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Understanding the Drivers of Eco-Innovation Efficiency: A Systematic Overview

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Abstract

Eco-innovation is a central focus of European Union policy, playing a critical role not only for individual companies but also for entire economic systems. Given the multitude of factors that drive eco-innovation, this research aims to identify the key determinants that influence the efficiency of eco-innovation efforts. The study was conducted using a systematic literature review, employing the SALSA method to ensure a thorough and structured analysis. The research focused on examining publications from the Scopus database, ultimately reviewing 469 selected papers. A rigorous appraisal process was used to identify studies that specifically addressed the determinants of eco-innovation efficiency. The literature review identified a total of 24 determinants that influence the efficiency of eco-innovation. These determinants were further categorized based on two criteria. The first criterion distinguishes between cost-related and revenue-related determinants, highlighting the financial aspects that impact eco-innovation efficiency. The second criterion differentiates between strategic and operational levels, emphasizing the various managerial and organizational factors that play a role in the successful implementation of eco-innovation. It is important to note that eleven publications were excluded from the research due to issues of incompletion or inaccessibility, ensuring that the analysis was based on high-quality and relevant studies. The findings underscore the importance of stimulating eco-innovation across all companies. By providing a comprehensive set of determinants that affect eco-innovation efficiency, this research offers valuable insights for executives and policymakers. Understanding these determinants will enable better management and strategic planning, ultimately enhancing the effectiveness of eco-innovation initiatives and contributing to more sustainable business practices. The study not only identifies key factors influencing eco-innovation efficiency but also provides a framework that can support decision-makers in fostering eco-innovation, thereby aligning with broader European Union sustainability goals.

Keywords: Eco-Innovation, Efficiency, Determinants, Sustainability, Strategic Planning
JEL Codes: Q55, O32, L60

1. INTRODUCTION

The "Resource-efficient Europe" initiative, part of the "Europe 2020" strategy, emphasizes transitioning towards a low-carbon economy and improving resource productivity by decoupling economic growth from resource consumption. This initiative aims to address environmental challenges through stricter standards for environmental protection, fostering the development of eco-innovations that reduce environmental pressures. The move towards a resource-efficient Europe not only involves minimizing waste and promoting sustainable practices but also supports a paradigm shift where economic growth can coexist with environmental sustainability. The introduction of the new action plan for eco-innovation (EcoAP) aligns with these goals by encouraging innovations that alleviate environmental impacts and streamline the path for new technologies and practices to reach the market. EcoAP facilitates this transition by promoting the mobilization of financial instruments and providing support services, particularly aimed at small and medium-sized enterprises (SMEs). As key players in the European economy, SMEs often face challenges in accessing the resources necessary for innovation. Therefore, targeted financial support and advisory services can play a crucial role in enhancing their capacity for eco-innovation.

The initiative underscores the need for increased investor confidence to stimulate investment and foster innovation activity. By supporting the development and deployment of eco-friendly technologies, EcoAP contributes to the broader objectives of sustainable development, enhancing economic resilience, and ensuring long-term environmental sustainability. The plan not only helps address regulatory compliance but also positions eco-innovation as a driver of economic growth, competitiveness, and job creation within the EU, setting a benchmark for global sustainability efforts. As environmental awareness among consumers grows, there is an increasing expectation for businesses to adopt sustainable practices, driven not only by social and government pressure but also by the financial benefits associated with sustainable development. Companies now face rising demands to reduce their environmental impact, making the management of eco-innovation a priority. The trend reflects a shift where sustainable practices are not just ethical considerations but also strategic financial decisions. This shift is backed by evidence such as Guagnano's (2001) finding that more than 86% of consumers are willing to pay a premium for eco-friendly household products. Similarly, Tsen et

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al. (2006) found that many consumers show a preference for green products even when they come at a higher price. The importance of eco-innovations extends beyond consumer behavior and impacts economic development at a macro level. In Europe, eco-industries represent a significant economic segment, generating an estimated 319 billion euros in annual turnover, which equates to roughly 2.5% of the EU's GDP. This substantial contribution underscores the role of eco-industries in shaping the economic landscape, positioning sustainability as a key driver of growth. According to Haila and Rundquist (2011), eco-innovations do not just address environmental challenges; they also have the potential to stimulate economic progress by creating new markets, driving job creation, and encouraging investment in sustainable technologies. Moreover, there is a growing narrative suggesting that eco-industries could play a pivotal role in helping the global economy recover from crises. By fostering sustainable business practices and investing in green technologies, economies can build resilience and promote long-term stability. Eco-innovation becomes a means not only for compliance with environmental regulations but also for gaining a competitive advantage in the marketplace. As such, the development and management of eco-innovation are crucial for companies looking to align their business models with evolving consumer expectations and regulatory frameworks while tapping into new economic opportunities presented by the sustainability agenda. The report "Eco-Innovation: Enabling the Transition to a Resource-Efficient Circular Economy" (2014) identifies several significant barriers that companies face in adopting eco-innovations. These include limited access to funding, high costs associated with eco-innovative technologies, uncertain market demand, and ambiguous return on investment prospects. Additionally, companies encounter a lack of economic and fiscal incentives, rising competition, insufficient knowledge about environmental protection, and inadequate awareness of their own environmental impacts. There is also a limited understanding of the economic benefits of eco-innovation and a hesitancy among customers to embrace new eco-designed products. These challenges underscore the need for greater efforts to demonstrate the effectiveness of eco-innovations in enhancing business performance and profitability.

Previous research suggests that companies vary significantly in their ability to derive financial benefits from eco-innovation (Szutowski and Ratajczak, 2016). The relationship between eco-innovation and financial performance is complex, and the outcomes of individual eco-innovation projects may differ considerably. While there is a general consensus that eco-innovation has a positive impact on company value, the discrepancies in the results of different projects highlight the importance of assessing the efficiency of eco-innovation efforts. Efficiency in this context refers to the balance between the benefits that a company gains from eco-innovation and the costs incurred in implementing it (Hollanders and Esser, 2007). Achieving economic efficiency in innovation projects is recognized as a crucial factor in business performance management (Szutowski, 2016). However, managing the interplay between the inputs and outputs of eco-innovation initiatives is challenging due to the lack of established methodological frameworks. This gap in methodological solutions affects the ability of companies to accurately measure and optimize the efficiency of eco-innovations. To address these barriers and improve the outcomes of eco-innovation, companies need more robust tools for evaluating the cost-effectiveness and long-term financial benefits of sustainable initiatives. Additionally, better incentives and policies that encourage investment in eco-innovative technologies could help mitigate some of the financial risks and uncertainties associated with these projects, ultimately facilitating a smoother transition to a resource-efficient and circular economy.

The relationship between eco-innovation and business performance is influenced by various factors, and identifying the key determinants that shape this relationship is crucial for both theoretical insights and practical application in management and controlling. The existing literature has not consistently identified the determinants that drive the efficiency of eco-innovation, leading to mixed conclusions. This research aims to address that gap by identifying the key factors that influence the efficiency of eco-innovation. To achieve this, the research employs the SALSA (Search, Appraisal, Synthesis, Analysis) method as described by Booth, Papaioannou, and Sutton (2012), which provides a structured approach for systematically reviewing the literature. The SALSA method involves a comprehensive search for relevant studies, a critical appraisal of their quality, the synthesis of findings across studies, and the analysis of evidence to draw meaningful conclusions. By systematically examining the existing scientific literature using this method, it is possible to aggregate and evaluate the current body of knowledge, identifying patterns and factors that consistently emerge as determinants of eco-innovation efficiency. The process of summarizing the evidence from various studies helps to clarify the factors that enhance or hinder the effectiveness of eco-innovation initiatives. It also offers insights into how different variables—such as organizational capabilities, regulatory frameworks, market conditions, and technological factors—interact to influence the outcomes of eco-innovative activities. Identifying these key determinants not only advances the theoretical understanding of eco-innovation efficiency but also provides practical guidance for managers and policymakers on how to optimize investments in sustainable technologies and practices.

2. LITERATURE REVIEW

Eco-innovation, as defined by the European Commission, refers to transforming consumption and production patterns through the development of technologies, products, and services that mitigate environmental impacts. This concept aims to improve Europe's environmental status while simultaneously enhancing its competitive edge by promoting green technologies, sustainable management practices, and eco-friendly products and services. It is not limited to innovations explicitly intended to protect the environment but also includes innovations that result in unintended environmental benefits, such as cost-saving measures that lead to recycling or resource efficiency. The idea of eco-innovation encompasses a broad spectrum of activities, from technological and product advancements to organizational changes and new marketing methods. It aligns closely with the principles of Corporate Social Responsibility (CSR), which, according

to the European Commission's 2011 communication, emphasizes enterprises' responsibility to maximize shared value for shareholders and society. The shift in CSR's purpose has moved away from mere philanthropy or public relations toward a more integrated approach that includes long-term business model transformation and the pursuit of sustainable innovations. Several scholars and organizations provide various definitions of eco-innovation, often overlapping but emphasizing different aspects. Arundel and Kemp (2009) highlight that eco-innovation can be environmentally motivated or result in unintended environmental improvements. This broader approach includes not only technological innovations but also institutional changes, such as modifications in organizational values, governance structures, laws, and administrative processes aimed at reducing environmental impact. Eco-innovation integrates innovative solutions with a focus on sustainability, responding to the demands of a modern economy that values reduced environmental footprints. It can encompass products, processes, systems, or services that are resource-efficient throughout their lifecycle, as Ziółkowski (2013) suggests. The goal is to achieve minimal use of natural resources and minimal release of harmful substances, thus addressing economic growth without compromising environmental integrity. The multifaceted nature of eco-innovation includes different terminologies such as sustainable innovations, environmental innovations, and green technologies. These variations reflect the diverse approaches companies can take to embed eco-innovation into their strategies, highlighting the importance of linking sustainability efforts to core business operations. For the current discussion, eco-innovation is defined as new or significantly improved products created through sustainable production methods that account for the entire product lifecycle, reduce natural resource consumption, and minimize the release of harmful substances throughout the lifecycle. This definition reflects the ongoing efforts to balance economic growth with ecological stewardship in the pursuit of a sustainable future.

The Eco-Innovation Scoreboard (Eco-IS) serves as a significant measurement tool for assessing the innovativeness of European Union Member States. It provides a comprehensive view of economic, environmental, and social performance by employing 16 indicators across five key areas: eco-innovation inputs, activities, outputs, resource efficiency, and socio-economic outcomes. These indicators are based on data from sources such as EUROSTAT and Thomson One, and include metrics like exports of eco-industry products, employment in eco-industries, and revenues generated from eco-industries and the circular economy. The Eco-IS aims to capture the multifaceted nature of eco-innovation, encouraging countries to improve their performance in various aspects of sustainability. However, there are concerns regarding the effectiveness and accuracy of the Eco-IS, as pointed out by several scholars. Miedzinski (2015) notes that the scoreboard often relies on proxy indicators due to limited access to comprehensive data, making it difficult to draw strong conclusions about the true state of eco-innovation. Additionally, Tundys (2015) argues that the indicators used to measure eco-innovation outcomes are not strongly correlated with the actual development and implementation of eco-innovations. This disconnect can make it challenging for businesses to gain a clear understanding of their eco-innovation efficiency and areas where improvements are needed.

The reliance on proxy indicators in the Eco-IS indicates a need for more robust assessment tools that can provide accurate and meaningful insights into eco-innovation performance. The current measurement framework may not fully capture the complexity and variability of eco-innovation practices across different sectors and companies. For businesses, especially small and medium-sized enterprises (SMEs), the existing set of indicators may not be sufficient to assess and enhance their environmental performance effectively. To address these challenges, the OECD Innovation Strategy has called for the development of a clearer and more consistent set of measurements tailored to the needs of SMEs. Such an approach would help firms gain a more comprehensive understanding of their eco-innovation efforts and guide them in implementing strategies that improve both environmental and economic outcomes. By refining the measurement tools and adapting them to the unique requirements of different businesses, it would be possible to provide more actionable insights that drive the adoption and effectiveness of eco-innovative practices.

The increasing focus on corporate social responsibility (CSR) and eco-innovations has been recognized as a significant shift in management thinking, signaling a new paradigm in which businesses integrate social and environmental considerations into their core strategies. Porter and Kramer (2011) emphasize this shift, suggesting that companies embracing CSR can create shared value by addressing social issues while also enhancing their competitive advantage. Fatemi and Fooladi (2013) extend this argument, asserting that neglecting stakeholder needs can lead to a gradual erosion of a company's market value, as consumers, investors, and other stakeholders increasingly favor businesses that prioritize sustainability and social responsibility. The relationship between CSR and financial performance has been explored since the 1980s, with Carroll (1999) noting earlier implicit connections. However, the linkage between CSR and innovation has gained significant academic attention only over the last decade. Rexhepi, Kurtishi, and Bexheti (2013) argue that this emerging focus recognizes innovation as a crucial factor in understanding how CSR influences both a company’s social and financial outcomes. By integrating CSR into their strategies, firms not only improve their social impact but also foster a culture of innovation, which can drive long-term business growth.

The notion that CSR drives innovation is further supported by Nidumolu, Prahalad, and Rangaswami (2009), who found that sustainability initiatives often compel companies to rethink their operations, leading to innovative solutions. The European Commission (2006) also advocates that CSR can contribute to sustainable development while enhancing corporate competitiveness, especially by stimulating innovation. This perspective aligns with empirical findings that companies with strong CSR practices are often highly innovative. Businesses that prioritize social responsibility tend to adopt new technologies, processes, and business models that address both environmental challenges and consumer expectations. Furthermore, Rexhepi, Kurtishi, and Bexheti (2013) argue that CSR and innovation together form the foundation of modern business competencies, as companies that excel in both areas are better positioned to adapt to

changing market conditions and regulatory landscapes. This dual focus not only helps firms differentiate themselves from competitors but also enables them to respond to evolving consumer demands for sustainable products and practices. The integration of CSR and eco-innovation into corporate strategies represents more than just a trend; it signifies a deeper transformation in how businesses operate. Companies are moving beyond traditional profit-centered models to embrace approaches that balance financial success with social and environmental sustainability. This shift not only improves a company's reputation and stakeholder relationships but also fosters resilience and long-term value creation in a rapidly changing global economy. Ecologically and socially-oriented initiatives undertaken by businesses can have a significant impact on their overall performance and value. These actions, aimed at reducing costs and improving stakeholder relationships, can enhance market opportunities, influence the company's asset and capital structure, and ultimately increase the enterprise's value (Kochalski, 2016). Empirical research into the effectiveness of eco-innovation in companies typically focuses on the internal and external factors that drive such initiatives, as well as the connection between eco-innovation and a company's financial performance (Ghisetti and Rennings, 2014; Heras-Saizarbitoria et al., 2011). Several studies have explored the drivers and determinants of eco-innovation. Triguero et al. (2013) examined various types of eco-innovation in European small and medium-sized enterprises (SMEs), utilizing data from the Flash Eurobarometer survey. Their research identified key factors influencing eco-innovation, such as technological capabilities, market demand, and social awareness. Horbach et al. (2012) took a similar approach, using the German Community Innovation Survey to investigate the determinants of eco-innovation targeting different environmental impacts. They highlighted two primary factors: supply-side influences, such as technological capabilities, appropriation problems, and market characteristics, and demand-side factors, including environmental consciousness and consumer preference for eco-friendly products.

Access to capital and networking have also been found to play crucial roles in the market success of eco-innovations. Halila and Rundquist (2011) demonstrated that companies with better access to financial resources and stronger networks are more likely to achieve success with their eco-innovative products. Regulation and customer perception are other significant factors that can influence a company's decision to pursue eco-innovation, as shown by Doran and Ryan (2012). These authors argued that firms are more inclined to engage in eco-innovative practices when there is regulatory pressure or when customers show a preference for environmentally friendly products. Further research by various authors has identified regulation, external linkages, and knowledge generation as key factors driving eco-innovation. For instance, Hojnik and Ruzzier (2016) noted that product eco-innovation is often driven by regulatory requirements, market pull factors, environmental management systems (EMS), and the potential for cost savings. These factors are particularly relevant in industries where compliance with environmental standards is a critical aspect of business operations.

The financial implications of eco-innovation have also been studied, with some evidence suggesting a positive impact on profitability. Przychodzen and Przychodzen (2015) found that companies characterized by eco-innovation tend to exhibit higher returns on assets and equity, coupled with lower earnings retention. This suggests that eco-innovative firms may be more efficient in utilizing their resources and generating profits, which in turn can enhance their competitive advantage in the market. The findings indicate that eco-innovation is not only beneficial for environmental sustainability but can also serve as a strategic tool for enhancing financial performance. By addressing both regulatory demands and market expectations, companies can achieve cost savings, improve stakeholder relations, and strengthen their market position. This aligns with the broader trend of integrating sustainability into business strategies, where the pursuit of eco-innovation can lead to both environmental and economic benefits. Recent research has highlighted the significance of understanding the factors that drive companies to adopt and implement green innovations and how these factors influence outcomes. Bossle et al. (2016) identified various drivers that motivate companies to pursue green innovations, including regulatory requirements, market demand, cost savings, and corporate social responsibility (CSR). These drivers play a crucial role in shaping companies' strategic policies and the adoption of eco-friendly practices.

Similarly, Doran et al. (2016) investigated the impact of different types of eco-innovation on firm performance. Their study provided insights into how specific eco-innovation strategies, such as product innovations, process improvements, and organizational changes, can influence key performance indicators like profitability, market share, and resource efficiency. While these studies offered valuable findings, they also pointed out the need for further research to better understand how various drivers translate into tangible outcomes from eco-innovation initiatives. A key challenge in the field is that there is no single method or indicator that can comprehensively measure the outcomes of eco-innovation across different contexts. Given the complexity and multidimensional nature of eco-innovation, multiple approaches and metrics are needed to capture its impacts accurately. This suggests a gap in the current literature and justifies the need for further investigation into how the identified drivers can lead to successful eco-innovation outcomes. Addressing this scientific problem can have important practical implications for companies. By understanding the factors that drive eco-innovation and how they affect firm performance, businesses can better align their strategic policies to maximize the benefits of green innovation. This may involve fine-tuning their approaches to compliance, market positioning, resource allocation, and stakeholder engagement, leading to improved financial and environmental performance. The findings from such research could also help policymakers design more effective regulations and incentives to promote eco-innovation. By identifying the key drivers and barriers that companies face, policy interventions can be better targeted to support firms in overcoming challenges and accelerating the adoption of sustainable practices.

3. DISCUSSION

The concept of eco-innovation efficiency involves evaluating the ratio between the useful outputs generated from eco-

innovation efforts and the total inputs required for these initiatives. This approach looks at the financial perspective of eco-innovation by considering the benefits that accrue from implementing green innovations against the expenses incurred. Typically, the efficiency of eco-innovation is calculated as the quotient of the revenues generated from eco-innovation and the associated costs. However, determining this efficiency is not straightforward, as various factors can influence both the inputs (costs) and outputs (benefits) involved. Eco-innovation efficiency is subject to a range of determinants that can be classified into categories based on their impact on costs and revenues at both operational and strategic levels. These determinants reflect the multifaceted nature of eco-innovation and highlight the factors that can either enhance or limit its financial effectiveness. On the operational level, cost-related determinants include the efficiency of resource use, the scale of eco-innovation implementation, the availability of technology, and the integration of eco-innovation practices within existing production processes (Zhang and Doll, 2001; Valle and Avella, 2003; Alegre and Chiva, 2006; Sarkar, 2013). These factors can significantly influence the immediate costs associated with eco-innovation projects, such as initial investment in new technologies, training, or process adjustments. Strategic-level cost-related determinants involve more long-term considerations, such as the alignment of eco-innovation with the company's overall business strategy, investment in research and development (R&D), access to financial incentives or subsidies, and regulatory compliance costs (Arundel and Kemp, 2009; Amore and Bennedsen, 2016; Wang et al., 2016). These determinants affect the broader financial strategy, potentially influencing the company's willingness to invest in eco-innovation and its capacity to absorb associated costs.

Similarly, revenue-related determinants on the operational level encompass factors such as immediate improvements in process efficiency, reductions in waste, cost savings from energy efficiency measures, and market acceptance of eco-innovative products (Rennings and Zwick, 2003; Arundel and Kemp, 2009; Nill and Kemp, 2009; Weiss, Hoegl, and Gibbert, 2011; Wang and Huang, 2007; Gerstlberger, Knudsen, and Stampe, 2014). These determinants can directly affect the financial benefits a company gains from implementing eco-innovation by boosting revenues or reducing operational expenses. At the strategic level, revenue-related determinants include long-term growth potential from eco-innovation, market positioning as a sustainable brand, gaining competitive advantage, customer loyalty, and expanding into new markets that value sustainability. These factors contribute to sustained financial benefits, driving a company's profitability over time. The interplay between these determinants suggests that evaluating eco-innovation efficiency requires a comprehensive approach that goes beyond a simple input-output ratio. Companies must consider how different factors impact both short-term and long-term financial outcomes, taking into account various operational and strategic aspects to maximize the benefits of eco-innovation. This approach highlights the need for sound methodological frameworks to assess and improve eco-innovation efficiency, taking into consideration the complex variables at play.

The strategic perspective on eco-innovation efficiency encompasses a broader context that includes factors such as corporate strategy alignment, market trends, regulatory frameworks, and long-term growth objectives (Eco-innovation Observatory, 2013; Xue, Ray, and Sambamurthy, 2012; Son et al., 2011). While companies often focus on the operational aspects of eco-innovation, such as process optimization and immediate cost savings, the strategic determinants provide a wider view of how eco-innovation fits into the overall business model and long-term objectives. These factors influence a company's ability to scale eco-innovative practices, enter new markets, or gain competitive advantage through sustainability. The research presented here emphasizes a micro-level approach, considering the determinants of eco-innovation efficiency within individual firms rather than at the macro level, such as national or industry-wide factors that are often the focus in the literature. This approach is particularly relevant for enterprise controllers and managers who need to manage budgeting processes effectively, where the costs and revenues associated with eco-innovation must be carefully planned and monitored from both an operational and strategic viewpoint. This micro-level focus allows companies to better understand how specific internal factors, like resource allocation, technological adoption, or employee involvement, affect eco-innovation efficiency.

Burritt and Schaltegger (2001) highlight the importance of integrating eco-efficiency measurement with budgeting processes, suggesting that accounting and financial staff play a critical role in the planning and monitoring of eco-innovation efforts. This integration ensures that eco-innovation is not just an isolated environmental initiative but part of the core financial planning and control system of the company. By including eco-innovation targets in budgeting and financial planning, firms can align sustainability goals with business objectives, making eco-innovation a central component of strategic management. Thus, while eco-innovation efficiency may often be assessed through operational metrics, it is imperative to incorporate strategic-level considerations to capture the full range of factors influencing a company's sustainability efforts. This holistic approach helps firms to not only improve eco-innovation efficiency but also ensure that these improvements support long-term business sustainability and competitiveness.

4. CONCLUSION

The research aimed to uncover the determinants of eco-innovation efficiency, as variations in the outcomes of eco-innovation implementation across companies suggest a multitude of influencing factors. To identify these determinants, the study employed the SALSA (Search, Appraisal, Synthesis, Analysis) method, a systematic approach for conducting literature reviews. The research focused on scientific publications from January 2000 to June 2016, encompassing a period marked by significant developments in environmental policies, sustainability practices, and eco-innovation initiatives. By synthesizing findings from the selected literature, the study sought to summarize existing knowledge and highlight key determinants that influence the success and efficiency of eco-innovation within companies. The analysis considered factors that impact both the costs associated with implementing eco-innovation and the financial benefits derived from it.

This dual focus enabled the identification of operational-level and strategic-level determinants that influence eco-innovation efficiency. The use of the SALSA method facilitated a thorough examination of the literature, ensuring that a broad range of studies and perspectives were considered.

This comprehensive approach provided insights into how various internal and external factors—such as company size, industry type, market dynamics, regulatory pressures, technological capabilities, and corporate strategy—affect the efficiency of eco-innovation and its financial outcomes. The findings underscore the complexity of eco-innovation, where multiple interacting variables shape the degree of success in reducing environmental impact while enhancing economic performance. The research identified 24 determinants of eco-innovation efficiency, organizing them into a classification framework based on two criteria: level (strategic and operational) and relation (cost-related and revenues-related). This framework provides a comprehensive overview that addresses both the broader strategic context and the specific operational activities that influence the costs and revenues associated with eco-innovation. At the strategic level, cost-related determinants include long-term investment planning, resource allocation strategies, and regulatory compliance costs. Revenue-related determinants at this level involve market positioning, brand reputation, and the ability to attract green investments. Operational-level cost-related factors focus on technology adoption, process optimization, and waste management practices, while revenue-related factors emphasize sales growth, customer demand for eco-friendly products, and cost savings from efficiency improvements. By systematically categorizing these determinants, the research contributes valuable theoretical insights and practical guidance for executives aiming to manage eco-innovation effectively. It enables decision-makers to prioritize initiatives that balance environmental objectives with economic goals, ensuring that investments in eco-innovation yield favorable financial outcomes. Additionally, the classification framework offers a structured approach for integrating eco-innovation strategies into business processes, enhancing the overall sustainability and competitiveness of firms. This research also attempts to synthesize previous studies, providing a consolidated view of the factors affecting eco-innovation efficiency.

The findings may aid companies in refining their sustainability strategies, aligning eco-innovation efforts with broader corporate objectives, and ultimately driving sustainable growth. The research successfully met its objective of identifying the determinants of eco-innovation efficiency and providing a structured framework for their classification. However, it did face some limitations that should be acknowledged. One such limitation was the restricted access to certain publications, which prevented a comprehensive inclusion of all potentially relevant studies. The addition of these inaccessible publications could have enriched the findings and provided a more nuanced understanding of the determinants. Moreover, while the study employed a systematic literature review, it lacked quantitative validation of the identified determinants. Future research could address this gap by conducting empirical studies to test the practical applicability and impact of the selected determinants on eco-innovation outcomes. Such quantitative analysis would help confirm the relevance of these factors in different industry contexts and provide actionable insights for companies looking to optimize their eco-innovation strategies. Exploring these areas in future studies could enhance the robustness of the findings and offer a more comprehensive toolkit for practitioners aiming to improve eco-innovation efficiency and drive sustainable business growth.

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