Startupreneur Business Digital (SABDA Journal)
Vol. 4, No. 2, October 2025, pp. 146−154
E-ISSN: 2962-0260 P-ISSN: 2962-0279, DOI:10.33050

Empowering Eco-Innovation Through Digitalization in Startup Enterprises

Jessica Wilson[1], Erika Erika[2*]
[1]Faculty of Computer Science, Adi Journal Incorporation, United Kingdom
[2]Faculty of Economics and Business, STIE Professional Manajemen College Indonesia, Indonesia
[1]wil.jessica@adi-journal.org, [2]iyoori.seol@gmail.com
***Corresponding Author**

Article Info

Article history:
Submission July 21, 2025
Revised September 13, 2025
Accepted September 19, 2025
Published October 02, 2025

Keywords:
Startup
E-Commerce
Digital Era
Business
Eco-Innovation

ABSTRACT

The digital era has created a new landscape for the world of entrepreneurship, where environmental challenges and changes in consumer behavior require business actors, especially startups, to Innovate to create products that are not only competitive but also sustainable. **The background** of this research is the urgent need for business solutions that support sustainability principles and align with the Sustainable Development Goals (SDGs). **This study aims** to identify strategic opportunities in the development of eco-innovative products by startups in the digital era, as well as the factors that encourage and hinder their implementation. Using a descriptive qualitative approach, data was collected through literature studies and in-depth interviews with several startup founders operating in the environmental and technology sectors. **The results show** that the integration of digital technologies, such as the Internet of Things (IoT), e-commerce, and big data, opens up significant opportunities for the development of more efficient, personalized, and affordable eco-friendly products. However, challenges such as limited access to green financing and a lack of sustainability literacy remain major obstacles. **The conclusion** of this study confirms that the digital era offers significant opportunities for startups to become agents of change through eco-innovative products, provided they are able to integrate environmental values into their business models and utilize digital technology optimally.

DOI: https://doi.org/10.33050/sabda.v4i2.893

1. INTRODUCTION

In recent decades, sustainability issues have become a global concern, especially following the United Nations adoption of the Sustainable Development Goals (SDGs). Environmental issues such as climate change, pollution, and resource scarcity require all sectors, including businesses, to take an active role in creating sustainable solutions. Amidst these challenges, a new approach has emerged that combines an entrepreneurial spirit with environmental awareness ecopreneurship [1]. This concept encourages business actors to pursue not only financial gain but also contribute to environmental preservation and social welfare. One concrete manifestation of ecopreneurship is the development of eco-innovative products, namely products designed to minimize negative impacts on the environment through resource efficiency, recycling, and the use of environmentally friendly materials [2]. The development of digital technology has opened up significant opportunities for startups to apply ecopreneurship principles more effectively, as technology enables efficient production processes,

widespread information distribution, and the creation of added value through sustainable innovation [3].

The rapid development of the digital era has brought about fundamental transformations in the business world, especially for startups as new actors with high flexibility in adapting and innovating. This era is marked by the emergence of various digital platforms, artificial intelligence, big data, and the Internet of Things (IoT), which provide great opportunities in creating solutions that are not only economically efficient but also ecologically sustainable [4]. Startup's as a form of pioneering business have unique characteristics, such as an agile organizational structure, technology orientation, and the ability to experiment with new business models [5]. With the support of digital technology, they have the capacity to design, produce, and market eco-innovative products that meet market needs while maintaining environmental sustainability [6]. On the other hand, consumer demand for socially and environmentally responsible products is also increasing, especially among the younger generation who are more aware of the ecological impact of daily consumption. This phenomenon confirms the existence of a great opportunity for startups to exploit this market gap by offering products that align with sustainable values [7].

However, despite these wide-open opportunities, the realization of eco-innovative product development by startups still faces various structural and technical challenges. Some of the main obstacles include limited access to green financing, a lack of sustainability literacy among business actors, and minimal regulatory support that supports sustainable business development [8]. In addition, many startups still view sustainability issues as an additional burden, rather than a potential business opportunity. However, with the right approach, eco-innovative product development can actually become a competitive advantage that differentiates them in an increasingly saturated market [9]. Therefore, a more in-depth study is needed on how startups can strategically respond to these opportunities and challenges, and how they can integrate ecopreneurship principles into their digital-based product innovation processes. This approach is crucial to support the transition to a more inclusive and resilient green economy [10].

Based on this background, this study aims to explore the opportunities for developing eco-innovative products by startups in the digital era, as well as identifying the supporting and inhibiting factors that influence this process [11]. This research is expected to provide theoretical contributions to the development of ecopreneurship and sustainable innovation literature, while also providing practical contributions for startup actors, policymakers, and other stakeholders in designing strategies and policies that encourage the growth of technology-based green businesses [12]. Through a qualitative approach, this study will explore the direct experiences of startup founders who have implemented sustainability principles in their product development. It is hoped that the results of this study can serve as a reference in developing eco-innovative product development models that are relevant to the local context and dynamics of the digital era, thereby strengthening the green innovation ecosystem in Indonesia [13].

2. LITERATURE REVIEW

Ecopreneurship as a form of sustainable entrepreneurship is increasingly receiving academic and practical attention. Ecopreneurship is the process of developing environmentally friendly products and technologies in the market, with the integration of market orientation and innovation to support sustainable growth [14]. This shows that in the modern era, ecopreneurs are not only profit-oriented, but also committed to environmental responsibility. In line with this, the digital era supports ecopreneurship business models through digital economy technologies such as IoT, e-commerce, and big data, opening up huge opportunities to produce eco-innovative products with high efficiency and a minimal environmental footprint [15].

2.1. The Role of Digital Technology in Driving Green Innovation

Digital transformation plays a crucial and multifaceted role in facilitating and accelerating green innovation. It is no longer merely a technological trend but a strategic foundation for the global shift towards a sustainable economy. Digital advancements, such as big data, Artificial Intelligence (AI), and cloud computing, fundamentally strengthen the capacity for green innovation in previously unimaginable ways. These technologies enable drastic improvements in operational efficiency from optimizing supply chains to reduce carbon footprints, to smart energy management in buildings and factories, and precision agriculture that minimizes water and pesticide use. Moreover, digitalization opens up access to previously unreachable financing mechanisms, such as green fintech platforms, crowdfunding for renewable energy projects, and advanced data analytics that allow investors to more accurately assess the risks and impacts of environmental projects [2].

Beyond the technical and financial benefits, the synergy between digitalization and demographic shifts creates a powerful driving force for environmentally friendly innovation. A new generation of digital natives has higher environmental awareness and demands transparency and sustainability from the products and services they consume. Digital platforms become a medium for them to voice these demands, compelling companies to innovate or risk losing market relevance. Thus, the interaction between digital technology adoption and shifting social values synergistically enhances eco-innovation and promotes sustainable corporate growth. This phenomenon underscores that digitalization is not merely about technological implementation but is a catalyst for a broader paradigm shift in the market and consumer behavior. It changes the way we produce, consume, and interact, steering the entire ecosystem towards a more inclusive and responsible green growth [16]. In essence, digital transformation provides the tools, data, and connectivity needed to redesign conventional business models into innovative and environmentally friendly circular economy models.

2.2. Startup Ecosystem and Green Financing Challenges

Startups as the main drivers of eco-innovative product development need to be supported by a conducive entrepreneurial ecosystem. Sustainable digital innovation in the context of an entrepreneurial ecosystem includes education, entrepreneurial culture, government and social support that mediate sustainable business performance [17]. However, financing remains a significant obstacle. A systematic review conducted in 2024 concluded that financing models for green startups are still limited, especially at the early stages, and require innovative approaches such as blended finance and crowdfunding specifically for green startup's. This shows that while opportunities exist, supporting infrastructure in the form of access to green capital and an adequate digital ecosystem is essential for startups to optimally develop eco-innovative products [18].

3. METHOD

The research subjects arestartup founder or product managerwho are actively developing eco-innovative products and using digital technology as part of their business processes [19]. Those who are actively developing eco-innovative products and have integrated digital technology as part of their core business processes. These respondents generally have direct experience in designing, testing, and marketing environmentally friendly products through digital-based approaches, both in terms of production, distribution, and promotion [20]. With their direct involvement in the company's strategic decision-making, these subjects provide relevant and in-depth insights into the challenges and opportunities in the sustainable startup ecosystem [21].

3.1. Data Collection Techniques

Table 1 describes the two main techniques used in the data collection process in-depth interviews and documentation. In-depth interviews were conducted using a semi-structured guide to allow researchers to explore the experiences, strategies, and perspectives of startup actors regarding eco-innovative product development more flexibly and in-depth.

Table 1. Data Collection Techniques and Instruments

Collection Techniques	Instrument	Objective
In-depth interview	Semi-structured interview guide	Exploring the strategies, opportunities, and challenges of eco-innovative product development
Documentation	Official documents, websites, startup publications	Obtaining supporting data and validating interview results

This method also opened opportunities for probing questions, enabling researchers to capture more detailed information and unexpected insights that emerged during the conversation. In addition, the interactive nature of this technique made it possible to identify practical challenges, success factors, and contextual aspects that may not be explicitly documented elsewhere. Meanwhile, documentation was used to obtain supporting data such as company profiles, innovation reports, and content available on startup websites or publications, which served as complementary evidence to strengthen the findings and provide an additional layer of validation. The purpose of using these two techniques was to gain a comprehensive understanding and validate the interview findings with other data sources, thereby increasing the credibility, accuracy, and reliability of the overall research results.

Table 2. Techniques and Procedures for Thematic Data Analysis

Data Analysis Techniques	Transcription of interview results
	Initial coding of emerging themes
	Data categorization by theme: opportunities, strategies, challenges
	Interpretation of meaning and conclusion of results
Thematic Data Analysis Procedure	Copy the interview data into text form
	Coding important data sections
	Grouping data into theme categories
	Constructing interpretive narratives based on categories

Table 2 outlines two main techniques, data analysis techniques and thematic analysis procedures, the primary method used to process qualitative data in this study. The first section outlines four key stages, transcription of interview results, coding emerging themes, categorizing them based on key topics (opportunities, strategies, challenges), and final interpretation of meaning. The second section describes the technical steps of thematic analysis compiling and filtering interview data, coding, grouping information according to themes, and constructing an interpretive narrative. These procedures enable researchers to identify key patterns in the data that support the research objectives.

4. RESULT AND DISCUSSION

Digital transformation has opened up significant opportunities for startups to create environmentally friendly products. The use of technologies such as the Internet of Things (IoT), big data, and digital platforms makes it easier to access market information, optimize production processes, and expand product distribution. Startups are able to design more efficient products, in line with the preferences of increasingly environmentally conscious consumers, and reach a wider market online [22]. The increasing public interest in sustainability issues has also increased the market potential for eco-innovative products [23].

4.1. Driving Factors of Eco-Innovation

Several key factors are driving the growth of eco-innovation among startups [24]. Consumer awareness of environmental impacts is a key factor motivating startups to develop sustainable products. Support from digital technology developments is also significant, simplifying the innovation process and increasing operational efficiency [25]. Furthermore, incentives from the government and supporting institutions, including training, financing, and market access, have strengthened the enthusiasm of entrepreneurs to provide innovative, environmentally friendly solutions.

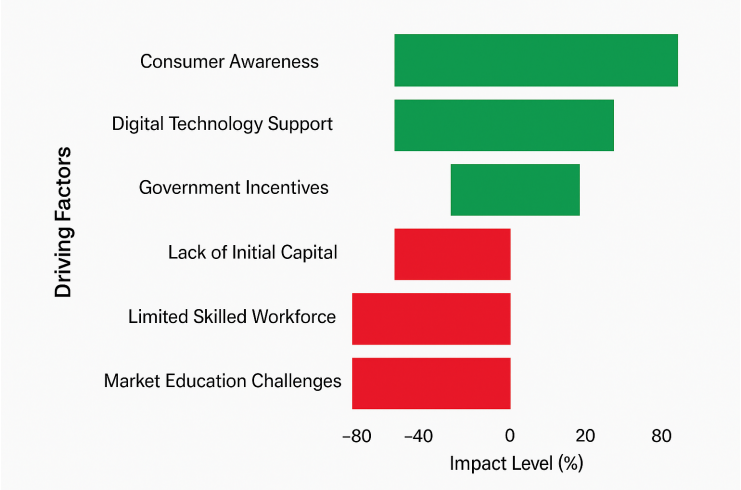

Figure 1. Driving and Inhibiting Factors of Eco-Innovation in Startups

Figure 1 shows the horizontal bar chart depicting the main factors driving and inhibiting the development of eco-innovative products. Consumer awareness, with an influence level of 85%, emerged as the strongest driving factor. Growing environmental awareness among consumers encourages startups to innovate and offer sustainable alternatives. Digital technology support followed with an influence level of 75%, emphasizing the importance of tools that accelerate processes and facilitate innovation. Government incentives also played a role (60%), demonstrating that policy support can significantly encourage green initiatives. On the other hand, several inhibiting factors remain significant challenges. Limited initial capital, reported at -70%, is the most pressing barrier, especially for startups in the early stages of development. A lack of skilled labor (-65%) further limits startups' ability to effectively implement eco-innovations. Furthermore, market education challenges (-50%) indicate that consumers may not fully understand or appreciate eco-innovative products, creating barriers to adoption and market expansion.

Startups that successfully develop eco-innovative products generally adopt a strategic approach to address challenges while maximizing opportunities [26]. They often collaborate with local communities to create sustainable solutions, partner with technology incubators and universities to access digital infrastructure and research support, and employ value-based branding strategies through storytelling and social media campaigns to attract environmentally conscious consumers. These strategies enable startups to overcome capital constraints and market barriers, while simultaneously driving innovation and building strong customer loyalty [27].

4.2. Factors Inhibiting Eco-Innovation

On the other hand, the development of eco-innovative products still faces various obstacles. Limited initial capital is a major challenge, especially for startups that lack access to sustainable funding sources [28]. The lack of human resources with expertise in sustainability and technology also hinders the full implementation of innovations. Furthermore, low levels of sustainability literacy among consumers slow down the adoption of eco-friendly products, as most consumers still prioritize price over environmental value.

Table 3. Inhibiting Factors of Eco-Innovation in Startups

No.	Inhibiting Factor	Impact Level (%)	Explanation
1	Lack of Initial Capital	-70%	This is the most pressing barrier, especially for early-stage startups, due to limited access to sustainable funding sources.
2	Limited Skilled Workforce	-65%	A lack of human resources with expertise in sustainability and technology limits the startup's ability to effectively implement eco-innovation.
3	Market Education Challenges	-50%	Consumers may not fully understand or appreciate eco-innovative products, often prioritizing price, which slows down product adoption and market expansion.

Based on Table 3 of Eco-Innovation in Startups, there are three primary factors identified as challenges to eco-innovation, along with their estimated impact levels and explanations. These factors collectively highlight challenges in funding, talent, and consumer reception, which are critical areas for any startup, but particularly for those focused on the often more complex and potentially higher-cost field of eco-innovation.

4.3. Startup Adaptation Strategy

In the face of these challenges, many startups are taking strategic steps to continue innovating. They are developing collaborative approaches with various parties, such as local communities, universities, and funding institutions. The use of communication strategies that emphasize sustainability values through social media and digital platforms is also an important tool in building consumer awareness and trust. Adaptive startups tend to leverage digital flexibility to create business models that respond to changing market needs [29]. The digital era offers significant opportunities for startups to develop eco-innovative products. Key driving factors include increasing environmental awareness, advances in digital technology, and external support from

the entrepreneurial ecosystem. However, barriers such as limited capital, a shortage of skilled workers, and low consumer education remain significant challenges. By implementing collaborative strategies and innovative, values-based approaches, startups have significant potential to become key players in realizing sustainable business practices in the digital era [30].

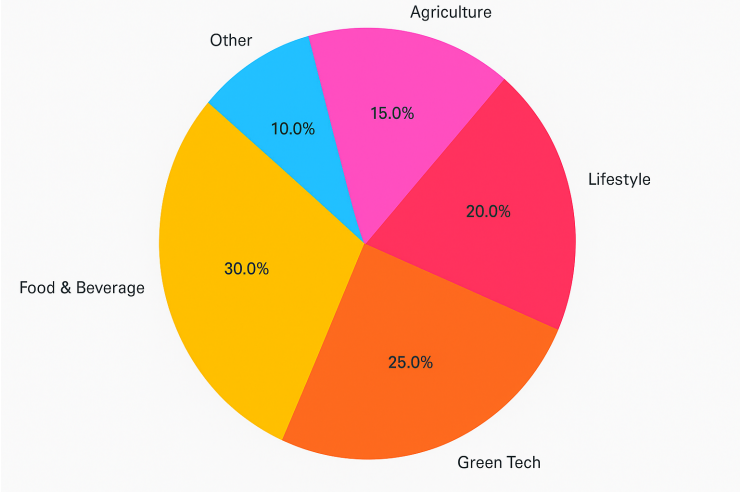

Figure 2. Composition of respondents based on startup sector

This Figure 2 pie chart illustrates the distribution of startups participating in the study based on their sectors. The largest proportion is in the Food & Beverage sector (30%), followed by Green Technology (25%) and Lifestyle Products (20%). Agriculture and OtherSectors represent smaller portions. This composition reflects the diversity of eco-innovative initiatives across industries in the digital era. These include the use of e-commerce platforms to reach environmentally conscious consumers, the Internet of Things (IoT) and sensors to optimize energy use and monitor resource efficiency, and big data and Artificial Intelligence (AI) tools to analyze market trends and predict demand for sustainable products. Startups that leverage digital infrastructure are better positioned to create scalable, cost-efficient, and personalized eco-friendly products. This reinforces the view that digital transformation is not just a technological shift, but also a shift in market paradigms and mindsets.

5. MANAGERIAL IMPLICATIONS

The findings of this study provide several important managerial implications for startups in Indonesia seeking to develop eco-innovative products. First, managers must prioritize the integration of digital technologies such as IoT, big data, and e-commerce not only to improve efficiency but also to ensure that technological innovation consistently supports sustainability goals. Addressing resource limitations is equally critical managers are encouraged to leverage partnerships with government programs, incubators, universities, and other stakeholders to access funding and skilled human resources.

In addition, given the low level of consumer literacy regarding sustainability, managers should invest in market education and transparent communication strategies that highlight the environmental benefits of their products, thereby building consumer trust and loyalty. Long-term strategic planning is also essential, with managers needing to anticipate regulatory changes, manage costs effectively, and adopt flexible business models to remain competitive. Finally, startups should actively contribute to strengthening the sustainable innovation ecosystem by collaborating with policymakers, investors, research institutions, and consumer communities, as such collaboration can accelerate the adoption and market acceptance of eco-innovative products.

Finally, startups should view themselves not just as participants within the sustainable innovation ecosystem but as active contributors to its strengthening. Success is not achieved in a vacuum. Managers should proactively engage and collaborate with a wide range of stakeholders, including policymakers, investors, research institutions, and consumer communities. By working with policymakers, startups can help shape regulations that are favorable to green innovation. By engaging with impact investors, they can secure ”patient

capital" from sources aligned with their mission. Collaborating with research institutions can accelerate technological breakthroughs, while building strong ties with consumer groups can provide invaluable feedback and co-create market demand.

6. CONCLUSION

The digital era offers immense opportunities for Indonesian startups to advance the development of eco-innovative products. The rapid growth of digital technologies such as the Internet of Things (IoT), big data analytics, artificial intelligence, and e-commerce platforms has not only opened access to wider markets but also enabled more efficient production processes and facilitated the creation of environmentally friendly solutions. These technologies allow startups to optimize resources, monitor sustainability performance, and connect directly with environmentally conscious consumers. At the same time, increasing consumer awareness of sustainability issues serves as a powerful driving force, providing momentum for startups to succeed in producing innovations that align with global demands for greener products. Nevertheless, the extent to which these opportunities can be capitalized on depends largely on the ability of startups to integrate digital capabilities with environmental values within their core business models.

The study highlights both the driving and inhibiting factors influencing the development of eco-innovative products, as well as the strategies employed by startups to address these dynamics. While opportunities are abundant, significant challenges remain. Constraints such as limited access to financial capital, shortages of skilled human resources, and low levels of consumer literacy regarding sustainability present barriers that hinder the pace of eco-innovation adoption. These structural issues limit startup's capacity to scale up their innovations and fully penetrate the market. Furthermore, the study acknowledges its own limitations, as it relies on a qualitative research design with a relatively small number of respondents and is confined to a specific regional context. Consequently, the findings should be interpreted with caution and cannot be generalized to represent the entire Indonesian startup ecosystem.

Building on these findings, future research is encouraged to adopt broader and more systematic approaches, particularly through quantitative methods, to explore the relationships among the variables influencing the success of eco-innovation. Expanding the scope of research to cover a larger and more diverse sample of startups across different regions of Indonesia would enhance the robustness and generalizability of the results. In addition, further exploration of the role of government policies, institutional support, and multi-stakeholder collaboration could provide valuable insights into strengthening the sustainable startup ecosystem. Research that focuses specifically on consumer behavior toward eco-innovative products also has great potential, as it could inform more effective marketing strategies, guide targeted educational campaigns, and ultimately contribute to increasing consumer acceptance of sustainable innovations in the digital economy.

7. DECLARATIONS

7.1. About Authors

Jessica Wilson (JW) https://orcid.org/0009-0005-4774-8547
Erika Erika (EE) https://orcid.org/0000-0002-2696-3839

7.2. Author Contributions

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

7.3. Data Availability Statement

The data presented in this study are available on request from the corresponding author

7.4. Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

7.5. Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

REFERENCES

[1] S. Sahili and V. Barrales-Molina, "Analyzing how european startups generate eco-processes and eco-products: Eco-innovation implementation, financial resources, and patents," *Sustainability*, vol. 16, no. 22, p. 10028, 2024.

[2] R. Mishra, R. K. Singh, and N. P. Rana, "Digital orientation, digital eco-innovation and circular economy in the context of sustainable development goals," *Business Strategy and the Environment*, vol. 33, no. 4, pp. 2752–2770, 2024.

[3] R. Pratama and S. Wahyuni, "Turning eco-investments into sustainable competitive advantages: an exploratory case study of eco-oriented startup," in *Proceeding of the International Conference on Family Business and Entrepreneurship*, vol. 2, no. 1, 2022.

[4] P. S. Borah, "Practical implications and the future of eco-innovation, digital transformation, and green marketing: Future of sustainable marketing," in *Regulatory Frameworks and Digital Compliance in Green Marketing*. IGI Global Scientific Publishing, 2025, pp. 329–356.

[5] D. Barile, G. Secundo, and P. Del Vecchio, "An artificial intelligence-based innovation ecosystem enabling open innovation and sustainable growth: evidence from a case study," *Innovation*, pp. 1–23, 2025.

[6] N. Ghezali and H. Sekkal, "Eco-innovation and corporate social responsibility in algerian environmental startups. economics and finance, volume 12, issue 3, 65-75," *Economics and Finance*, p. 65, 2024.

[7] C. R. Casas, M. La Rubia, J. Aguilar-Peña, C. Gilabert-Torres, and L. Hontoria, "From classroom to business ideas: Fostering eco-innovation through engineering entrepreneurship education," in *New Perspectives in Science Education-International Conference*, no. 14, 2025.

[8] N. K. A. Sukri, S. N. ulkiffli, N. H. N. Mat, K. Omar, M. K. Mawardi, and N. F. Z. Zaidi, "An analysis of eco-innovation capabilities among small and medium enterprises in malaysia," *Administrative Sciences*, vol. 13, no. 4, p. 113, 2023.

[9] L. Sanbella, I. Van Versie, and S. Audiah, "Online marketing strategy optimization to increase sales and e-commerce development: An integrated approach in the digital age," *Startupreneur Business Digital (SABDA Journal)*, vol. 3, no. 1, pp. 54–66, 2024.

[10] P. Gurudiwan, R. Sehgal, and G. Sharma, "Eco-innovation as a competitive advantage in smes," *International Journal of Environmental Sciences*, vol. 11, no. 6s, pp. 82–88, 2025.

[11] R. Sharma, A. Gunasekaran, M. Sharma, S. Luthra, and S. Joshi, "Building a sustainable future: The role of green innovation and green premium in transforming indian smes," *Environment, Development and Sustainability*, pp. 1–26, 2025.

[12] F. Ince, "Sustainable eco-innovation: Some points to ponder," in *Leadership Perspectives on Effective Intergenerational Communication and Management*. IGI Global, 2023, pp. 16–35.

[13] A. Awa, C. A. Pramestidewi, and A. J. Aziz, "Comprehensive exploration of ecopreneurship principles for sustainable business practices," in *E3S Web of Conferences*, vol. 593. EDP Sciences, 2024, p. 06002.

[14] A. Dudhat and E. Dolan, "Evaluation of ecopreneurship business sustainability in the context of the digital economy," *Startupreneur Business Digital (SABDA Journal)*, vol. 4, no. 1, pp. 64–72, 2025.

[15] W. A. Srisathan, W. Worrakittikul, K. Rattanapon, T. Hongto, A. Phrommasakha Na Sakhonnakon, and P. Naruetharadhol, "Digitalisation to zero-waste: the interplay of open eco-innovation and the circular economy in agricultural enterprises," *International Journal of Sustainable Engineering*, vol. 18, no. 1, pp. 1–21, 2025.

[16] J. A. Antončič, J. Hojnik, M. Ruzzier, M. K. Ruzzier, and B. Soltwisch, "The role of demographic changes and digitalization in eco-innovations and their effects on the growth of companies," *Sustainability*, vol. 16, no. 14, p. 6203, 2024.

[17] M. D. Vasilescu, G. C. Dimian, and G. I. Gradinaru, "Green entrepreneurship in challenging times: a quantitative approach for european countries," *Economic research-Ekonomska istraživanja*, vol. 36, no. 1, pp. 1828–1847, 2023.

[18] R. Lesmana, I. Wijaya, E. A. Nabila, H. Agustian, S. Audiah, and A. Faturahman, "Enhancing market

trend analysis through ai forecasting models," *International Journal of Cyber and IT Service Management*, vol. 4, no. 2, pp. 105–113, 2024.

[19] C. Duran, "Green entrepreneurship and sustainable technoparks: Ecosystems of the future," *International Research in Social, Human and Administrative Sciences XXII*, vol. 61, 2024.

[20] K. Mansilla-Obando, G. Llanos, E. Gómez-Sotta, P. Buchuk, F. Ortiz, M. Aguirre, and F. Ahumada, "Eco-innovation in the food industry: exploring consumer motivations in an emerging market," *Foods*, vol. 13, no. 1, p. 4, 2023.

[21] J. Hojnik, M. Ruzzier, M. K. Ruzzier, B. Sučić, and B. Soltwisch, "Challenges of demographic changes and digitalization on eco-innovation and the circular economy: Qualitative insights from companies," *Journal of Cleaner Production*, vol. 396, p. 136439, 2023.

[22] J. Martínez Falcó, E. Sánchez-García, B. Marco-Lajara, and U. Akram, "Digital transformation and green innovation performance: unraveling the role of green knowledge sharing and top management environmental awareness," *Internet Research*, 2024.

[23] U. Rahardja, T. Hongsuchon, T. Hariguna, and A. Ruangkanjanases, "Understanding impact sustainable intention of s-commerce activities: The role of customer experiences, perceived value, and mediation of relationship quality," *Sustainability*, vol. 13, no. 20, p. 11492, 2021.

[24] G. A. Pangilinan, S. Audiah, M. R. Shauqy, and O. F. P. Wahyudi, "Entrepreneurial marketing mindset as a determining factor for digital startup success," *Startupreneur Business Digital (SABDA Journal)*, vol. 4, no. 1, pp. 34–46, 2025.

[25] R. Kuceba and G. Chmielarz, "Internal development strategies of partners of eco-innovative services network: Consortium's source of knowledge," in *European Conference on Knowledge Management*, vol. 1. Academic Conferences International Limited, 2022, pp. 677–R32.

[26] A. Kuzior, M. Sira, and P. Brożek, "Use of artificial intelligence in terms of open innovation process and management," *Sustainability*, vol. 15, no. 9, p. 7205, 2023.

[27] J. J. Ferreira, A. J. C Fernandes, and M. Ramírez-Pasillas, "Start-ups and entrepreneurial ecosystems in the circular economy: A multi-level approach for safe and just planetary boundaries," *International Small Business Journal*, vol. 42, no. 4, pp. 416–445, 2024.

[28] U. Rahardja, Q. Aini, D. Manongga, I. Sembiring, and I. D. Girinzio, "Implementation of tensor flow in air quality monitoring based on artificial intelligence," *International Journal of Artificial Intelligence Research*, vol. 6, no. 1, 2023.

[29] A. Sutarman, U. Rahardja, F. P. Oganda, S. Millah, and N. N. Azizah, "The role of information technology in empowering the creative economy for sustainable tourism," *Aptisi Transactions on Technopreneurship (ATT)*, vol. 5, no. 2sp, pp. 175–185, 2023.

[30] S. Montresor and A. Vezzani, "Digital technologies and eco-innovation. evidence of the twin transition from italian firms," *Industry and Innovation*, vol. 30, no. 7, pp. 766–800, 2023.