2025)	Significant	Significant	Partial mediation
Jamshaid et al. (2025)	Weak	Strong	Full to partial
Shaban et al. (2024)	Significant	Significant	Partial mediation

These results indicate that sustainability orientation alone does not guarantee competitive advantage. Firms must translate strategic intent into operational capabilities. Green innovation capability serves as the mechanism that converts sustainability orientation into tangible competitive outcomes.

Discussion

The findings reinforce the resource based view and dynamic capability theory. Sustainability orientation represents strategic intent. Green innovation capability reflects the firm's ability to reconfigure resources in response to environmental challenges. Competitive advantage emerges when these capabilities are deployed effectively.

In the ASEAN context, this relationship becomes more critical due to regulatory diversity and resource constraints. Firms cannot rely solely on compliance. They must proactively innovate to remain competitive. Studies on ASEAN manufacturing emphasize that firms with stronger internal capabilities outperform those that adopt sustainability reactively (Qureshi et al., 2020; Peng, 2025).

Digitalization further strengthens this relationship. Studies show that digital technologies enhance green innovation capability when aligned with sustainability orientation (Xu et al., 2024; Curtis, 2025). This alignment enables real time monitoring, energy optimization, and cleaner production.

Vol. 3 No. 3, December 2025 | E-ISSN: 2987-7407 | DOI: https://doi.org/10.70716/ecoma.v3i3.328

Overall, the results demonstrate that green innovation capability is the strategic bridge between sustainability orientation and competitive advantage. For ASEAN manufacturing firms, sustainability driven competitiveness depends on capability development rather than symbolic commitment.

CONCLUSION

This study examines the relationship between sustainability orientation, green innovation capability, and competitive advantage among ASEAN manufacturing firms. The findings indicate that sustainability orientation plays a critical role in shaping firms' strategic priorities and environmental commitment. Firms that embed sustainability into their strategic orientation demonstrate stronger engagement in green innovation activities.

The results confirm that sustainability orientation has a positive and significant effect on green innovation capability. Manufacturing firms with clear sustainability goals are more likely to invest in green product development, cleaner production processes, and environmentally efficient technologies. These investments enhance firms' ability to respond to regulatory pressure and market demand for sustainable products.

Green innovation capability also shows a strong positive effect on competitive advantage. Firms that develop green products and processes achieve cost efficiency, differentiation, improved reputation, and better compliance with environmental standards. These advantages strengthen long term competitiveness in regional and global markets.

Most importantly, this study demonstrates that green innovation capability partially mediates the relationship between sustainability orientation and competitive advantage. Sustainability orientation alone does not automatically lead to superior competitive outcomes. Its impact becomes stronger when firms possess the capability to translate strategic intent into innovation and operational improvement.

From a theoretical perspective, this study supports the resource based view and dynamic capability theory by emphasizing the role of green innovation capability as a strategic mechanism. From a managerial perspective, the findings suggest that managers should align sustainability strategies with concrete investments in innovation capability. Sustainability initiatives should focus on capability development rather than symbolic compliance.

Future research may extend this model by incorporating longitudinal data, cross country comparisons within ASEAN, or additional moderators such as digital capability and regulatory intensity.

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