


The Role of Green Innovation in Strengthening the Sustainability Performance of Digital Startups in Indonesia

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ABSTRACT

The increasing awareness of environmental sustainability has encouraged many digital startups in Indonesia to adopt green innovation as a strategic approach to achieving long-term business resilience. **This study** aims to explore the role of green innovation in strengthening the sustainability performance of digital startups in Indonesia. **Using a qualitative** approach, the research gathers insights from interviews with startup founders and managers who have integrated eco-friendly practices into their business operations. **The findings reveal** that green innovation not only enhances operational efficiency and reduces environmental impact but also strengthens brand reputation and stakeholder trust. Furthermore, startups that embed sustainability principles into their core business models demonstrate greater adaptability to market changes and long-term competitiveness. **This study contributes** to the understanding of how environmental responsibility can coexist with business growth in the digital startup ecosystem. The implications highlight the need for policy support, technological collaboration, and education to foster green innovation in Indonesia's startup landscape.

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1. INTRODUCTION

In the era of rapid digital transformation, startups play a crucial role as drivers of innovation, economic growth, and social change [1]. However, the rise of digital entrepreneurship has also raised concerns about its environmental footprint, energy consumption, and resource use [2]. To address these challenges, the concept of green innovation the integration of environmentally friendly practices into business processes, products, and technologies has emerged as a key element in achieving sustainable development. For digital startups, which often rely on agile and technology-driven models, adopting green innovation is not only an ethical choice but also a strategic one that enhances competitiveness and long-term sustainability [3]. In Indonesia, the increasing emphasis on sustainability aligns with global movements such as the United Nations Sustainable Development Goals (SDGs), particularly SDG 9 (Industry, Innovation, and Infrastructure), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action), which emphasize sustainable innovation, efficient resource use, and climate-resilient business practices.

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The country's startup ecosystem, particularly in the digital sector, has experienced rapid expansion over the past decade, supported by government initiatives, venture capital, and a growing digital economy. Despite this progress, many startups still face challenges in balancing growth with environmental responsibility [4]. Limited access to green technology, insufficient regulatory incentives, and a lack of environmental awareness among entrepreneurs are among the barriers that hinder the adoption of sustainable practices. Existing studies have examined sustainability in large corporations and manufacturing sectors, however research focusing on digital startups and green innovation in emerging economies remains limited [5]. Therefore, this study seeks to explore how Indonesian digital startups implement green innovation and how these efforts contribute to strengthening their sustainability performance [6]. By understanding the motivations, strategies, and outcomes of green innovation adoption, this research aims to provide valuable insights for entrepreneurs, policymakers, and investors in promoting environmentally responsible digital entrepreneurship [7].

2. LITERATURE REVIEW

2.1. Green Innovation

Green innovation refers to the development and implementation of products, processes, or business models that aim to reduce environmental impacts and promote the sustainable use of resources [8]. This concept encompasses various activities such as the adoption of energy-efficient technologies, eco-friendly product design, waste reduction, and the application of circular economy principles. In the context of digital startups, green innovation can be realized through the use of cloud-based systems, paperless operations, and the integration of sustainability indicators into digital platforms [9]. The implementation of green innovation not only serves as a form of corporate social responsibility but also as a competitive strategy that enhances a company's image and ensures long-term business sustainability.

2.2. Sustainability Performance

Sustainability performance refers to an organization's ability to achieve a balance among economic, environmental, and social goals commonly known as the triple bottom line [10]. For startups, sustainability performance means not only focusing on profitability but also ensuring resource efficiency and social responsibility within their operational activities [11]. Various studies have shown that companies integrating sustainability principles into their business strategies tend to achieve higher customer loyalty, attract ethical investors, and demonstrate greater resilience in facing market dynamics [12]. The evaluation of sustainability performance typically includes indicators such as energy efficiency, waste management, carbon emission reduction, and stakeholder engagement [13].

2.3. Digital Startups in Indonesia

The digital startup ecosystem in Indonesia has experienced rapid growth over the past decade, driven by technological advancement, an expanding middle class, and government initiatives such as the "National 1000 Startups Digital Movement". However, despite this significant development, sustainability remains a secondary priority for many early-stage startups. Most digital startups tend to focus on market expansion and funding rather than integrating environmental aspects into their core strategies [14]. The main challenge lies in balancing innovation speed with sustainable resource management, particularly amid capital limitations and intense market competition.

2.4. Relationship Between Green Innovation and Sustainability Performance

Various studies have indicated that green innovation positively influences sustainability performance by improving resource efficiency, reducing operational costs, and strengthening brand reputation [15]. In digital startups, the application of green innovation can generate sustainable digital solutions, such as energy-efficient algorithms, digital waste reduction, and environmentally friendly product life cycles [16]. Moreover, startups that adopt sustainability-oriented approaches tend to gain higher investor trust and stronger consumer preferences [17]. However, the success of green innovation implementation is highly dependent on organizational culture, leadership commitment, and supportive government policies [18].

3. METHOD

This study adopts a qualitative research approach to explore how green innovation contributes to strengthening the sustainability performance of digital startups in Indonesia [19]. A qualitative design is particularly appropriate for capturing complex organizational phenomena, as it allows researchers to examine processes, contextual factors, and strategic decision-making in depth. Through this approach, the study seeks to understand not only the implementation of environmentally friendly practices but also the underlying motivations, challenges, and strategic considerations that shape their adoption [20]. Furthermore, qualitative inquiry enables a richer exploration of entrepreneurs' lived experiences, perceptions, and interpretations regarding the integration of green innovation into daily business operations, thereby providing nuanced insights into its environmental, economic, and social implications.

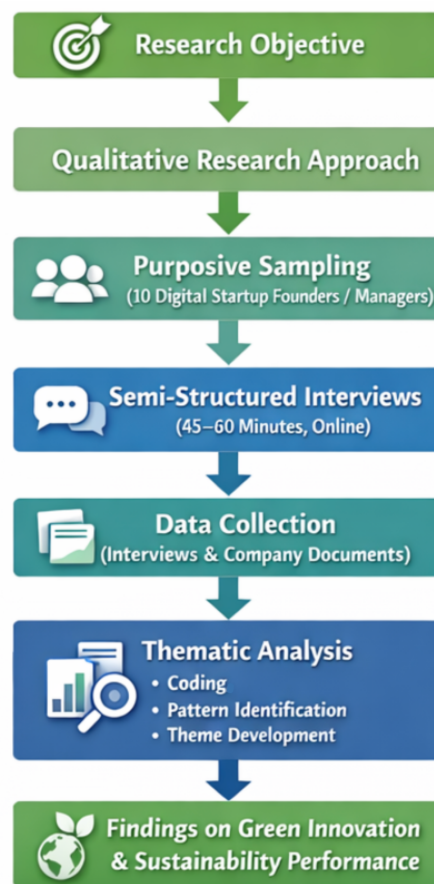


Figure 1. Research Methodology Process

This method is considered appropriate for examining complex and context-specific phenomena, such as sustainability implementation within the dynamic and fast-evolving digital startup ecosystem. As illustrated in Figure 1, the research methodology follows a systematic qualitative process, beginning with clearly defined research objectives and a qualitative research approach [21]. Data for this study were collected through semi-structured interviews with founders, managers, and sustainability officers from selected digital startups that have adopted green innovation practices [22]. The participants were chosen using a purposive sampling technique, ensuring that only individuals with relevant experience and insights were included in the research. A total of ten participants representing startups from various sectors such as e-commerce, fintech, and green technology were interviewed [23]. Each session lasted between 45 and 60 minutes and was conducted online to maintain flexibility and accessibility while ensuring the richness of information gathered. The collected data were analyzed using thematic analysis based on the established framework [24]. This analytical process

involved familiarization with the data, generating initial codes, identifying key patterns, and developing overarching themes that represent the relationship between green innovation and sustainability performance [25]. The analysis aimed to uncover how the adoption of green innovation influences the environmental, social, and economic dimensions of sustainability within Indonesia's digital startup ecosystem [26]. Triangulation was also applied through additional document reviews such as company reports and online publications to enhance the validity and reliability of the findings.

4. RESULT AND DISCUSSION

The findings of this study reveal that green innovation plays a vital role in enhancing the sustainability performance of digital startups in Indonesia [27]. Most participants emphasized that the adoption of eco-friendly initiatives such as digital waste reduction, energy-efficient systems, and paperless operations has improved both environmental and operational efficiency [28].



Figure 2. Conceptual Model of Green Innovation and Sustainability

These innovations not only help reduce carbon emissions but also optimize cost structures, allowing startups to achieve better resource management [29]. Furthermore, green innovation was perceived as a key differentiator that strengthens a startup's brand image and fosters greater customer trust, especially among environmentally conscious consumers [30]. The study also found that entrepreneurial mindset and leadership commitment are crucial in driving the adoption of green innovation [31]. Founders who possess a strong sustainability vision tend to embed environmental considerations into every stage of their business model, from product design to supply chain management. However, several challenges were identified, including limited financial resources, lack of technical knowledge, and insufficient policy support from the government [32]. Despite these obstacles, participants demonstrated a growing awareness that green innovation is not merely a moral obligation but also a long-term investment that enhances competitiveness and resilience in the face of market uncertainty [33]. Green innovation positively influences sustainability performance by balancing economic, environmental, and social outcomes [34]. Moreover, digital transformation facilitates sustainability adoption by enabling data-driven monitoring of environmental impact and resource usage [35]. These findings highlight the importance of cultivating a supportive ecosystem through collaboration among startups, policymakers, and academia to accelerate the transition toward sustainable digital entrepreneurship in Indonesia [36].

Table 1 presents a summary of the main green innovation practices implemented by digital startups in Indonesia and their multidimensional impacts on sustainability performance [37]. The findings indicate that green innovation contributes simultaneously to environmental improvement, economic efficiency, and social value creation. These practices not only reduce ecological footprints but also enhance operational efficiency, stakeholder trust, and long-term business competitiveness [38, 39].

Table 1. Green Innovation Practices and Their Sustainability Impacts

Practice	Environmental	Economic	Social	Sustainability Effect		
Energy-Efficient Systems	Lower emissions, energy use	emissions, less energy use	Reduced operating costs	Shows environmental responsibility	Improves long-term efficiency	
Digital Waste Reduction	Less digital/waste	digital/e-waste	Resource savings	cost	Improves company credibility	Supports resource sustainability
Paperless Operations	Reduced paper use	paper	Lower costs	admin	Promotes green culture	Strengthens eco-commitment
Eco-Friendly Business Models	Sustainable product lifecycle	product lifecycle	Attracts green investors/customers	Builds trust and loyalty	Enhances competitiveness	

Table 2 illustrates the thematic analysis results derived from semi-structured interviews with startup founders and managers. The themes were developed through coding, pattern identification, and categorization of recurring insights [40]. The results demonstrate that green innovation positively influences sustainability performance across environmental, economic, and social dimensions [41]. However, challenges such as financial constraints and limited regulatory support remain significant barriers to wider implementation [42].

Table 2. Thematic Findings on Green Innovation and Sustainability Performance

Theme	Sub-Themes	Key Findings	Startup Implication
Green Innovation Adoption	Energy efficiency, digitalization, waste reduction	Eco-friendly practices increasingly embedded in operations	Improves operational efficiency
Environmental Performance	Emission reduction, resource efficiency	Reduces environmental footprint	Aligns with SDGs
Economic Performance	Cost efficiency, competitive advantage	Lowers long-term costs, boosts profitability	Strengthens financial sustainability
Social Performance	Trust, brand reputation	Consumers favor responsible startups	Enhances market position
Challenges	Funding gaps, policy limits	Financial/regulatory barriers hinder adoption	Needs ecosystem support

The findings indicate that green innovation exerts a positive influence across environmental, economic, and social dimensions of sustainability [41]. Environmentally, startups reported reductions in emissions and improved resource efficiency. Economically, respondents highlighted cost optimization, enhanced operational efficiency, and the creation of competitive advantages. Socially, the adoption of environmentally responsible practices contributed to stronger stakeholder trust, improved brand reputation, and increased customer loyalty.

5. MANAGERIAL IMPLICATION

The findings of this study provide important managerial implications for founders and managers of digital startups in Indonesia. First, green innovation should be positioned as an integral part of strategic decision-making rather than as a peripheral or compliance-driven activity. Managers are encouraged to embed eco-friendly practices such as energy-efficient systems, digital waste reduction, and paperless operations into core business processes from the early stages of startup development. By doing so, startups can simultaneously improve operational efficiency, reduce long-term costs, and strengthen their environmental performance. Leadership commitment plays a critical role in this process, as founders with a clear sustainability vision are more likely to foster an organizational culture that supports continuous innovation and responsible resource management.

Furthermore, the results suggest that managers should view green innovation as a source of competitive advantage and stakeholder value creation. Startups that actively communicate their sustainability initiatives

tend to build stronger brand reputation, customer trust, and investor confidence, particularly among environmentally conscious markets. From a managerial perspective, collaboration with external stakeholders such as technology providers, government agencies, and academic institutions is essential to overcome constraints related to funding, technical expertise, and regulatory support. By leveraging ecosystem partnerships and aligning business strategies with sustainability goals, digital startup managers can enhance long-term resilience, support alignment with the Sustainable Development Goals (SDGs), and ensure sustainable growth in an increasingly competitive digital economy.

6. CONCLUSION

This study concludes that green innovation serves as a strategic foundation for enhancing the sustainability performance of digital startups in Indonesia. By integrating environmentally friendly practices such as energy efficient systems, waste reduction initiatives, and digital process optimization startups are able to simultaneously improve operational efficiency and minimize their ecological footprint. These practices demonstrate that sustainability-oriented innovation is not merely an ethical consideration, but also a viable strategic approach to strengthening long-term business resilience.


The findings indicate that green innovation contributes positively to multiple dimensions of sustainability. Beyond supporting environmental objectives, it enhances economic performance through cost efficiency and resource optimization, while also reinforcing social value by strengthening competitiveness, brand reputation, and stakeholder trust. Startups that consistently apply green principles tend to build stronger relationships with customers, investors, and partners who increasingly prioritize responsible and sustainable business conduct. The research further highlights that the successful implementation of green innovation depends heavily on the entrepreneurial mindset, leadership commitment, and organizational culture within startups. Entrepreneurs who perceive sustainability as an integral component of their core business strategy rather than as an external compliance requirement are more likely to embed green values into their decision making processes, innovation strategies, and daily operations. Such alignment fosters internal coherence, employee engagement, and long term strategic consistency, resulting in more substantial and enduring sustainability outcomes.

However, the study also identifies several structural and operational barriers that limit broader adoption across Indonesia's startup ecosystem. Financial constraints, particularly limited access to green financing mechanisms, remain a major challenge. In addition, gaps in technical expertise and the absence of strong policy incentives or regulatory frameworks hinder the scalability of green innovation initiatives. These obstacles suggest that while startups demonstrate strong potential, systemic support mechanisms are crucial to accelerate transformation. Overall, this study contributes to the growing body of knowledge on sustainable entrepreneurship by offering contextual insights into how digital startups can effectively integrate green innovation into their business models. The implications underscore the importance of collaborative efforts among government, academia, investors, and the private sector to build an enabling ecosystem that supports sustainable digital innovation. Future research may extend these findings through quantitative assessments, comparative regional studies, or longitudinal analyses to measure the long-term impact of green innovation on startup performance and sustainability outcomes.

7. DECLARATIONS

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Conceptualization: LA; Methodology: CT; Software: IN; Validation: LA and IN; Formal Analysis: CT and LA; Investigation: IN; Resources: CT; Data Curation: YM; Writing Original Draft Preparation: LA and IN; Writing Review and Editing: CT and LA; Visualization: IN; All authors, LA, CT, and IN, have read and agreed to the published version of the manuscript.

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