ESG AND TECHNOLOGY USE IN SMES: A FUTURE APPROACH TO GREEN INNOVATION

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ABSTRACT

This study explains how green innovation and using new technology can help small and medium-sized businesses (SMEs) become more sustainable. As customers and government agencies push for more eco-friendly practices, SMEs are dealing with both difficulties and chances when it comes to adopting sustainable technologies. The research points out main challenges like expensive start-up costs and a lack of technical knowledge, but it also shows the long-term advantages, such as saving money and becoming more competitive. The paper uses a detailed review of existing research to find ways to overcome these challenges, stressing the need to include technologies in how businesses operate. It also suggests that government help, like financial support and training programs, is important for creating an environment that encourages sustainable innovation. The study ends by saying that by using green innovation, SMEs can meet environmental rules and stand out in the market, which helps achieve bigger sustainability goals worldwide.

Keywords: Green Innovation, SMEs, ESG, Technology

INTRODUCTION

In the modern era, ESG has become a crucial issue for all economic sectors, especially Micro, Small, and Medium Enterprises (MSMEs). MSMEs play a significant role in the global economy, including Indonesia, contributing significantly to gross domestic product (GDP) and creating jobs. However, demands for ESG are increasing, both from consumers, governments, and the wider community. Climate change and environmental degradation have prompted many countries to adopt policies that support more environmentally friendly business practices. In this context, technology is used and functions as a supporter in supporting MSMEs to shift to more sustainable business practices. The use of advanced technology not only helps in reducing environmental impact but also improves operational efficiency. Although there are various challenges faced by MSMEs in adopting technology or the term for environmentally friendly technology, such as initial costs and lack of knowledge, various studies show that investment in sustainable technology can lead to long-term cost efficiency and increased competitiveness (Urbancová et al., 2020).

Thus, the adoption of sustainable technology is a must for MSMEs that want to survive and grow. One important aspect of the use of technology in the context of ESG is innovation. Technology, including renewable energy, waste treatment, and energy efficiency, can encourage MSMEs to develop new products and services that meet the needs of a market that is increasingly aware and concerned about environmental damage (Nainggolan et al., 2023). Thus, technology is not just a tool, but also a catalyst for green innovation. Furthermore, MSMEs that successfully integrate sustainable technology into their business processes tend to gain greater

competitive advantages. Various studies show that companies that implement sustainable practices have a better reputation and higher levels of customer satisfaction (Hamid, 2024). This suggests that ESG can be a strong brand differentiator in the market. However, not all MSMEs have the same capabilities in the technology needed to achieve sustainability. Factors such as geographic location, industrial sector, and education level of business owners can influence the ability of MSMEs to adopt technology (Utami et al., 2024). Therefore, a more inclusive approach and support from the government and relevant institutions are needed.

Governments in many countries have begun implementing policies to encourage the use of technology among MSMEs. Incentives such as subsidies, training, and access to technology can increase the capacity of MSMEs to innovate and implement sustainable practices (Nainggolan et al., 2023). However, the effectiveness of these policies still needs further evaluation to fully understand their impact. In a global context, collaboration between MSMEs, research institutions, and governments is crucial for creating a sustainable innovation ecosystem. Collaborative initiatives can help MSMEs share knowledge and resources, and accelerate the adoption of technology (Roy, 2024). This collaboration can also produce innovative solutions that can be adapted by various types of MSMEs.

This study aims to explore the relationship between technology use and sustainability in the context of MSMEs and highlight how technology can be a pathway for green innovation. By understanding these dynamics, it is hoped that more effective strategies can be found to encourage the adoption of sustainable technology among MSMEs, so that they can contribute to global sustainability goals. Based on this background, this study was conducted to determine the policies and challenges faced by MSMEs in implementing technology and how this study can provide practical recommendations for stakeholders involved in the development of sustainable MSMEs?

LITERATURE REVIEW

Theoretical Frameworks

This research employs many theoretical frameworks and conceptual models to elucidate the adoption of green technology by MSMEs for sustainable performance.

Resource-Based View (RBV)

The Resource-Based View (RBV) is a fundamental theory in strategic management, positing that a firm's competitive advantage relies on its capacity to obtain and manage valuable, rare, inimitable, non-substitutable, or non-renewable resources (VRIN) (Adomako & Ahsan, 2022). The Resource-Based View (RBV) posits that an organization's enduring competitive advantage is contingent upon its internal resources, encompassing both tangible assets (such as physical assets and money) and intangible assets (including knowledge, innovation, corporate culture, and reputation). In the realm of MSMEs, the Resource-Based View (RBV) is frequently employed to evaluate how internal resources, including innovation, managerial competencies, and technological skills, enable firms to seize market opportunities and surmount external obstacles. Micro, Small, and Medium Enterprises (MSMEs) possessing advanced technological capabilities (rare and valuable resources) can more readily implement green technology and innovate, leading to a sustainable competitive advantage (Audretsch et al., 2023)

Theory of Innovation

Innovation Theory examines the impact of innovation in products, processes, and business models on the growth and success of MSMEs. Innovation is a critical determinant of the Company's competitive advantage and sustainability (Bhatti et al., 2023). Innovation may manifest as incremental innovation (minor, ongoing enhancements) or radical innovation (significant alterations that disrupt the industry). The capacity of a corporation to innovate is frequently influenced by its internal competencies and external circumstances (Oduro, 2024). In the realm of MSMEs, innovation theory examines how enterprises can cultivate competitive advantages via their innovation skills. MSMEs that can rapidly create products in response to market demand would enhance their competitiveness and expand their market share (Pilav–Velic et al., 2024).

Sustainability Theory

Sustainability Theory pertains to the notion of sustainability, highlighting the necessity of harmonizing economic, environmental, and social performance (Bhatti et al., 2023). This theory posits that corporations must evaluate the long-term consequences of their economic operations, considering not just profitability but also environmental and societal impacts (triple bottom line). Sustainability encompasses methods that promote the judicious use of resources, minimize waste, and foster long-term social well-being (Suryawan & Lee, 2024). Within the framework of MSMEs, Sustainability Theory assesses the impact of sustainability practices on the long-term performance of enterprises (Hidayat-ur-Rehman & Alsolamy, 2023). Micro, Small, and Medium Enterprises (MSMEs) that implement green technology and sustainable practices will achieve a competitive edge by enhancing their reputation, lowering operational expenses, and accessing new markets that prioritize sustainability (Hariyono & Narsa, 2024).

Micro, Small and Medium Enterprises (MSMEs)

Micro, Small and Medium Enterprises (MSMEs) emphasize the important role of MSMEs in the economy, especially in creating jobs, increasing innovation, and supporting sustainable economic growth. MSMEs function as the backbone of the economy, especially in developing countries, by contributing significantly to gross domestic product (Sastradinata, 2024). This theory also explains how MSMEs can become agents of change by adopting sustainable technology and innovation, which not only increases their competitiveness but also has a positive impact on the environment. In addition, the MSME theory also includes the concept of capacity building, which states that the managerial and technical capabilities of business owners greatly influence the growth and sustainability of their businesses. The capacity building can be achieved through training, access to technology, and support from the government and financial institutions. By strengthening this capacity, MSMEs can be better prepared to face market challenges, improve operational efficiency, and adapt to changing consumer demands that increasingly shift toward sustainable practices.

Green Innovation

Green innovation refers to the development of products, processes, or systems aimed at reducing environmental impacts and increasing sustainability. This concept encompasses the use of technologies and practices that not only meet current needs but also consider future generations. Green innovation includes environmentally friendly product innovation, process innovation that reduces waste, and organizational innovation that increases resource efficiency (Hendro & Pranogyo, 2023). This is particularly relevant in the context of climate change, where companies are encouraged to adopt more sustainable practices to reduce their carbon footprint and meet increasingly stringent environmental regulations. Furthermore, green innovation

theory also demonstrates the relationship between sustainability and business competitiveness. The strategies that integrate environmental aspects into the innovation process can generate cost efficiencies and open up new market opportunities (Suryahanjaya et al., 2024). Green innovation not only focuses on reducing negative impacts on the environment but also creates economic value through the development of more efficient and environmentally friendly products. Thus, companies that adopt green innovation not only fulfill their social responsibilities but also improve their competitive position in an increasingly sustainability-oriented global market.

A specific theoretical gap is the lack of models that explicitly position ESG Commitment as a structural moderating variable. Most studies ignore the role of ESG Commitment as a conditional driver that determines the quality and direction of technology investments. We argue that without a robust ESG framework particularly Governance (G) and Environmental (E) targets Technology Adoption tend to simply optimize existing processes (business-as-usual) and fails to generate green, disruptive innovation. If MSMEs can effectively implement green innovation, it will indirectly improve their business ethics. The relationship between these two factors can be seen when MSMEs innovate environmentally friendly products, process innovations that reduce waste, and organizational innovations that increase resource efficiency. This also serves as an effort to mitigate the negative impacts of business activities, and the surrounding community will perceive MSMEs as having good environmental and social ethics.

ESG is strategic for MSMEs due to its social proximity to the community, differentiation and competitive advantage, reputation building and external support, and its relatively inexpensive implementation. MSME practices tend to focus on internalizing values and operational efficiency, while corporate practices are driven by capital market and regulatory pressures. The key to ESG success lies not in the size of the action, but in its usefulness, engagement, and sustainability. With appropriate and consistent implementation, businesses, both large and small, can become agents of change, delivering tangible positive impacts on society and the environment.

ESG is essentially a framework for developing sustainability strategies, which are then implemented through policies and measured as a performance measurement tool. The main difference with corporations lies in the adoption of external (investors/regulation) for corporations versus internal (value/efficiency) for MSMEs.

Table 1. The relevant previous research

No	Title	Author	Year	Summary
1	Green Innovation and Its Effects on Innovation Climate and Environmental Sustainability	Alshammari & Alshammari	2023	Focus on the relationship between environmental sustainability, work environment, green innovation, and innovation climate in industrial companies.
2	Green R&D Investment, ESG Reporting, and Corporate Green Innovation Performance	Rauf et al.	2024	Focus on the moderating impact of ESG reporting on the relationship between green R&D expenditure and corporate green innovation performance in China
3	Sustainability and Technology Use	Bratamanggala	2024	Focusing on the policy direction and challenges of MSMEs in

	in SMEs: A Pathway to Green Innovation	implementing environmentally friendly technology.

Based on the relevant previous research above, there are similarities, namely both discuss environmentally friendly technology in companies, especially emphasizing how environmentally friendly technology affects the business processes of MSMEs. The difference between this research and previous research is that previous research discusses the relationship and impact of environmentally friendly technology in the business processes of companies/MSMEs, while this research focuses on the challenges and policy directions for implementing sustainable environmentally friendly technology in MSMEs.

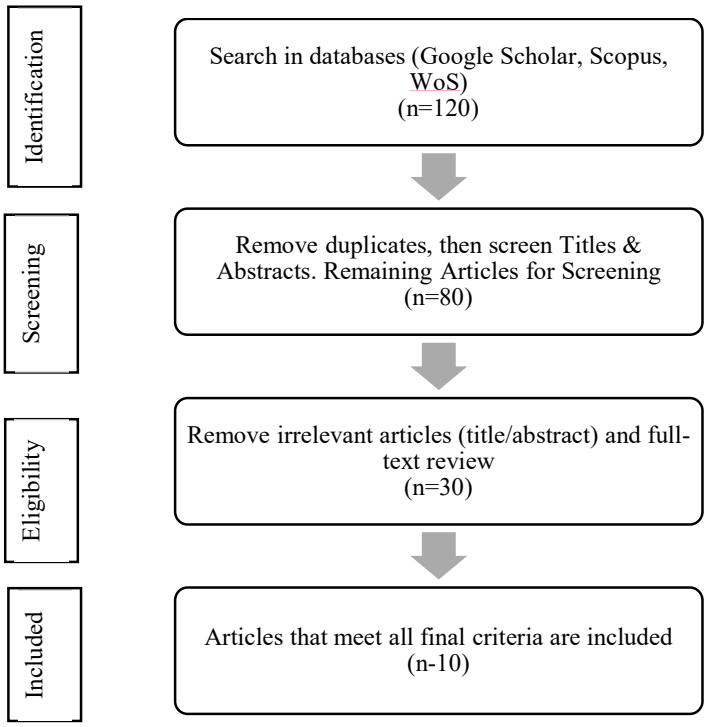
METHODS

This study uses a systematic literature review approach to identify and analyze studies related to green innovation, ESG reporting, and corporate green innovation performance. This method was chosen because of its ability to gather information from various sources and provide a comprehensive overview of the topic being studied. This process involves several steps, starting from identifying the research question to collecting and analyzing data from various relevant literature. Data sources were collected from leading academic databases such as Google Scholar, Scopus, and Web of Science. Inclusion criteria included articles published in peer-reviewed journals in the last five years, focusing on green innovation, ESG, and MSME performance.

After collecting relevant articles, a selection process was carried out by reviewing the abstracts and conclusions to ensure relevance to the research topic. Articles that did not meet the criteria or were deemed irrelevant were removed from the list. This process was followed by an in-depth analysis of the selected articles, using a thematic analysis framework to identify patterns, similarities, and differences in the research findings. The findings from the analyzed literature were categorized into several main themes, including the impact of green innovation on company performance, the role of ESG reporting in driving innovation, and factors influencing the successful implementation of green innovation. This categorization aims to provide deeper insight into the dynamics between green innovation, ESG reporting, and company performance, as well as to identify gaps in existing research (Utomo et al., 2022). The results of the thematic analysis were synthesized to generate new insights into the relationships between the studied variables. By conducting this synthesis, this study not only contributes to the theoretical understanding of green innovation and ESG reporting but also provides practical recommendations for stakeholders in implementing sustainability strategies in their businesses (Alfalisyado et al., 2024). This synthesis also identifies future research directions that can help deepen the understanding of green innovation in a broader context.

This study employed the Systematic Literature Review (SLR) methodology by the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) standards (Oduro, 2024). PRISMA offers a systematic framework for the identification, selection, assessment, and analysis of pertinent papers. The phases of this methodology are delineated in detail as follows:

Figure 1. PRISMA Diagram



A descriptive analysis of research on ESG and technology adoption in MSMEs. This section describes how ESG adoption and technology adoption can be effectively implemented in MSMEs. Among the 10 articles published between 2020-2025, the author countries are as follows: Indonesia (n=5), China (n=4), and Netherlands (n=1).

FINDINGS

Table 2. The literature review

No	Title	Author	Year
1	How does ESG performance promote corporate green innovation?	Long, et al.	2023
2	Green innovation, firm performance, and risk mitigation: evidence from the USA	Liu	2023
3	The effect of ESG performance on corporate green innovation	Bratamanggala	2023
4	The effect of innovation on environmental, social and governance (ESG) practices	Dicounzo, et al	2021
5	Green innovation and corporate sustainability: A panel data approach	Ai, et al.	2022
6	Will ESG disclosure affect the green innovation level of SMEs?	Bao, et al.	2024
7	Improving Green Innovation Performance by SMEs In Indonesia	Riani	2022
8	Green Manufacturing Practices and Green Innovation and Their Role In Sustainable Business Performance Through Culture	Hakim	2023

	Green Organization at Small Industrial Enterprises		
9	Examining the Link between Green Innovation and Financial Performance in Indonesian Firms	Setyawan & Wijayanti	2020
10	Green Innovation Adoption and Corporate Social Responsibility in Indonesian SMEs	Kusuma	2020

Through this literature review approach, this study aims to provide an in-depth and informed view on how MSMEs can understand policy directions and face challenges and take advantage of opportunities in the application of environmentally friendly technologies to improve efficiency, productivity, and business processes or economic performance.

DISCUSSION

Green innovation has become a major focus in efforts to create more sustainable business processes. Various studies have shown that integrating green innovation into corporate strategy not only helps reduce environmental impact but also improves economic performance. For example, companies that implement green innovation practices tend to experience improvements in operational efficiency and brand reputation, which in turn can attract more customers and investors who care about sustainability issues. One key aspect of green innovation is Environmental, Social, and Governance (ESG) reporting. ESG reporting provides transparency about a company's performance in terms of sustainability and social responsibility. Research by Long et al., 2023 shows that good ESG performance can contribute to increased green innovation in companies, because companies with a good reputation for sustainability are more likely to gain support from stakeholders and access to the resources needed for innovation. However, the challenges faced by companies in implementing green innovation and ESG reporting cannot be ignored. One of the main challenges is the high costs associated with investing in green research and development (R&D).

Many companies, especially small and medium-sized enterprises (SMEs), often struggle to allocate sufficient resources to these projects. In many cases, SMEs may choose to prioritize short-term profits over long-term investments in green innovation. However, research shows that initial investments in green innovation can yield significant returns in the future. For example, according to a study by Hakim, 2023, despite high initial costs, green innovation often results in improved operational efficiency and cost reductions in the long term. Companies that adopt environmentally friendly technologies can reduce energy costs and waste, thereby increasing their profit margins.

Another factor influencing the success of green innovation is support from top management. Research by Liu, 2024 shows that companies with strong leadership support are more likely to implement green innovation initiatives effectively. Managers committed to sustainability can create an organizational culture that encourages innovation and collaboration in achieving sustainability goals. Furthermore, the involvement of external stakeholders also plays a crucial role in the success of green innovation. Engaging with local communities, non-governmental organizations, and the government can help companies gain the insights and support

needed to implement sustainability initiatives. For example, research by Setyawan & Wijayanti, 2023 shows that collaboration with third parties can accelerate the innovation process and help companies gain access to the latest technologies.

Changes in government policy can also influence the implementation of green innovation and ESG reporting. Policies that support sustainability practices, such as tax incentives for companies investing in technology, can encourage more companies to adopt green innovations. In Indonesia, the government has begun to provide support for MSMEs in adopting sustainable practices, although challenges in implementation remain. From a market perspective, increasingly environmentally conscious consumers are also encouraging companies to shift to more sustainable business practices. Research shows that consumers prefer products produced with environmentally friendly processes, which in turn forces companies to innovate and improve sustainability practices. This also creates opportunities for companies to differentiate themselves in an increasingly competitive market (Ai et al., 2024). While there are many benefits to be gained from green innovation and ESG reporting, it is important for companies or MSMEs to recognize that this approach must be carried out strategically. Companies need to thoroughly evaluate how they can integrate green innovation into their business model without sacrificing profitability. This requires careful planning and long-term commitment from all levels of the organization.

In fact, these ESG indicators cannot be fully implemented by MSME owners due to limited capital. Generally, MSMEs in Indonesia are funded by the owner's personal capital. Entrepreneurs who rely solely on personal capital tend to lack the desire to improve performance due to the fact that product demand in the market is still within reach and their business activities are stagnant. Consequently, the implementation of green innovation may be minimal.

CONCLUSION

This study emphasizes the importance of creating an ecosystem that supports green innovation. This includes collaboration between companies, governments, and communities to create an environment conducive to innovation and sustainability. By creating policies that support and strengthen stakeholder engagement, it is expected that there will be a significant increase in the adoption of green innovation and ESG reporting practices in the future, which will ultimately benefit all parties involved. Based on the literature review that has been conducted, it can be concluded that:

1. The Importance of Green Innovation: Green innovation is a key strategy in achieving sustainability in the business sector. Research shows that the adoption of green innovation can improve operational efficiency and company reputation, as well as provide long-term benefits in terms of cost reduction and increased power.
2. The Role of ESG Reporting: Environmental, Social, and Governance (ESG) reporting is crucial to encourage companies to undertake green innovation. Good ESG performance can increase transparency and stakeholder trust, which in turn facilitates access to resources and support for sustainability initiatives.
3. Challenges in Implementation: Despite the many benefits associated with green innovation, challenges such as high costs and limited resources remain obstacles for many companies, especially SMEs. Research shows that companies need good planning and management to integrate sustainability practices without sacrificing profitability.
4. Support from Management and Stakeholders: Commitment from top management and involvement of external stakeholders are crucial for the success of green

innovation. Companies that have strong support from their leaders and involve communities and governments in sustainability initiatives tend to be more successful in implementing green innovation practices.

5. Supportive Policies and Ecosystems: Supportive government policies and the development of a conducive ecosystem are needed to increase the adoption of green innovation. By integrating sustainability policies and strengthening collaboration between companies, governments, and communities, it is hoped that there will be a significant increase in sustainability practices in the future.

Based on the conclusions that have been outlined, here are some suggestions that MSMEs can consider in facing sustainability through the application of technology in MSMEs, namely:

1. Companies, especially MSMEs, should allocate more resources for research and development (R&D) focused on green innovation. This can help them to develop more efficient and environmentally friendly products and processes, which in turn can improve their competitiveness and financial performance.
2. Companies should be more active in involving stakeholders, including customers, local communities, and non-governmental organizations, in their sustainability initiatives. This involvement can not only provide valuable insights but also build support for green innovation projects that will be implemented.
3. The government needs to formulate policies that support sustainability practices and green innovation. This can include tax incentives, grants for green projects, and training for MSMEs in adopting environmentally friendly technologies.
4. Companies should invest in educational programs that raise public awareness about the importance of sustainability and green innovation. A more educated public will be more likely to choose environmentally friendly products, which in turn can encourage companies to adopt more sustainable practices.
5. Companies should implement systems to regularly evaluate and measure the performance of their green innovations. This measurement can help companies understand the impact of their sustainability initiatives and improve strategies based on the data collected.
6. Access to Special Funding: The government or financial institutions need to provide subsidized green financing schemes or soft loans explicitly aimed at sustainable investments, thereby reducing the initial cost burden on MSMEs.
7. Education on Costs vs. Long-Term Benefits: There needs to be widespread education demonstrating that green innovations result in long-term operational cost reductions (e.g., savings in electricity, water, and raw materials), not just additional costs.

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