

Green Product Innovation and Competitive Advantage: A Sectoral Study Based on Global Insights

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Abstract: This study explores how green product innovation (GPI) contributes to competitive advantage across various industries. Drawing on data from China and Jordan, it examines the relationship between environmental product innovations and firm performance. The research highlights that companies investing in green innovation not only improve sustainability credentials but also strengthen market positioning. By analyzing existing empirical studies, the paper reveals that customer perception, regulatory compliance, and cost-efficiency are key mediators in achieving long-term competitiveness through GPI.

Keywords: Green product innovation, sustainability, competitive advantage, firm performance, eco-innovation.

❖ INTRODUCTION

In the context of rising environmental awareness and increasingly stringent global regulations, firms are being compelled to transition toward sustainable business models. This global shift has given rise to green product innovation (GPI), a vital component of corporate sustainability strategy. GPI refers to the development or improvement of products with reduced environmental impact throughout their life cycle—from design and production to consumption and disposal.

Governments, industries, and consumers worldwide are recognizing the dual role of GPI in both addressing environmental concerns and creating business value. Companies engaging in GPI can potentially realize cost savings through energy and resource efficiency, enhance their brand image, comply with regulatory standards more easily, and cultivate consumer loyalty among environmentally conscious buyers.

This paper critically examines the impact of green product innovation on achieving competitive advantage. It draws insights from empirical studies in diverse contexts such as the Chinese manufacturing sector and Jordanian chemical industry, while also incorporating foundational theoretical perspectives. Through a sectoral comparison, the research provides an integrated view of how GPI contributes to firm-level competitiveness and long-term sustainability.

❖ REVIEW OF LITERATURE

Green product innovation has been widely studied in environmental management, innovation theory, and competitive strategy literature. Key studies shaping the theoretical foundation and empirical understanding include:

- Zhang et al. (2022): This study investigated the Chinese manufacturing sector and concluded that both green product and process innovation significantly enhance firm performance. It highlighted the mediating role of organizational learning and innovation capability in realizing these benefits.
- Al-Mahmoud & Saleh (2021): An empirical investigation in Jordan's Qualified Industrial Zones (QIZs) revealed that green innovation practices directly contribute to improved market share, customer satisfaction, and environmental compliance, particularly in the chemical and manufacturing sectors.
- Porter & van der Linde (1995): The seminal Porter Hypothesis argued that strict environmental regulations can stimulate innovation, potentially offsetting compliance costs and even creating competitive advantages. The paper redefined the understanding of regulation as a driver rather than a constraint on business growth.
- Dangelico & Vocalelli (2017): Emphasized the importance of green product attributes such as durability, recyclability, and non-toxicity in shaping consumer perceptions and purchase behavior.
- Nidumolu et al. (2009): Identified sustainability as a key driver for innovation and long-term value creation, proposing a five-stage model that companies undergo in their journey toward sustainability-driven innovation.

❖ RESEARCH METHODOLOGY

This paper adopts a qualitative, literature-based research methodology. It draws on secondary data from peer-reviewed academic journals, sector-specific industry reports, and global innovation indices. The selection criteria for literature included relevance to green innovation, empirical grounding, geographical diversity, and coverage of multiple industry sectors.

Key research questions guiding this study include:

- How does green product innovation influence firm performance across different sectors?
- What mediating factors link GPI to competitive advantage?
- How do national contexts and regulatory environments impact GPI implementation?

A comparative approach is used to analyze findings from China, Jordan, the EU, and other developed and developing economies, with an emphasis on sectoral variation (e.g., manufacturing, chemical, electronics, and consumer goods).

❖ FINDINGS AND DISCUSSION

1. Cost Savings and Operational Efficiency: One of the most significant benefits of GPI is operational cost reduction through improved energy efficiency and waste management. For example, firms in the electronics sector adopting green design practices reported a decrease in material use by up to 30%, directly impacting cost structures. Similar findings were noted in the automotive sector, where green engineering led to reduced fuel consumption and lightweight vehicle components.

2. Enhanced Brand Image and Customer Loyalty: Green innovation often leads to differentiation in highly competitive markets. In the consumer goods sector, companies like Unilever and Procter & Gamble have integrated eco-friendly product lines that resonate with environmentally conscious customers. Brand loyalty is often strengthened when consumers perceive a company as socially and environmentally responsible. This is particularly evident among millennials and Gen Z consumers.

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3. Regulatory Compliance and Risk Management: Firms that proactively invest in GPI are better positioned to meet and exceed environmental regulations. For example, compliance with the EU's Restriction of Hazardous Substances (RoHS) and Waste Electrical and Electronic Equipment (WEEE) directives is more manageable for green innovators. In China, government subsidies and green tax incentives further motivate companies to align with national sustainability goals.

4. Sectoral Insights:

- **Manufacturing:** GPI improves resource utilization and waste reduction. Adoption of lean-green manufacturing practices in China has resulted in enhanced productivity and reduced environmental penalties.
- **Chemical Industry:** In Jordan, firms reported increased exports and partnerships due to adherence to international green standards, enabling entry into more regulated global markets.
- **Textile Sector:** Eco-textiles and organic fabrics are gaining ground. Innovations in dyeing techniques and biodegradable packaging are creating a niche market that is both profitable and sustainable.
- **FMCG Sector:** Rapid innovation in biodegradable packaging and natural product formulations has improved customer engagement and brand perception.

5. Challenges and Barriers: Despite the promising advantages, several barriers hinder the full-scale adoption of GPI:

- **High initial costs:** Investment in R&D and green technologies can be prohibitively expensive for small and medium enterprises (SMEs).
- **Lack of consumer awareness:** In many developing countries, consumer awareness about the environmental benefits of green products remains low.
- **Uncertainty in return on investment:** Some firms are hesitant due to the unclear financial payback from green innovation.
- **Complexity in supply chains:** Implementing GPI requires alignment across suppliers, which can be logistically challenging.

6. Mediating Factors for Competitive Advantage:

- **Customer Perception:** Trust and perceived environmental value are critical in translating green innovation into purchase decisions.
- **Regulatory Alignment:** Governments that provide clear regulatory frameworks and support mechanisms enable faster GPI diffusion.
- **Market Dynamics:** Competitive pressure and market saturation can drive firms to innovate sustainably.
- **Organizational Culture:** Firms with sustainability-oriented leadership and inclusive decision-making are more likely to succeed in GPI implementation.

❖ CONCLUSION

Green product innovation is increasingly being recognized as a strategic imperative rather than an optional initiative. By embedding environmental responsibility into the core innovation process, firms can not only comply with regulations but also build a strong competitive edge. The comparative analysis across sectors and countries demonstrates that while the impact of GPI on firm performance varies, the overall trend is toward greater integration of environmental goals with business strategy.

To realize the full potential of GPI, concerted efforts from governments, industry bodies, and consumers are essential. Policymakers must support GPI through fiscal incentives, standardized certification processes, and innovation funding. Firms must overcome barriers through collaboration, strategic planning, and cultural transformation. Finally, informed and engaged consumers play a vital role in sustaining the green innovation movement.

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