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SUSTAINABLE INNOVATION IN THE DIGITAL AGE: FACING CHALLENGES AND OPPORTUNITIES IN GLOBAL MARKETS

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ABSTRACT

The global climate crisis necessitates a paradigm shift in business practices, one of which is through the implementation of a circular economy. Startups in Southeast Asia have significant potential to become agents of change by developing sustainable business models. This study aims to explore the innovative circular economy-based business models implemented by startups in Southeast Asia and to understand the challenges and strategies involved in their implementation. This research adopts a qualitative approach with a case study design. Data were collected through semi-structured interviews with 10–15 startup founders and analysis of related documents. Findings show that startups innovating in circular economy-based products and services not only reduce environmental impact but also create significant economic value. However, challenges such as low consumer awareness, limited access to resources, and regulatory complexities remain obstacles. Education and collaboration strategies with various stakeholders proved effective in overcoming these challenges. Significance: This study extends the application of circular economy theory to the startup context in developing economies, offering actionable insights for entrepreneurs and policymakers on integrating sustainability into business models while enhancing competitiveness. It also provides practical guidance for managers on fostering consumer awareness and building stakeholder partnerships to scale sustainable innovation.

1. INTRODUCTION

In the midst of the industrial revolution 4.0, sustainable innovation is the main agenda for companies that want to maintain competitiveness in the global market. The digital age has shaped the business landscape and presented new challenges that require creative and strategic responses. According to Klaus Schwab (2016), rapid technological changes require organizations to adapt to dynamic market needs. This creates an urgent need for companies to invest in innovations that not only prioritize short-term gains but also to environmental and social sustainability (Porter & Heppelmann, 2014; Bocken et al., 2014).

This research is important because sustainable innovation not only contributes to the success of organizations but also plays a crucial role in addressing global challenges such as climate change and social injustice. Stiglitz (2017) shows that businesses that integrate sustainable values in their strategies tend to achieve more stable growth. At the same time, a report from McKinsey (2020) indicates that consumers are increasingly aware of the impact of products on the environment, which requires companies to innovate. Therefore, this research aims to explore how sustainable innovation can be optimized in the digital era.

Based on the Global Innovation Index survey (2021), countries with strong sustainable innovation show better economic performance than other countries. The data shows that investment in research and development (R&D) is directly proportional to economic growth (World Economic Forum, 2021). Here is a table showing the relationship between R&D investment and innovation indices in some countries:

Table 1. The relationship between R&D investment and innovation indices in several countries

Country	R&D investment (% of GDP)	Innovation Index
Sweden	3.3	85.8
Switzerland	3.4	88.4
China	2.2	75.2
Indonesia	0.8	50.0

Various previous studies have identified key factors influencing sustainable innovation. According to research by Adams et al. (2016), collaboration between the public and private sectors is the main driver in creating sustainable innovative solutions. Meanwhile, the smooth access of information technology as a driver of change has been discussed by Chesbrough (2010), who shows that the ability of companies to adapt to new technologies can accelerate innovation. However, many studies still lack to explore how companies adapt to specific challenges in the global marketplace.

Although various studies have delved into sustainable innovation, there is a lack of understanding of the specific mechanisms related to innovation strategies in the digital age. Most studies focus on the implementation of technology without considering the broader social and economic context. This is a significant gap, considering that the success of sustainable innovation is also influenced by external factors such as regulations, culture, and changes in consumer behavior (Melnyk et al., 2014). This study addresses this gap by examining innovative circular economy-based business models in Southeast Asian startups, identifying key challenges, and proposing strategic pathways for scaling sustainable innovation. The research contributes both theoretically by extending circular economy applications into the startup context in developing economies and practically, by offering actionable guidance for entrepreneurs, managers, and policymakers.

This research presents a new approach by integrating the theory of sustainable innovation and digital transformation in the context of the global market. Leveraging big data analytics and digitization tools, the study not only provides an overview of the challenges faced but also recommends innovative strategies based on the experience of leading companies that have successfully adapted (Brynjolfsson & McAfee, 2014). This approach is expected to provide deeper insights into the role of technology in strengthening sustainable innovation.

Overall, the aim of this research is to explore how companies can face challenges and capitalize on opportunities in the digital age through continuous innovation. By analyzing data and insights from various sources, this study aims to provide practical recommendations for organizations looking to improve their innovative performance after experiencing digital disruption. In addition, this research also aims to contribute to the academic literature in the field of sustainable innovation, as well as help practitioners understand the dynamics that exist in the global market

2. METHOD

1. Types of Research

This study uses a mixed approach with qualitative and quantitative methods. The qualitative method is used to dig into an in-depth understanding of the sustainable innovation strategies implemented by the company, while the quantitative method is used to measure the relationship between innovation variables and

company performance in the digital age. This mixed approach is expected to provide a comprehensive view of the phenomenon being studied (Creswell & Plano Clark, 2017).

2. Population and Sampling

The population in this study consists of companies operating in the technology and innovation sectors that are listed on stock exchanges in several countries, including Indonesia, Sweden, and Switzerland. From this population, samples were taken by purposive sampling, with the following criteria:

1. Companies that have a clear continuous innovation program.
2. Companies that have been operating for at least 5 years.
3. Companies that engage in international activities and have a significant impact on the global market.

It is expected that at least 100 respondents from these companies can be involved to provide representative data.

3. Research Instruments

The research instruments used in this study consist of two main parts:

1. Questionnaire: For quantitative data collection, the questionnaire was designed using a Likert scale to measure respondents' views on various aspects of sustainable innovation, such as the company's strategy, resources, and performance.
2. In-Depth Interviews: For qualitative data collection, semi-structured interviews will be conducted with top-level managers and innovation teams in each company. The interview questions will focus on the challenges and opportunities in the implementation of sustainable innovation (Patton, 2015).

4. Data Collection Technique

Data will be collected through the following steps:

1. Survey Questionnaire: The questionnaire will be distributed online through the survey platform to obtain data from selected respondents.
2. Interviews: In-depth interviews will be scheduled with innovation managers and staff, conducted in-person or via video conferencing app, depending on the respondent's geographic and health conditions.
3. Documentation Study: Analysis of documents related to the company's annual report and innovation policy will also be conducted to obtain additional context regarding the innovation strategy implemented.

5. Research Procedure

The research procedure will be carried out in several stages:

1. Initial Preparation: Research begins with a literature study to formulate a conceptual framework and develop research instruments.
2. Respondent Recruitment: Identification and selection of companies that meet the sample criteria.
3. Data Collection: Fill out an online questionnaire for two weeks. After that, interviews will be conducted for one month with each company.
4. Data Analysis: Questionnaire perceptions will be analyzed using statistical software such as SPSS, while interviews will be documented and analyzed thematically to obtain relevant patterns.

6. Data Analysis Technique

Data analysis will be carried out using the following techniques:

1. Quantitative Analysis: Data from the questionnaire will be analyzed using descriptive statistics to illustrate the results. Furthermore, regression analysis will be applied to measure the relationship between the variable of sustainable innovation and company performance.
2. Qualitative Analysis: Interview transcription will be performed, then analyzed using a thematic analysis approach with a coding process (Braun & Clarke, 2006). Findings from the qualitative analysis will be combined to support the results of the quantitative analysis and provide a more holistic picture of sustainable innovation in the digital age.

7. Ethical Considerations and Instrument Validation

All research procedures complied with established ethical guidelines for social science research. Ethical clearance was obtained and informed consent was secured from all participants before data collection. Respondents were assured of confidentiality, anonymity, and the right to withdraw at any stage without

penalty. All interview recordings, transcripts, and related documents were stored securely and accessible only to the research team.

To ensure instrument validity, the semi-structured interview guide and document analysis framework underwent pilot testing with two startups not included in the main sample. Feedback from the pilot was used to refine question wording, sequence, and clarity. Reliability was strengthened through inter-coder agreement checks during thematic analysis, where two independent researchers coded a subset of transcripts and achieved an agreement rate of over 85%. This process minimized subjective bias and enhanced the credibility of findings.

3. RESULTS AND DISCUSSION

The results of this study describe the challenges and opportunities of sustainable innovation in the digital era based on data collected from questionnaires and interviews. Based on the method used, the discussion will be divided into several subheadings as follows:

1. Company Profile Based on Sustainable Innovation
2. Continuous Innovation Strategy in Improving Company Performance
3. Challenges Faced in the Implementation of Sustainable Innovation
4. Sustainable Innovation Opportunities in the Digital Era

1. Company Profile Based on Sustainable Innovation

The results of the questionnaire showed that the companies participating in the study tended to have a strong background in sustainable innovation practices. Of the 100 respondents surveyed, about 70% of companies have implemented a sustainable innovation program that is integrated into their business strategy. This is in line with research by Adams et al. (2016), which revealed that cross-sector collaboration is essential to drive sustainable innovation.

From the qualitative analysis, interviews with innovation managers confirm that their main goal is to not only increase short-term profits but also create positive social and environmental impacts (Porter & Kramer, 2011). Company leaders like PT XYZ explain that their philosophy focuses on creating eco-friendly products that meet consumer needs. This reflects findings by Bocken et al. (2014), which indicate that companies focused on sustainability tend to have a stronger commitment to R&D for innovation.

Here is a table showing the ratio of sustainable innovation implementation in the companies studied:

Table 2. Sustainable Innovation Implementation Table

Criterion	Percentage (%)
Have an innovation program	70
Integrating sustainability	60
Measuring social impact	45

2. Continuous Innovation Strategy in Improving Company Performance

The study found that almost 65% of companies that implement sustainable innovation strategies report improved operational and financial performance. Regression analysis conducted on quantitative data showed a significant relationship between continuous innovation and company productivity, with an R^2 value of 0.68 ($p < 0.05$). This confirms previous findings that investment in sustainable innovation can improve operational efficiency and effectiveness (Melnyk et al., 2014).

In interviews, many managers noted that they make productive innovations by leveraging digital technology to improve the production and delivery processes of products. For example, PT ABC implements Internet of Things (IoT) technology in their supply chain, which not only reduces costs but also increases transparency and responsiveness to market demand (Brynjolfsson & McAfee, 2014). This is in line with a report from McKinsey (2020) which shows that companies that adopt digital technology effectively can create a competitive advantage.

3. Challenges Faced in the Implementation of Sustainable Innovation

While many companies have successfully implemented sustainable innovation, the study also identified some significant challenges. The results of the interviews showed that 55% of respondents felt that the lack of support from top management was a major obstacle in the implementation of innovation (Chesbrough, 2010). In addition, there are high-cost pressures and uncertainty in long-term investments that often make companies hesitant to innovate.

Research also shows that many companies face difficulties in adapting to changing government regulations and policies related to the environment (Stiglitz, 2017). Some managers state that this can make it difficult for them to predict the financial impact of their sustainable initiative investments. Data from the questionnaire showed that 40% of respondents felt that complex regulations hindered their innovative initiatives.

4. Opportunities for Sustainable Innovation in the Digital Era

One interesting finding from this study is that there are many opportunities related to sustainable innovation in the digital age. Despite the challenges, most respondents believe that digital transformation can help them create new products and services that are more sustainable. Quantitative results show that more than 60% of companies have started exploring strategic partnerships in order to develop sustainable innovation (Adams et al., 2016).

Some managers highlight the importance of collaborating with tech startups that focus on sustainable solutions. This is expected to accelerate the innovation process and reduce the risks associated with new product development (Porter & Kramer, 2011). In the qualitative analysis, support from research institutions and governments was also identified as a significant opportunity to drive sustainable innovation (McKinsey, 2020).

To illustrate the opportunities that exist, here is a table showing the many partnerships undertaken by companies in the development of sustainable initiatives:

Table 3. Table of Partnerships in Innovation Development

Partnership Type	Number of Companies
Collaboration with startups	35
Research with universities	22
Partnerships with NGOs	15

4. CONCLUSION

Based on the results of the research that has been presented, it can be concluded that sustainable innovation plays an important role in strengthening the competitiveness of companies in the digital era. The main objective of this study, which is to explore how companies are facing challenges and capitalizing on opportunities in the digital age through continuous innovation, has been achieved through a blended approach that combines quantitative and qualitative data. The study found that companies that strategically integrate sustainability principles in their innovative activities tend to experience improvements in operational and financial performance. The use of digital technologies such as IoT and big data analytics has also been proven to accelerate the innovation process and increase business efficiency.

The findings of this study also highlight significant challenges, such as lack of management support and regulatory uncertainty, that hinder the implementation of sustainable innovation. However, on the other hand, the digital era opens up great opportunities through strategic collaborations with startups, research institutions, and non-governmental institutions. By leveraging these partnerships and digital technologies, companies can create solutions that are not only innovative but also socially and environmentally sustainable.

Overall, this research makes an important contribution to the academic literature and managerial practice by providing strategic insights into how sustainable innovation can be optimized in the face of increasingly complex and digitized global market dynamics.

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