



DOI: <https://doi.org/10.38035/jmpis.v7i4>
<https://creativecommons.org/licenses/by/4.0/>

Digital Transformation and Green Innovation: The Role of Ambidexterity and CSR in SMEs

Faishal Hidayat Maajid^{1*}, Siti Nursyamsiah²

¹Universitas Islam Indonesia, Yogyakarta, Indonesia, 21311346@students.uii.ac.id

²Universitas Islam Indonesia, Yogyakarta, Indonesia

*Corresponding Author: 21311346@students.uii.ac.id

Abstract: *This study aims to analyze the role of Corporate social responsibility (CSR) as a moderating variable in the relationship between organizational ambidexterity, digital transformation, and green innovation among Small and Medium Enterprises (SMEs) in Yogyakarta. This study employs an explanatory quantitative approach using the SEM-PLS method on a sample of 200 SME operators. The results indicate that organizational ambidexterity has a positive effect on digital transformation, and digital transformation has a positive effect on green innovation. Furthermore, digital transformation mediates the relationship between organizational ambidexterity and green innovation. CSR was found to strengthen the effect of digital transformation on green innovation, thereby directing the use of digital technology toward sustainable innovation. Descriptively, respondents were predominantly from the food and beverage sector (22.5%) and SMEs with fewer than 10 employees (65.5%). These findings underscore the importance of synergy between organizational capabilities, digitalization, and social responsibility in driving green innovation among SMEs.*

Keywords: *Organizational Ambidexterity, Digital Transformation, Green Innovation, Corporate Social Responsibility, SMEs*

Abstrak: Penelitian ini bertujuan untuk menganalisis peran *Corporate social responsibility* (CSR) sebagai variabel moderasi dalam hubungan antara *organizational ambidexterity*, *digital transformation*, dan *green innovation* pada Usaha Kecil dan Menengah (UKM) di Yogyakarta. Penelitian ini menggunakan pendekatan kuantitatif eksplanatori dengan metode SEM-PLS terhadap 200 pelaku UKM. Hasil penelitian menunjukkan bahwa *organizational ambidexterity* berpengaruh positif terhadap *digital transformation*, serta *digital transformation* berpengaruh positif terhadap *green innovation*. Selain itu, *digital transformation* memediasi hubungan antara *organizational ambidexterity* dan *green innovation*. CSR terbukti memperkuat pengaruh *digital transformation* terhadap *green innovation*, sehingga pemanfaatan teknologi digital lebih terarah pada inovasi berkelanjutan. Secara deskriptif, responden didominasi sektor *food and beverage* (22,5%) dan UKM dengan tenaga kerja kurang dari 10 orang (65,5%). Temuan ini menegaskan pentingnya sinergi antara kemampuan organisasi, digitalisasi, dan tanggung jawab sosial dalam mendorong inovasi hijau pada UKM.

Kata Kunci: *Organizational Ambidexterity, Digital Transformation, Green Innovation, Corporate Social Responsibility, UKM*

INTRODUCTION

In recent years, rapid technological advancements and increasing environmental challenges have fundamentally reshaped the competitive landscape of firms worldwide. Digital transformation has emerged as a critical strategic response, enabling organizations to leverage digital technologies to enhance operational efficiency, innovation, and value creation. At the same time, growing concerns over climate change and resource depletion have intensified the need for green innovation as a pathway toward sustainable development. In this context, understanding how firms can simultaneously achieve digital transformation and green innovation has become an important research agenda.

A growing body of literature highlights the positive role of digital transformation in driving green innovation. Digital technologies facilitate knowledge integration, improve information processing, and reduce transaction costs, thereby enhancing firms' ability to develop environmentally friendly products and processes (Wang & Zhong, 2024). Moreover, digital transformation strengthens organizational learning and absorptive capacity, enabling firms to acquire and apply external knowledge for sustainable innovation (Zhou et al., 2025). These findings suggest that digital transformation is a key enabler of green innovation and sustainability performance.

However, despite these advances, existing research has primarily focused on the outcomes of digital transformation while paying limited attention to the underlying capabilities that drive its adoption and implementation. From the perspective of the dynamic capability view, firms must possess the ability to sense opportunities, seize them, and reconfigure resources in order to adapt to rapidly changing environments (Teece, 2007). In this regard, organizational ambidexterity defined as the ability to balance exploration and exploitation represents a critical capability that enables firms to manage innovation and efficiency simultaneously. Although prior studies have examined ambidexterity in relation to innovation performance, its role in facilitating digital transformation remains underexplored.

Furthermore, the relationships among organizational capabilities, digital transformation, and green innovation are often examined in isolation, leading to a fragmented understanding of how these constructs interact. While some studies acknowledge the importance of digital transformation as a driver of innovation, few have conceptualized it as a mediating mechanism that translates strategic capabilities into sustainable innovation outcomes. This lack of integrative perspective limits our understanding of the processes through which firms achieve green innovation in the digital era.

In addition, the role of contextual factors in shaping these relationships has received insufficient attention. Corporate social responsibility (CSR), which reflects firms' commitment to sustainability and stakeholder engagement, has been shown to enhance innovation and organizational performance by strengthening legitimacy and resource access (Kujala et al., 2022). However, existing studies have largely focused on the direct effects of CSR, overlooking its potential role as a moderating factor that influences the effectiveness of digital transformation in driving green innovation.

To address these gaps, this study develops an integrative framework that links organizational ambidexterity, digital transformation, and green innovation while incorporating CSR as a contextual moderator. Specifically, this study proposes that organizational ambidexterity serves as a strategic antecedent that enables firms to undertake digital transformation, which in turn drives green innovation. Moreover, CSR is expected to

strengthen the relationship between digital transformation and green innovation by providing legitimacy, stakeholder support, and access to critical resources.

This study makes several contributions to the literature. First, it advances the digital transformation literature by shifting the focus from technology-driven explanations to capability-driven perspectives, highlighting the role of organizational ambidexterity as a key antecedent. Second, it develops a capability–transformation–innovation framework that conceptualizes digital transformation as a mediating mechanism linking strategic capabilities and green innovation. Third, it integrates multiple theoretical perspectives, including the dynamic capability view, resource-based view, and stakeholder theory, to provide a more comprehensive understanding of sustainable innovation. Finally, it introduces CSR as a moderating variable, offering new insights into how contextual factors influence the effectiveness of digital transformation in achieving sustainability outcomes. Based on these arguments, this study proposes a research model that examines the relationships among organizational ambidexterity, digital transformation, green innovation, and CSR, and formulates four hypotheses to be empirically tested.

H1: Organizational ambidexterity positively influences digital transformation.

H2: Digital transformation positively influences green innovation.

H3: Digital transformation mediates the relationship between organizational ambidexterity and green innovation.

H4: Corporate social responsibility (CSR) positively moderates the relationship between digital transformation and green innovation.

Research Model

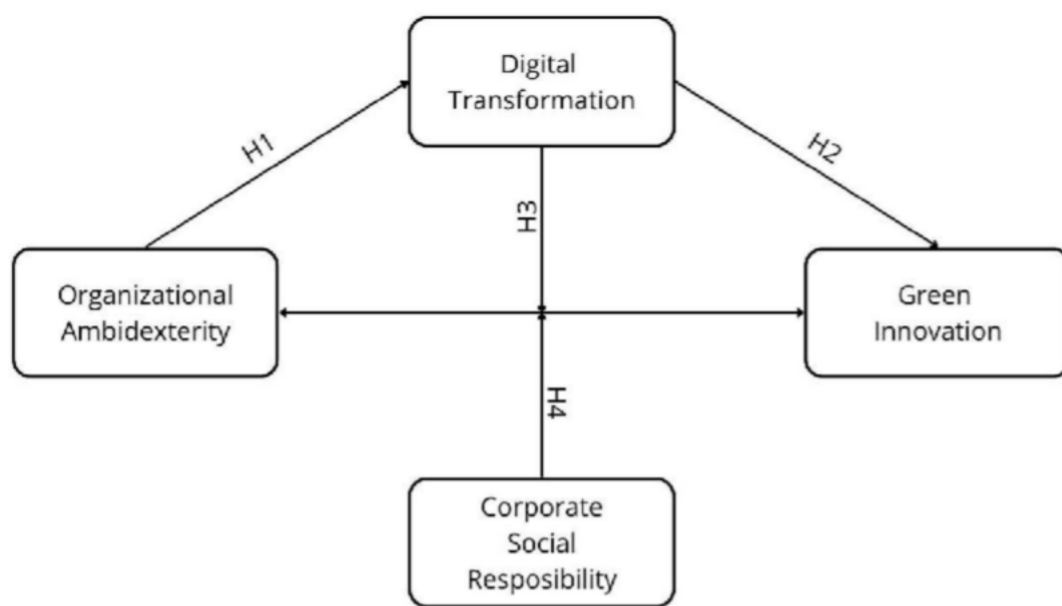


Figure 1. Conceptual model

METHOD

This study employed an explanatory quantitative research approach to examine the causal relationships among organizational ambidexterity, digital capability, corporate social responsibility (CSR), and green innovation in Small and Medium Enterprises (SMEs). Explanatory research is intended to test hypotheses and explain causal relationships objectively through numerical data and statistical analysis (Sugiyono, 2019). This research adopted a cross-

sectional design, in which data were collected at a single point in time from SMEs located in the Special Region of Yogyakarta, Indonesia.

Primary data were collected through a structured closed-ended questionnaire distributed online to SME owners and managers in Yogyakarta. Closed-ended questionnaires enable researchers to obtain focused, measurable, and easily processed data by minimizing variations in respondent interpretation (Asari et al., 2023). The questionnaire consisted of two sections. The first section captured respondents' demographic profiles, while the second section measured the research constructs, namely organizational ambidexterity, digital capability, corporate social responsibility (CSR), and green innovation. All constructs were measured reflectively using a five-point Likert scale ranging from 1 ("strongly disagree") to 5 ("strongly agree").

The collected data were analyzed using SmartPLS with the Partial Least Squares Structural Equation Modeling (PLS-SEM) approach. PLS-SEM was selected because of its capability to estimate complex relationships among latent variables, particularly when the sample size is relatively limited and data distribution assumptions are not strictly normal (Hair et al., 2021).

The analytical procedure was conducted in two stages. First, the measurement model (outer model) was evaluated to assess validity and reliability. Second, the structural model (inner model) was analyzed to examine causal relationships among constructs and test the proposed hypotheses. The measurement model evaluation focused on validity and reliability testing. Convergent validity was assessed using outer loading and Average Variance Extracted (AVE). Indicators were considered valid if the outer loading exceeded 0.70 and AVE values were greater than 0.50 (Hair et al., 2021). Discriminant validity was evaluated using the Fornell-Larcker criterion and cross-loading values. A construct demonstrates satisfactory discriminant validity when the square root of its AVE exceeds its correlations with other constructs (Fornell & Larcker, 1981). Construct reliability was measured using Composite Reliability (CR) and Cronbach's Alpha. A construct was considered reliable if both values exceeded 0.70, indicating adequate internal consistency (Nunnally & Bernstein, 1994). This analytical framework ensures that the measurement indicators accurately capture the intended latent constructs and provide a robust basis for hypothesis testing.

Population and sampling

The population of this study consisted of all SMEs operating in the Special Region of Yogyakarta (DIY). The sampling process was conducted using purposive sampling, where respondents were selected based on predetermined criteria relevant to the research objectives. Referring to recommendations for SEM analysis, a minimum sample size ranging from 100 to 200 respondents is considered adequate for structural equation modeling analysis (Hair et al., 2021). Accordingly, this study collected valid responses from 200 SMEs.

The demographic profile of respondents on Table 1, the majority of SMEs operate in the food and beverage sector, accounting for 22.5% of the total sample, followed by services (20%) and trade (19.5%). Most respondents employed fewer than 10 workers (65.5%), indicating the dominance of micro-scale enterprises. In terms of business age, SMEs operating for 1–5 years represented the largest proportion (33.5%), followed closely by businesses aged 6–10 years (33%). Regarding annual turnover, most SMEs generated less than IDR 500 million annually (45.5%). These findings indicate that the sample primarily consists of relatively young, small-scale enterprises with moderate operational capacity.

Table 1. Profile summary

Demographic information	Frequency	(%)
<i>Business Type</i>		

Accommodation	38	19.0%
Food & Beverage	45	22.5%
Services	40	20.0%
Manufacturing	38	19.0%
Trade	39	19.5%
Others	0	0%
Number of Employees		
<10 employees	131	65.5%
10–20 employees	49	24.5%
20–50 employees	19	9.5%
>50 employees	1	0.5%
Business Age		
<1 year	5	2.5%
1–5 years	67	33.5%
6–10 years	66	33.0%
Annual Revenue		
< IDR 500 million	91	45.5%
IDR 500 million–2.5 billion	49	24.5%
IDR 2.5–5 billion	41	20.5%
IDR 5–10 billion	16	8.0%
> IDR 10 billion	3	1.5%

Source: Primary Data Processed, 2026

RESULTS AND DISCUSSION

Measurement Model Testing (*Outer Model*)

In this study, measurements were conducted by testing the validity and reliability of each research variable, namely Organizational Ambidexterity, Digital Transformation, Green Innovation, and Corporate Social Responsibility (CSR). The validity and reliability testing process for all variables was processed using SmartPLS with the Partial Least Squares Structural Equation Modeling (PLS-SEM) approach with a total of 200 respondents. In data processing, the indicators used were spread across four research variables, consisting of 2 indicators for the Organizational Ambidexterity variable (X), 4 indicators for the Digital Transformation variable (M), 5 indicators for the Green Innovation variable (Y), and 4 indicators for the Corporate Social Responsibility variable (Z) as a moderating variable.

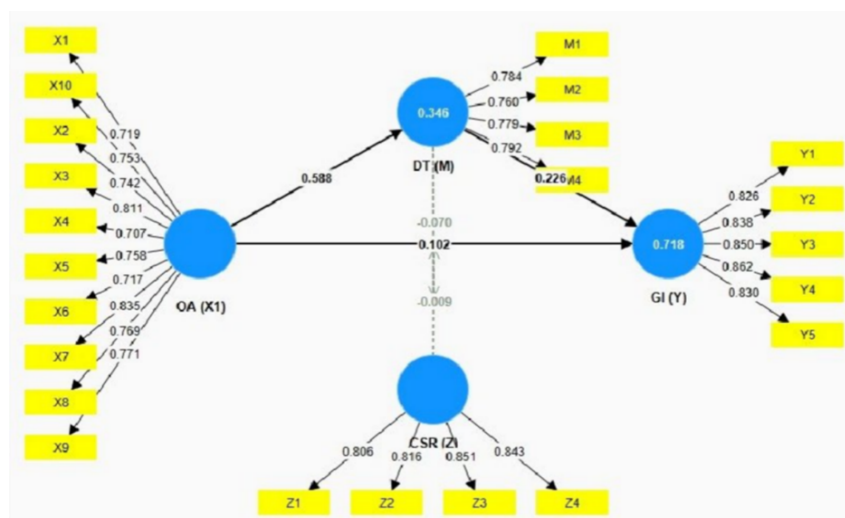


Figure 2. Hypothesized model

Based on Figure 2, the *Average Variance Extracted* (AVE) value for all variables has met the minimum criteria of >0.50 , so it can be stated that it meets convergent validity. It can be seen that the square root value of AVE for each construct (diagonal value) is greater than the correlation value between other constructs. These values are 0.759 for *Organizational Ambidexterity*, 0.641 for *Green Innovation*, 0.779 for *Digital Transformation* and 0.829 for *Corporate Social Responsibility*, respectively. All variables show *Cronbach's Alpha* values above 0.70, so it can be concluded that all constructs in this study have met the reliability criteria.

Table 2. Outer Model Test Results

Construct	Item	Outer Loading	AVE	Cronbach's Alpha	CR
Organizational Ambidexterity	X1	0.719	0.577	0.918	0.919
	X2	0.742			
	X3	0.811			
	X4	0.707			
	X5	0.758			
	X6	0.717			
	X7	0.835			
	X8	0.769			
	X9	0.771			
	X10	0.753			
Digital Transformation	M1	0.784	0.607	0.784	0.786
	M2	0.760			
	M3	0.779			
	M4	0.792			
Green Innovation	Y1	0.826	0.708	0.897	0.899
	Y2	0.838			
	Y3	0.850			
	Y4	0.862			
	Y5	0.830			
Corporate Social Responsibility	Z1	0.806	0.688	0.848	0.849
	Z2	0.816			
	Z3	0.851			
	Z4	0.843			

Structural Model Testing (Inner Model)

Collinearity Test

Collinearity test is one method for testing structural models that assess the relationship between latent variables in the context of PLS-SEM. Based on the results of the collinearity test on the structural model, all Inner VIF values are below the maximum limit of 5. This indicates that there are no multicollinearity problems between variables in the research model, so the model is suitable for further hypothesis testing.

Table 3. Outer Model Test Results

	<i>Organizational Ambidexterity</i>	<i>Green Innovation</i>	<i>Digital transformation</i>
<i>Organizational Ambidexterity</i>			1,000
<i>Digital transformation</i>		1,000	
<i>DT x CSR</i>		1,000	

Coefficient of Determination (*R-Square*) and (*Q-Square*)

Collinearity test is one method for testing structural models that assess the relationship between latent variables in the context of PLS-SEM. Based on Table 4, the Digital Transformation variable has an R-Square value of 0.346, indicating that 34.6% of the variation in Digital Transformation can be explained by Organizational Ambidexterity, while the remainder is explained by other factors outside the research model. The Q^2 value of 0.205 indicates that the model's predictive ability falls into the moderate category. Meanwhile, the Green Innovation variable has an R-Square value of 0.718, meaning that 71.8% of the variation in Green Innovation can be explained by the variables in the research model. A Q^2 value of 0.490 indicates strong predictive relevance. Thus, the research model has good explanatory and predictive power regarding the endogenous variables under study.

Table 4. R-Square and Q-Square Test Results

	<i>R-Square</i>	<i>R-Square Adjust</i>	<i>Q² predict</i>
<i>Digital transformation</i>	0.346	0.343	0.205
<i>Green Innovation</i>	0.718	0.708	0.409

Path Coefficient (Hypothesis Testing)

Based on table 5 above, it can be concluded that the results of the analysis of each hypothesis in this study are explained in depth as follows: The results of this study indicate that Organizational Ambidexterity has a positive and significant effect on Digital Transformation among SMEs in Yogyakarta, as reflected by a path coefficient of 0.588, a t-statistic of 7.184, and a p-value of 0.000 (<0.05), suggesting that SMEs with a stronger ability to balance exploratory and exploitative activities are more capable of adopting digital technologies to improve their operational processes

Table 5. Path Coefficient Test Results

	<i>Original Sample (O)</i>	<i>Sample Mean (M)</i>	<i>Standard Deviation (STDEV)</i>	<i>T Statistics (O/STDEV)</i>	<i>P Values</i>
OA (X1) -> DT (M)	0.588	0.595	0.082	7,184	0.000
DT (M) -> GI (Y)	0.226	0.220	0.062	3,635	0.000
OA (X1) -> DT (M) -> GI (Y)	0.133	0.131	0.042	3,180	0.001
DT (M) x CSR (Y) -> GI (Y)	-0.070	-0.072	0.090	0.784	0.433

Digital Transformation also shows a positive and significant effect on Green Innovation, with a coefficient of 0.226, a t-statistic of 3.635, and a p-value of 0.000 (<0.05), indicating that digitalization enables SMEs to improve process efficiency, optimize resource management, and support environmentally oriented innovations. This finding is consistent with the argument of Morteza Ghobakhloo (2020), who emphasized that digitalization supports sustainable business practices through increased efficiency, and aligns with the Natural Resource-Based View proposed by Stuart L. Hart (1995), which highlights the strategic role of technological capability in environmental performance.

Furthermore, the mediation analysis confirms that Digital Transformation significantly mediates the relationship between Organizational Ambidexterity and Green Innovation, as shown by an indirect effect coefficient of $\beta = 0.133$, a t-statistic of 3.180, and a p-value of 0.001 (<0.05), implying that ambidexterity contributes to green innovation primarily through its ability to facilitate digital transformation. This result supports the Dynamic Capability perspective of Mikalef et al. (2023), which argues that organizational capabilities must be translated into practical strategic actions to create competitive advantage. However, the moderation test reveals that Corporate Social Responsibility (CSR) does not significantly

moderate the relationship between Digital Transformation and Green Innovation, with an interaction coefficient of $\beta = -0.070$, a t-statistic of 0.784, and a p-value of 0.433 (>0.05), indicating that CSR practices among SMEs in Yogyakarta have not yet developed sufficiently to strengthen the impact of digital transformation on environmental innovation. This finding contrasts with the expectations of Stakeholder Theory proposed by Le et al. (2024), which suggests that socially responsible organizations are more likely to integrate sustainability into their strategic initiatives.

Discussion

The findings of this study provide a deeper understanding of how organizational ambidexterity, digital transformation, corporate social responsibility, and green innovation are interrelated in the context of SMEs in Yogyakarta. Specifically, the results show that organizational ambidexterity has a positive and significant effect on digital transformation, digital transformation positively affects green innovation, and digital transformation significantly mediates the relationship between organizational ambidexterity and green innovation. However, corporate social responsibility does not significantly moderate the relationship between digital transformation and green innovation. These findings offer both theoretical and practical insights into the mechanisms through which SMEs can transform organizational capabilities into sustainability-oriented innovation.

First, the finding that organizational ambidexterity positively influences digital transformation supports the argument that firms require the ability to balance exploration and exploitation in order to successfully adopt digital technologies. SMEs that possess ambidextrous capabilities are more capable of exploring new technological opportunities while simultaneously exploiting existing resources and business processes. This finding is consistent with the dynamic capability perspective, which emphasizes that firms must be able to sense opportunities, seize them, and reconfigure organizational resources in response to environmental change (Teece, 2007). In the context of this study, organizational ambidexterity enables SMEs to respond to digital disruption by combining flexibility, learning capability, and operational efficiency.

This result is also in line with previous studies suggesting that ambidexterity is closely related to digital transformation and innovation capability. (Kokubun, 2025), for instance, found that ambidextrous management allows SMEs to respond more effectively to environmental and technological challenges. Similarly, (Li et al. 2025) highlighted that strategic flexibility and digital platform capability are important in strengthening innovation ambidexterity. The present study extends these findings by showing that, in the context of SMEs in Yogyakarta, ambidexterity functions as an antecedent of digital transformation. This means that digital transformation is not merely determined by access to technology, but also by the organizational capability to manage competing demands between innovation and efficiency.

Second, the positive effect of digital transformation on green innovation confirms that digitalization plays an important role in promoting environmentally oriented innovation. The result indicates that SMEs that adopt digital technologies are more likely to develop green innovation through improved efficiency, better resource management, and more effective operational control. This finding supports (Vial 2019) view that digital transformation creates organizational changes by enabling new processes, structures, and value creation mechanisms. In the sustainability context, digital transformation can help firms reduce waste, improve energy efficiency, and enhance environmental decision-making.

This finding is consistent with (Ghobakhloo, 2020), who argued that digitalization and Industry 4.0 technologies provide opportunities for firms to improve sustainability performance through efficiency improvement and resource optimization. It also supports (Li et

al. 2024), who found that digital technology contributes to green innovation and carbon performance in manufacturing enterprises. Furthermore, (Fiorini et al. 2024) emphasized that green digital technologies can strengthen environmentally friendly firm performance, particularly when supported by appropriate organizational resources. Therefore, the present study reinforces previous empirical evidence that digital transformation is not only a tool for business modernization, but also an important driver of green innovation.

Third, the finding that digital transformation mediates the relationship between organizational ambidexterity and green innovation provides an important theoretical contribution. This result indicates that organizational ambidexterity does not automatically generate green innovation unless it is translated into digital transformation. In other words, ambidexterity provides the strategic capability for SMEs to explore and exploit opportunities, while digital transformation serves as the mechanism that converts this capability into green innovation outcomes.

This finding is aligned with the dynamic capability view, which argues that organizational capabilities need to be transformed into concrete strategic actions in order to create performance outcomes (Teece, 2007). It also supports (Mikalef et al. 2023), who emphasized that organizational competencies must be operationalized through technological and strategic capabilities to improve organizational performance. In this study, digital transformation acts as a bridge between internal organizational capability and sustainability-oriented innovation. SMEs with strong ambidextrous capability are better able to identify digital opportunities, adopt relevant technologies, and reconfigure their processes toward environmentally friendly practices.

The mediation result also contributes to the literature by clarifying the mechanism through which ambidexterity supports green innovation. Previous studies have often examined the direct effects of digital transformation on innovation or sustainability outcomes (Ghobakhloo, 2020) (Li et al., 2024) (Vial, 2019). However, fewer studies have explained how organizational capabilities are converted into green innovation through digital transformation. Therefore, this study advances the capability–transformation–innovation framework by demonstrating that digital transformation is a key explanatory mechanism linking organizational ambidexterity and green innovation.

Fourth, the insignificant moderating effect of corporate social responsibility on the relationship between digital transformation and green innovation presents an interesting finding. Contrary to the proposed hypothesis, CSR does not strengthen the influence of digital transformation on green innovation. This result suggests that CSR practices among SMEs in Yogyakarta may not yet be sufficiently integrated with digital transformation and environmental innovation strategies. Although SMEs may engage in CSR-related activities, these activities may still be informal, philanthropic, or community-oriented rather than strategically connected to green innovation.

This finding differs from previous studies that found a positive relationship between CSR and green innovation. For example, (Le 2022) argued that CSR and green innovation can support sustainable firm performance when integrated into corporate green strategy. Similarly, (Le et al. 2024) found that CSR can strengthen corporate sustainable development through environmental strategy and green innovation. (Hanaysha et al. 2025) also showed that CSR, technological capability, and green entrepreneurial orientation contribute to green innovation and sustainable performance. However, the insignificant result in this study indicates that the role of CSR may differ depending on firm size, resource availability, and the maturity of sustainability practices.

One possible explanation is that most respondents in this study are micro and small enterprises, with 65.5% employing fewer than 10 workers and 45.5% generating annual revenue below IDR 500 million. These characteristics indicate that many SMEs in the sample

may still have limited financial, technological, and managerial resources. As a result, CSR may not yet function as a strategic capability that strengthens the relationship between digital transformation and green innovation. Instead, CSR may be perceived as a social obligation or informal community activity rather than as an integrated sustainability strategy.

Another explanation is that CSR implementation in SMEs is often less formalized than in large corporations. Large firms usually have structured CSR programs, sustainability reporting, and formal environmental management systems. In contrast, SMEs often implement CSR in simpler forms, such as supporting local communities, maintaining good relationships with employees, or participating in social activities. While these practices are valuable, they may not directly enhance the effectiveness of digital transformation in producing green innovation. This finding is consistent with the argument that CSR must be strategically embedded in business processes to generate stronger sustainability outcomes (Bittencourt et al., 2024).

The insignificant moderating effect of CSR may also indicate that digital transformation can directly promote green innovation even without strong CSR support. In other words, SMEs may adopt digital technologies primarily for efficiency, cost reduction, customer reach, and operational improvement, and these digital benefits may indirectly support green innovation. However, without a strong CSR orientation, digital transformation may not necessarily be guided by broader social and environmental commitments. Therefore, the role of CSR in SMEs needs to be strengthened so that it can function not only as a social practice, but also as a strategic mechanism for sustainability-oriented innovation.

Moreover, SMEs need to integrate CSR more strategically with digital transformation and green innovation. CSR should not be limited to social assistance or community-based activities, but should be connected to environmental responsibility and sustainable business practices. Government agencies, business associations, and policymakers can support this process by providing digital training, sustainability education, green technology incentives, and CSR-based capacity-building programs for SMEs. Such support is important because many SMEs still face resource limitations that may prevent them from fully integrating digitalization, CSR, and green innovation.

CONCLUSION

This study examined the relationship between organizational ambidexterity, digital transformation, corporate social responsibility, and green innovation among SMEs in Yogyakarta. Based on the empirical results, organizational ambidexterity was found to have a positive effect on digital transformation, indicating that SMEs with the ability to balance exploration and exploitation are more capable of adopting and utilizing digital technologies. In addition, digital transformation was proven to positively influence green innovation, suggesting that the use of digital technologies can support environmentally oriented innovation in SMEs.

The study also confirms that digital transformation mediates the relationship between organizational ambidexterity and green innovation. This finding indicates that organizational ambidexterity contributes to green innovation through the implementation of digital transformation. Thus, digital transformation serves as an important mechanism that converts organizational capability into sustainability-oriented innovation outcomes. However, corporate social responsibility was not found to moderate the relationship between digital transformation and green innovation. This suggests that CSR practices among SMEs may not yet be sufficiently integrated with digital and environmental strategies.

Theoretically, this study contributes to the literature by highlighting the role of digital transformation as a mediating mechanism linking organizational ambidexterity and green innovation. It also provides evidence that the role of CSR as a contextual factor may differ in

SMEs, particularly when CSR practices are still informal or not strategically embedded. Practically, the findings suggest that SME owners and managers should strengthen their ambidextrous capabilities and direct digital transformation efforts toward sustainability-related objectives. Digital tools should not only be used to improve efficiency and market reach, but also to support waste reduction, resource efficiency, and environmentally friendly innovation.

For policymakers and business support institutions, the findings indicate the need to provide SMEs with capacity-building programs related to digital adoption and sustainability practices. Support in the form of digital training, green innovation assistance, CSR education, and access to environmentally friendly technologies may help SMEs integrate digital transformation with sustainable business development.

This study has several limitations. First, the research was conducted only among SMEs in Yogyakarta, which may limit the generalizability of the findings to other regions or business contexts. Second, this study used a cross-sectional design, so it cannot fully capture changes in digital transformation and green innovation over time. Third, the study focused on CSR as a moderating variable, while other contextual factors such as environmental regulation, green culture, leadership, or market pressure may also influence the relationship between digital transformation and green innovation.

Future research is encouraged to examine similar models in broader geographical areas and different industrial sectors. Longitudinal studies may also provide deeper insights into how digital transformation and green innovation evolve over time. In addition, future studies may consider other moderating or mediating variables, such as green organizational culture, environmental strategy, stakeholder pressure, or digital capability, to further explain the conditions under which digital transformation can more effectively promote green innovation.

REFERENCES

- Al-Mamary, Y. H., & Singh, H. P. (2025). Modeling sustainable entrepreneurship and green economic growth: The role of policy, digital innovation, resource efficiency, infrastructure, entrepreneurial intentions, and innovative capacity. *Next Research*, 2(4). <https://doi.org/10.1016/j.nexres.2025.100859>
- Asari, A., Nababan, D., Amané, A. P. O., Kusbandiyah, J., Lestari, N. C., Hertati, L., Maswar, M., Farlina, B. F., Pandowo, A., & Purba, M. L. (2023). *Dasar penelitian kuantitatif*. Lakeisha. <https://repository.um.ac.id/5454/>
- Bhat, B. A., Makkar, M. K., & Gupta, N. (2024). Effect of board structure on stakeholders' centric perspective of sustainable corporate world. *Journal of Global Responsibility*, 15(4), 388–408. <https://www.emerald.com/jgr/article/15/4/388/1220568>
- Bitencourt, C., Zanandrea, G., Froehlich, C., Agostini, M. R., & Haag, R. (2024). Rethinking the company's role: Creating shared value from corporate social innovation. *Corporate Social Responsibility and Environmental Management*, 31(4). <https://doi.org/10.1002/csr.2723>
- Chen, Y. S., Lai, S. B., & Wen, C. T. (2006). The influence of green innovation performance on corporate advantage in Taiwan. *Journal of Business Ethics*, 67(4). <https://doi.org/10.1007/s10551-006-9025-5>
- Fiorini, P. C., Jabbour, C. J. C., Latan, H., De Sousa Jabbour, A. B. L., & Mariano, E. B. (2024). Green Emerging Digital Technologies, Green Supply Chains, and the Performance of Environmentally Friendly Firms: The Underpinning Role of Human Resources. *IEEE Transactions on Engineering Management*, 71. <https://www.emerald.com/jgr/article/15/4/388/1220568>
- Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 18(1), 39–50. <https://journals.sagepub.com/doi/abs/10.1177/002224378101800104>

- Freeman, R. E. (1984). *Strategic Management: A Stakeholder Approach*. Pitman.
- Ghobakhloo, M. (2020). Industry 4.0, digitization, and opportunities for sustainability. In *Journal of Cleaner Production* (Vol. 252). <https://doi.org/10.1016/j.jclepro.2019.119869>
- Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2021). *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)* (3rd ed.). SAGE Publications. https://link.springer.com/content/pdf/10.1007/978-3-319-57413-4_15.pdf
- Hanaysha, J. R., Abusharbeh, M., Dwikat, S. Y., Shubita, M. F., Sharif, M. N., & Alshdaifat, S. M. (2025). Impact of corporate social responsibility, technological capability, and green entrepreneurial orientation on green innovation and sustainable performance. *World Development Sustainability*, 7, 100233. <https://doi.org/10.1016/j.wds.2025.100233>
- Hanaysha, J. R., & Alhyasat, K. M. K. (2025). Leveraging technological innovation, social media, and green marketing for corporate reputation: the mediating role of business sustainability. *Cogent Business and Management*, 12(1). <https://doi.org/10.1080/23311975.2025.2518249>
- Hart, O. (1995). *Firms, contracts, and financial structure*. Clarendon press. [https://books.google.com/books?hl=id&lr=&id=t417I3nRmuMC&oi=fnd&pg=PA1&dq=Hart,+O.+\(1995\).+Firms,+contracts,+and+financial+structure.+Clarendon+press.&ots=6811uQrIni&sig=G8EMOp7apdq3mbRWsgrft6QrcpI](https://books.google.com/books?hl=id&lr=&id=t417I3nRmuMC&oi=fnd&pg=PA1&dq=Hart,+O.+(1995).+Firms,+contracts,+and+financial+structure.+Clarendon+press.&ots=6811uQrIni&sig=G8EMOp7apdq3mbRWsgrft6QrcpI)
- Huang, C. H., & Huang, Y. C. (2024). Exploring the linkages among green digital transformation capability, ambidextrous green learning and sustainability performance: a case study of manufacturing firms in Taiwan. *Journal of Manufacturing Technology Management*, 35(5). <https://doi.org/10.1108/JMTM-10-2023-0452>
- Bhuiyan, M. R. I., Faraji, M. R., Rashid, M., Bhuyan, M. K., Hossain, R., & Ghose, P. (2024). Digital Transformation in SMEs Emerging Technological Tools and Technologies for Enhancing the SME's Strategies and Outcomes. *Journal of Ecohumanism*, 3(4). <https://doi.org/10.62754/joe.v3i4.3594>
- Jaafar, M., Khan, K. N., & Salman, A. (2025). A systematic review and framework for organizational agility antecedents towards industry 4.0. *Management Review Quarterly*. <https://doi.org/10.1007/s11301-025-00489-6>
- KemenKopUKM. (2024). *Mendorong Pertumbuhan Ekonomi lewat KUR dan Insentif UMKM*. KemenKopUKM. <https://djpb.kemenkeu.go.id/kppn/watampone/id/profil/309-artikel/3796-mendorong-pertumbuhan-ekonomi-lewat-kur-dan-insentif-umkm.html>
- Kokubun, K. (2025). Ambidextrous Management and Eco-Innovation Strategies in Small- and Medium-Sized Manufacturing Enterprises: Responses to Decarbonization and the Renewable Energy Market—A Multi-Round Qualitative Examination. *World*, 6(4). <https://doi.org/10.3390/world6040160>
- Le, T. T. (2022). How do corporate social responsibility and green innovation transform corporate green strategy into sustainable firm performance? *Journal of Cleaner Production*, 362. <https://doi.org/10.1016/j.jclepro.2022.132228>
- Le, T. T., Tran, P. Q., Lam, N. P., Tra, M. N. Le, & Uyen, P. H. P. (2024). Corporate social responsibility, green innovation, environment strategy and corporate sustainable development. *Operations Management Research*, 17(1). <https://doi.org/10.1007/s12063-023-00411-x>
- Li, J., Ji, L., Zhang, S., & Zhu, Y. (2024). Digital technology, green innovation, and the carbon performance of manufacturing enterprises. *Frontiers in Environmental Science*, 12. <https://doi.org/10.3389/fenvs.2024.1384332>

- Li, Y., Chen, Y., Wang, J., Zhou, Y., & Wang, C. (2025). Digital platform capability and innovation ambidexterity: The mediating role of strategic flexibility. *Journal of Business Research*, 186. <https://doi.org/10.1016/j.jbusres.2024.114971>
- Mikalef, P., Islam, N., Parida, V., Singh, H., & Altwaijry, N. (2023). Artificial intelligence (AI) competencies for organizational performance: A B2B marketing capabilities perspective. *Journal of Business Research*, 164. <https://doi.org/10.1016/j.jbusres.2023.113998>
- Mosavi, H., & Triansyah, F. A. (2023). Digitalization impacts on small businesses: A systematic review. *Jurnal Penelitian Ekonomi Manajemen Dan Bisnis*, 2(2), 194–205. <https://doi.org/10.55606/jekombis.v2i2.1556>
- Nambisan, S., Lyytinen, K., Majchrzak, A., & Song, M. (2017). Digital innovation management: Reinventing innovation management research in a digital world. *MIS Quarterly: Management Information Systems*, 41(1). <https://doi.org/10.25300/MISQ/2017/41:1.03>
- Sijabat, S., & Alfian, E. (2024). The Role of Digital Transformation in Moderating The Influence of Green Innovation Capability on Supply Chain Resilience and Competitive Advantage. *Journal of Management & Agribusiness/Jurnal Manajemen & Agribisnis*, 21(1). <https://search.ebscohost.com/login.aspx?direct=true&profile=ehost&scope=site&authType=crawler&jrnl=16935853&AN=178904241&h=tDANMOIHrIN0Pi%2Bjd9n9FP4fMsQJqhc4tfv2amQM7FzG9OoVCT35fSAagLZSF3x2YwS%2BDXloqVIHhUm%2BFJ2nBA%3D%3D&crl=c>
- Teece, D. J. (2007). Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal*, 28(13), 1319–1350. <https://doi.org/10.1002/smj.640>
- Tushman, M. L., & O'Reilly III, C. A. (1996). Ambidextrous organizations: Managing evolutionary and revolutionary change. *California Management Review*, 38(4), 8–29. <https://doi.org/10.2307/41165852>
- Verhoef, P. C., Broekhuizen, T., Bart, Y., Bhattacharya, A., Qi Dong, J., Fabian, N., & Haenlein, M. (2021). Digital transformation: A multidisciplinary reflection and research agenda. *Journal of Business Research*, 122. <https://doi.org/10.1016/j.jbusres.2019.09.022>
- Vial, G. (2019). Understanding digital transformation: A review and a research agenda. In *Journal of Strategic Information Systems* (Vol. 28, Number 2). <https://doi.org/10.1016/j.jsis.2019.01.003>