GREEN INNOVATION AS A CATALYST FOR FIRM PERFORMANCE: A SYSTEMATIC REVIEW OF ANTECEDENTS, OUTCOMES, AND FUTURE DIRECTIONS

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ABSTRACT

Environmental sustainability priorities have elevated green innovation to a strategic business need which firms use to achieve economic and ecological alignment. This review evaluates green innovation effects on environmental strategies and their relationship to firm performance through analysis of research conducted from 2020 until 2025. Research studied 21 peer-reviewed papers to discover main drivers such as managerial environmental concern and institutional pressures and transformational leadership and various contextual barriers. The adoption of prevention innovations produces continuing improvements for both environmental quality and financial metrics although control methods demonstrate limited effectiveness in these areas. Industrial effects differ between manufacturing and service companies since manufacturing entities experience greater impacts than service-focused businesses. The effects of these outcomes are modified by regulatory control standards together with unique market approaches. Research progress should be maintained but we emphasize the need to address two main weaknesses: outdated data collection methods and missing connections between production methods and digital practices and circular economy design. Future research initiatives and practical work into emerging economies require both cross-disciplinary plans and the collection of long-term data through multi-national surveys.

Keywords: Environmental Sustainability, Green Innovation, Firm Performance, Systematic Review, Stakeholder Theory.

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1. Introduction

Companies throughout the world focus on environmental sustainability as an essential business priority because of regulatory mandates together with stakeholder concerns and urgent climate change needs (Kumar et al., 2025). Green innovation has become vital for industries because it serves as their main competitive strategy to maintain business benefit through environmentally friendly technologies and products (Rehman et al., 2021). The combination of reduced waste emissions with financial performance gains comes from green innovation according to Cheng et al. (2025), Khanchel et al. (2023). Literature reviews demonstrate an inconsistency regarding how firms benefit from different environmental strategies because they use different mediating and moderating factors (Sherazi et al., 2025; Zhang & Ma, 2021). Systematic research ought to be performed because current gaps identify the necessity to combine empirical findings while clarifying the routes which guide green innovation toward organizational results.

1.1. Research Objectives

The paper reviews empirical research which demonstrates how green innovation functions as a connection factor or control mechanism between environmental strategies including green intellectual capital, environmental management and CSR and organizational performance. Through an assessment of recent research, we determine the main elements driving green innovation which consist of leadership management style and both institutional requirements and managers' environmental awareness together with high implementation expenses and uncertain profit margins (Mulaessa & Lin, 2021; Van et al., 2023). The analysis examines how green innovation affects different sectors as well as company dimensions and regulatory settings to deliver useful guidance to public officials and enterprise leaders (Al-Mesaiadeen et al., 2022; Becker, 2023; Bhatti et al., 2023; Chang et al., 2025).

1.2. Theoretical Foundations

The research bases its foundation on three important theoretical frameworks. The NRBV shows that competitive advantage becomes sustainable when firms deploy their exclusive environmental assets which include green innovation and eco-efficient procedures (Kumar et al., 2025). As per the write-up by Malik, et al. (2023) who discussed Stakeholder Theory and Signaling Theory, companies resort to green

innovative processes to correspond to the requirements of stakeholders as well as to introduce their sustainability engagements to current and potential shareholders, as well as the authorities. The AMO from Sherazi et al. (2025) posits that certain elements in an organization, such as the ability of the employees, managerial support, and institutional partnerships, are the main drivers that can result in successful green innovation (Dogbe & Marwa, 2024; Du et al., 2023). This review also outlines in a comprehensive manner, by combining different theoretical opinions, the complete process that connects the environmental strategies of the company to the firm's performance through green innovation (Shah & Ivascu, 2024; Sherazi et al., 2025; Somjai et al., 2020).

2. Literature Review

Researching the green innovation impact on company success is the trending topic for scholars due to the fact they find out the reasons and the outcomes of different things. Firms are seen to make use of unique environmentally friendly resources such as green R&D and eco-efficient technologies to gain such competitive advantages that are long-lasting as set forth in the Natural Resource-Based View (Kumar et al., 2025). Stakeholder Theory companies implement green innovation because investors and regulators and environmentally conscious consumers create increasing demand for responsible environmental practices (Malik et al., 2023).

Green intellectual capital (GIC) stands as a primary focus within the existing research field which contributes to innovation development. Green innovation benefits from both green human capital and structural capital under all scenarios but research shows relational capital produces variable results because of competitive stakeholder interests (Kumar et al., 2025). The research community emphasizes how proactive environmental management systems and CSR create better innovation outcomes compared to simply meeting compliance requirements (Nureen et al., 2023).

The association between green innovation and its consequent performance effects still raises conflicting arguments in the literature. The research indicates that there is positive linkage between the anti-pollution technology, high-environmental and financial performance (Cheng et al., 2025). The study results display different industry behaviors in the sense that manufacturing corporations realize greater efficiency gains than service industries (Khanchel et al., 2023). These EES

interventions-performance relationships are moderated by antecedents such as regulatory strictness and manager at the same time situational factors like competitive market conditions (Özgül 8:08 PM??Zehir, 2023; Al-Meshaiadeen et al., 2022).

Despite these advances, gaps persist. The analysis of many studies they mainly investigate developed economies according to Sherazi et al. (2025). There still appears having a lack of literature on green innovation embedded with digitalization and circular economy models which offers an important future research avenue (Abbas et al., 2024; Adomako & Nguyen, 2023; Agustia, 2023; Angeles-Nunez, 2025; Agyapong et al., 2024). The analysis fills current research gaps through evidence synthesis while developing an integrated system to enable sustainable business change (Jesuka et al., 2025; Jing & Zhang, 2024; Jing et al., 2023; Khan et al., 2023; Khanchel et al., 2023). The synthesis forms a basis for explaining how companies should merge sustainability practices with competitive advantages through emerging technological changes and environmental disruptions.

3. Methodology

The methodical review implements an organized research model for studying connection between green innovation and firm performance. Research focuses on peer-reviewed quantitative studies which publish their findings between 2020 and 2025 to analyse green innovation as both a mediator and moderator to enhance environmental and financial results (Huang & Huang, 2024; Isfianadewi et al., 2025; Jermsittiparsert et al., 2020; Kumar et al., 2025; Le & Mohiuddin, 2024). Our research selects articles featuring result-based measurements of firm performance as main criteria yet omits theoretical discussions absent empirical data. We retrieved data through searches on Web of Science, Scopus and Google Scholar using the keywords combination of "green innovation" and "environmental performance" and "firm performance". The study uses thematic synthesis to discover main patterns in addition to comparative methodology assessment to analyze research designs which incorporate PLS-SEM, system dynamics and regression models. A strict analytical framework provides researchers with complete evidence-based knowledge about the relationship between sustainable business achievement and green innovation (Özgül & Zehir, 2023; Rehman et al., 2021; Roh et al., 2022; Su et al., 2020; Van et al., 2023; Yan & Zhang, 2021; Zhang & Ma, 2021).

3.1. Systematic Review Protocol

A systematic structured review method guides this study to perform comprehensive unbiased evaluation. Empirical research consisting of both quantitative and qualitative methodology is considered for inclusion if they explore the linkages between green innovation and environmental performance and firm outcomes through peer-reviewed channels. The research only utilized studies from the period 2020 to 2025 in order to reflect current industry trends. Studies that do not validate their findings empirically along with those lacking explicit firm performance measurements are excluded under the established criteria.

3.2. Data Sources & Search Strategy

Research materials were extracted from the top academic databases consisting of Scopus and Web of Science in combination with Google Scholar. A strategic combination of terms included "green innovation" AND "environmental performance" AND "firm performance" OR "green intellectual capital" OR "sustainability" in the search process to find important studies. Boolean logical operators served to refine the search results while obtaining a focused and broad collection of articles from relevant sources.

3.3. Analysis Framework

Analysis of the review by means of thematic synthesis helps to identify the most important discoveries in three key areas of green innovation which are the determinants of it, with the influence of firm performance, and the moderating aspects (X. Chen et al., 2024; Y. Chen et al., 2024). Review tested several types of research methodologies such as PLS-SEM and system dynamics, game theory through which their benefits and drawbacks in different studies are passed. A mixed method of analysis is one that used a combination of both the exploratory and the confirmatory analysis and the mixture of them in the study keeps the study results without sidelining the findings through stringent judgmental evidence.

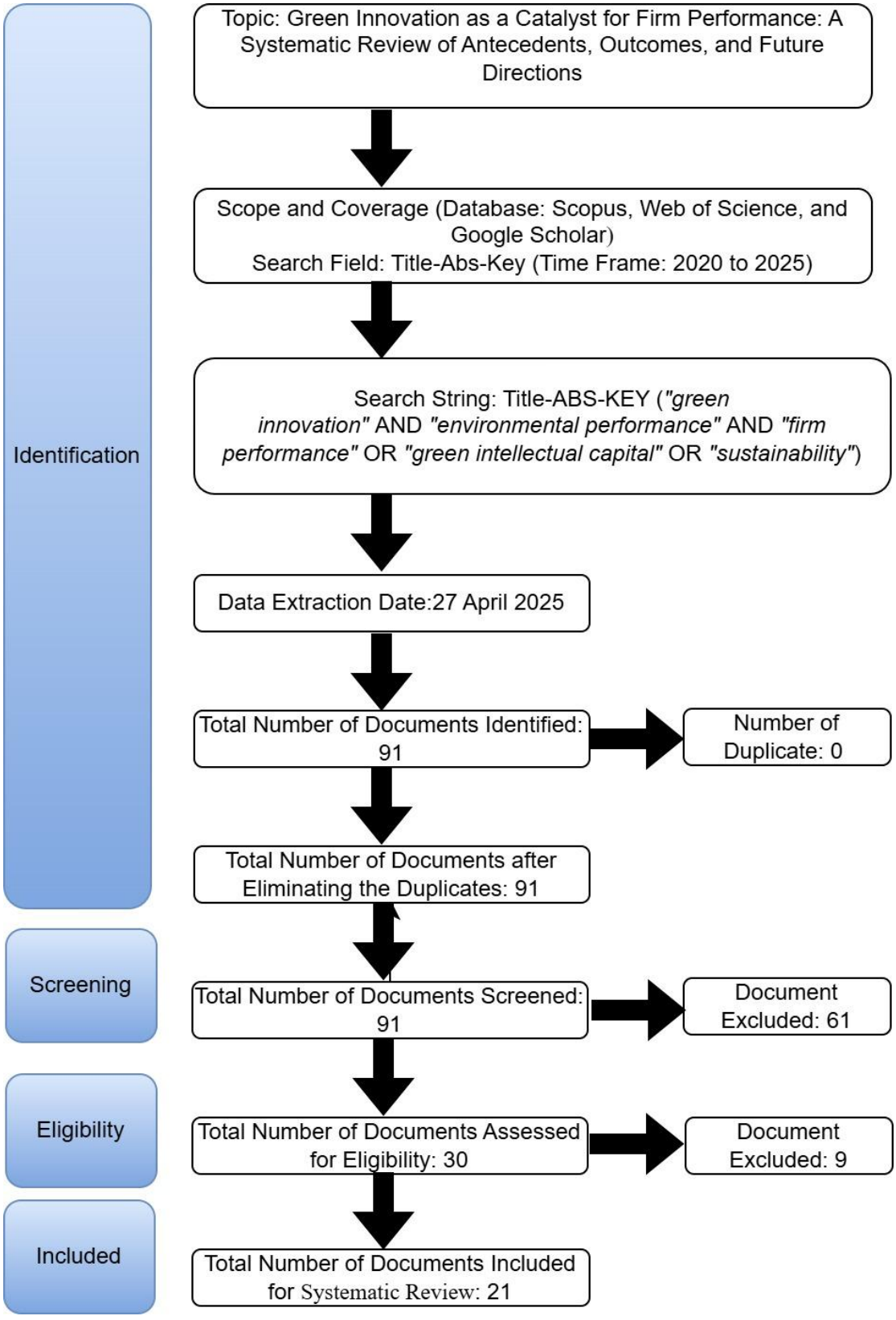

Figure 1. PRISMA Guidelines

Figure 1 displays synthesis of systemic literature identifies green innovation as a

vehicle for corporate performance from 2020 to 2025 research papers. Web of Science, Scopus, and Google Scholar were three gigantic academic sources which faculty members and researchers searched through with a comprehensive literature review. The key expression of Title-ABS-KEY ("green innovation" AND "environmental performance" AND "firm performance" OR "green intellectual capital" OR "sustainability") was the one used to search academic papers that delve into these basic concepts.

Out of 91 documents the search process produced not one of them was a duplicated record. Titles and abstracts were the sources that helped narrow down the number of documents. With a substantial number of excluded documents (61 papers) the reason was either that they did not include adequate empirical evidence or that did not exclusively cover the required subject matter. Authors themselves after going through the full text eligibility criteria of 30 documents made the final step in evaluating those documents. Thus, another nine studies were discarded where there were no data, as well as researchers' subjective opinions diverged from the objectives of the research. A total of 21 documents comprised the selected studies for the detailed examination performed in this systematic review. The rigorous process of study selection results in findings that are derived from sound and applicable studies with which to build a good foundation for understanding effect green innovation as well as its business implications, including new trends. The objective of this study is to resolve varying results between studies as well as to find the best approach and identify white space for future research (Cheng et al., 2025; Lestari & Soewarno, 2024).

4. Thematic Synthesis of Findings

The analysis consolidates vital information from literary studies through three essential categories consisting of (1) factors which prompt firms to adopt green innovation and (2) how green innovation influences environmental results in combination with (3) the performance impacts of green innovation on businesses. These findings demonstrate that green innovation functions simultaneously through results generation (mediating analysis) and results impact (moderating process) which depends on leadership activities as well as industry regulations. Environmental and economic performance benefits from pollution prevention innovations that always show positive results yet other green initiatives function based on organizational

abilities together with market conditions outside of the firm (Makeeva et al., 2024; Maldonado- Mukhopadhyay & Nayak, 2024; Mulaessa & Lin, 2021; Nureen et al., 2023). This analysis identifies essential knowledge deficits which stem from insufficient research on digital technology influences and requirements for cross-cultural assessment in developing markets. The integration of NRBV theory and Stakeholder Theory enables this review to create a systems viewpoint of green innovation success that requires organizational resource allocation, leadership direction and environmental pressure compliance.

Table 1: Summary of Green Innovation & Firm Performance

Authors (Year)	**Key Focus**	**Methodology**	**Sample**	**Key Findings**
Kumar et al. (2025)	Green intellectual capital (GIC) and firm performance	PLS-SEM	405 Indian SMEs	GHC & GSC positively affect green innovation; GRC has negative effects
Cheng et al. (2025)	Pollution prevention vs. control innovations	Patent analysis	US firms	Prevention innovations improve financial & environmental performance; control innovations don't
Agustin & Basuki (2025)	Mediating role of green innovation	Hayes Process Macro	153 Indonesian firms	Green innovation mediates environment orientation-performance link
Sherazi et al. (2025)	Institutional pressure and green innovation	PLS-SEM	260 Pakistani firms	Green HPWS mediates; managerial concern moderates
Eghbali et al. (2024)	Green innovation in tech firms	System dynamics	Tech firms simulation	Combined process/product innovation yields best environmental performance
Muketha et al. (2024)	Green innovation in floriculture	SEM	116 Kenyan firms	Product/process/service innovation improve environmental performance
Shah & Ivascu (2024)	Board characteristics and performance	Quantile regression	Romanian firms (2009-2019)	Green innovation moderates board-performance relationship
Khanchel et al.	ESG and green	Quantile regression	211 S&P 500 firms	ESG disclosure & green innovation boost

(2023)	innovation			performance
Van et al. (2023)	Green leadership and innovation	PLS-SEM	278 Vietnamese firms	Green mindfulness → innovation → performance
Nureen et al. (2023)	CSR and firm performance	SEM	650 Chinese firms	CSR → green innovation → performance
Özgül & Zehir (2023)	Green leadership effects	PLS-SEM	315 Turkish firms	GTL affects performance through innovation
Roh et al. (2022)	Green supply chain strategies	SEM	452 Korean firms	Green SCM mediates IPR-innovation link
Zhang & Ma (2021)	Environmental management effects	Regression	246 Chinese firms	Green innovation mediates EM-performance link
Rehman et al. (2021)	GIC and performance	SEM	244 manufacturing firms	Green innovation mediates GIC-performance link

As seen in table 1 Kumar et al. (2025) investigated the effects of green intellectual capital (GIC) on performance levels of SMEs through green innovation within India. The research utilizing PLS-SEM tested 405 firms and demonstrated that green human (GHC) and structural capital (GSC) promoted innovation yet found relational capital (GRC) to produce unexpected negative results which contradicted previous notions regarding collaborative external partnerships. The authors of Cheng et al. (2025) studied pollution prevention technologies against control measures in the United States patent database. Prevention technologies that reduce waste production demonstrated superior financial returns and environmental performance according to the study which demonstrated end-of-pipe control methods delivered no beneficial performance outcomes. Agustin & Basuki (2025) conducted research on Indonesian firms through application of Hayes Process Macro (N=153). The study revealed that green innovation acts as a complete intermediary factor for environmental orientation to influence performance outcomes because sustainability goals require actual innovative practices to produce measurable results. The study of Sherazi et al. (2025) analyzed institutional forces in Pakistani manufacturing operations through PLS-SEM analysis of 260 organizations. The connection between pressure and innovation received stronger support from green high-performance work systems as environmental concern from managers shaped this pathway according to the authors

who focused on human resource dynamics in sustainability transitions. The article of Eghbali et al. (2024) utilized system dynamics modeling for examining innovation choices within tech firms. Simulation models indicated that environmental performance achieved its maximum when companies adopted green processes alongside green products at the same time they received enough customer approval for higher prices. The authors of Muketha et al. (2024) conducted a study on Kenyan floriculture using SEM on 116 participants. The study results confirmed that combining all development elements (product/process/service) leads to environmental improvement thereby demonstrating the effectiveness of complete eco-innovation strategies in agricultural sectors. Shah & Ivascu (2024) executed quantile regression on Romanian firms operating between 2009 and 2019. Green innovation served as an essential condition for board vigilance to create enhanced performance outcomes indicating boards work optimally within specific environmental-strategic frameworks. This study produced results using quantile regression with data from 211 S&P 500 firms as per Khanchel et al. (2023). ESG disclosure together with green innovation delivery showed increased performance yet the returns started diminishing at intermediate investment amounts. Van et al. (2023) applied PLS-SEM to Vietnamese manufacturers (N=278). The framework revealed how green transformational leadership enhances employee environmental mindfulness which produces innovation results according to the framework. Nureen et al. (2023) performed a SEM analysis of Chinese businesses and obtained results from 650 participants. Green innovation served as an indirect performance enhancement route for CSR initiatives which constitutes the "doing good by doing green" mechanism. Research by Özgül & Zehir (2023) using PLS-SEM analysis with 315 Turkish firms indicated that green transformational leadership generated advantages only when combined with differentiation market approaches. The research by Roh et al. (2022) illustrates that Korean firms (N=452) need green supply chain management to make their intellectual property valuable for innovation development through supply chain integration elements. Research by Zhang & Ma (2021) used regression analysis (N=246) to show that Chinese companies achieve maximum performance enhancement through innovation when Environmental management falls within its peak breadth focus range with deep implementation depth. Rehman et al. (2021) used SEM analysis to establish that Global Information Connectivity creates performance impacts through innovation (N=244) while environmental strategy inspirations linkage between innovation and

performance in manufacturing.

4.1. Antecedents of Green Innovation

The review outlines multiple vital elements which stimulate green innovation adoption. The study reveals Green Intellectual Capital (GIC) is a premier element regarding green innovation, as the work of Kumar et al. (2025) prove that employee environmental skills and eco-friendly organizational processes form very good conditions for green innovation Research findings show that external partnerships belonging to green relational capital sometimes impede innovation although it stems from stakeholder interests clashing with each other. Research by Nureen et al. (2023) and (Zhang & Ma, 2021): Those firms that engage in a proactive environmental management-CSR to foster green innovation by integrating the sustainable business strategy. Results of Sherazi et al. (2025) with Van et al. (2023) reviewed the institutional pressures and leadership that lead to sustainable innovation through both managerial environmental concern and green transformational leadership in an organizational culture.

4.2. Green Innovation and Environmental Performance

The article finds key discriminant profiles of environmental outcomes on green innovation effects. According to Cheng et al. (2025) pollution prevention strategies such as developing clean production processes provides mutually beneficial double effects on business performance and environmental results, while end-of-pipe techniques of pollution control only have minor effects. Green innovation is a key linchpin of the performance improvement linkage between environmental policies and financial outcomes as indicated by Agustin & Basuki (2025) as well as Rehman et al. (2021). Innovation works as more than an output; it becomes a systemic relation supporting and enhancing performance on sustainability.

4.3. Green Innovation and Firm Performance

Green innovation effect on firm performance is not straightforward since it relies upon the specific business context. Research of Kumar et al. (2025) and Khanchel et al. (2023) shows that green innovation leads to superior QS success in manufacturing relative to service firms, due to the more perceptible efficiency benefits of manufacturing. The intensity of this link between green innovation and firm

performance is influenced by multiple exogenous factors. Studies by both Al-Mesaiadeen et al. (2022) and Özgül; Zehir (2023) have provided evidence of the positive moderating effect of firm management's attention to environmental issues on innovation-performance relationships as well as on the application of differentiation strategies, for maximizing green innovations. How green innovation performance benefits from regulatory governance enforcement. To effectively carry out green innovation, firms have to balance it with internal capability and market environmental factors. Leadership strategies laminated with external forces are the drivers for green innovation success capitalizing on amalgamation of greening goals and financial ends.

5. Discussion

The systematic review throws light on the important mechanisms that demonstrate business performance through green innovation from environmental approaches. This has been unveiled of through three key findings. The combination of green innovation is the main figure by working as a connecting link to the performance outcomes of environmental management practices that include green intellectual capital and CSR. The innovation that is green has the requirement of environmental factors which are: leadership dedication and regulatory aspects as well as market-specific marketplace. The paper clarifies how the environmental and financial advantages that come with the preventive type of pollution innovations enable the occurrence of insignificant results in comparison to the pollution control methods thereby marking the importance of initiating proactive sustainable practices. Besides, the paper combines research results with the Stakeholder Theory and the NRBV theoretical framework and then proceeds to unveil the unanswered questions on green innovation and digital transformation synergy for future research. According to this article, policy incentives and organizational capabilities are practical elements for the scalability of sustainable innovation (H. Li et al., 2023; J. Li et al., 2023; Li et al., 2025; Liu, 2024; Liu et al., 2025; Mahsina & Soewarno, 2024).

5.1. Key Theoretical Contributions

This paper has significance theoretically by linking the concept Natural Resource-Based View (NRBV) to stakeholder perspectives that allows the reader to have a complete understanding of the ways a firm can use green innovation to gain

competitive advantages. A firm's sustainability performance based on NRBV suggests that internal capabilities affect the performance success while, at the same time, stakeholder theory emphasizes the significance of external factors, therefore, a firm's performance understanding becomes comprehensive (Alshuaibi et al., 2024; Altassan, 2024; Asad, 2024; Asad et al., 2023; Asad et al., 2024). In one review that looked at studies on the influence of relational capital on green innovation, the review had the role of finding out why different papers revealed different data as observed by Kumar et al. (2025). The recognition of industry parameters in association with legal requirements outlines how individual environment programs achieve different results, thus, contributing to the advancement in theoretical clarity in the sustainability research.

5.2. Managerial Implications

The findings made in the text have implications for both business and government regarding the urgency of the situation and the number of lives at stake. Companies need to undertake two main undertakings for sustainability to be achieved (Guzmán et al., 2023; Malik et al., 2023; Marco-Lajara et al., 2023; Muketha et al., 2024). First, they need to go with green human capital development through sustainable practice training while at the same time, they must be guided by transformational leaders towards green during the innovation process (Van et al., 2023). The government is seen as bestowing with those initiatives which encourage companies to be involved in sustainability. This can best be accomplished through the implementation of policies that encourage environmentally friendly R&D and eco-technology development (Mulaessa & Lin, 2021). The companies that follow such practices typically make the environment better hence more profits coming from the sector they are innovating, which also matches the demand from the market and the quality specifications.

5.3. Limitations & Future Research

The research benefits from this review yet it showcases multiple restrictions that exist within existing studies. Research should embrace longitudinal analysis instead of cross-sectional analysis since researchers need time-series data to properly examine green innovation effects. Research on green innovation requires expanded analysis across different cultures especially in emerging markets because their institutional frameworks and resource allocation systems operate unlike developed economies

(Sherazi et al., 2025). The study of cultural, economic and regulatory antecedents that have implications for the effectiveness of green innovation should support improved overall planning for sustainability at global level (Deng et al., 2025; Eghbali et al., 2024; Farida & Setiawan, 2024, 2025; Hameed et al. 2024). Research on these theoretical and practical voids improve the structure of sustainable business management in terms of theory and implementation. At present, there's been marked advancement of green innovation but researchers should endeavor further to better implement it in the best possible way in varying forms of organizations across countries.

6. Conclusion

Key findings in relation to how green innovation improves firm performance via environmental strategies are presented from the systematic review. Green intellectual capital with proactive environmental management and institutional forcing factors decisively promotes a great promotion of green innovation performances resulting in better environmental performance and financial performance. The effectiveness of such approaches critically depends on exogenous factors such as leadership commitment and industry sector and regulatory support. The twofold benefits of preventive-oriented innovations also outpace the unidimensional results of pollution control technologies, because firms require a more sustainable form of design. To deal with immediate requirements, it is necessary to integrate the green innovation with industry 4.0 and circular economy principles from framework approach. AI Technologies for Smart Manufacturing and Sustainability Analytics With the combination of smart manufacturing and AI-based sustainability analytics, firms have the ability to explore new sources of competitive advantage through resource efficiency and environmental issue solving. Further work should investigate the opportunities that connect these realms narrowly, by focusing on developing economies where technology adoption patterns and sustainable development advances are ongoing. When they are removed, companies and even elected leaders will be able to optimize better for achieving their sustainability goals while also maximizing profitability.

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