

The Determinants of Financial Performance and Implications for Sustainable Development

Royhisar Martahan Simanungkalit¹, Sapto Jumono²,
MF Arrozi³, Agus Munandar⁴

^{1,2,3,4}Faculty of Economics and Business, Universitas Esa Unggul, Indonesia

ABSTRACT: *This study aims to analyze the determinants of financial performance and their implications for sustainability development in Indonesia's manufacturing sector, integrating the roles of green technology, digital transformation, and green finance. Employing a quantitative approach with Structural Equation Modeling (SEM) and dynamic panel data (System-GMM), this research examines the simultaneous relationships among variables and the dual mediating roles of green innovation and financial performance. The findings reveal that green technology, digital transformation, and green finance have a significant positive effect on sustainability development, both directly and indirectly through green innovation and financial performance. Green innovation is proven to be a key mediator that strengthens the impact of green and digital strategies on sustainability, while financial performance serves as a bridge connecting sustainable investments to long-term goal achievement. These results provide theoretical contributions through the development of an integrative empirical model based on institutional theory, resource-based view, and stakeholder theory, while offering practical implications for manufacturing companies and policymakers in designing transition strategies toward an inclusive and resilient green economy.*

KEYWORDS- *Financial Performance, Sustainability Development, Green Technology, Digital Transformation, Green Finance, Green Innovation, Indonesian Manufacturing Sector, Structural Equation Modeling (SEM).*

I. INTRODUCTION

Sustainable development is a key paradigm that emphasises meeting the needs of the present generation without compromising the ability of future generations to meet their own needs. This paradigm integrates three main pillars economic, environmental and social to foster inclusive growth, environmental conservation and social justice (UNDP et al., 2024; Seyedsayamdost, 2020). In the era of globalisation, the demand for sustainable development has grown increasingly strong through various international and national agendas and regulations. The Sustainable Development Goals (SDGs) established by the United Nations, as well as Indonesia's national policies on sustainable finance, demonstrate that the principle of sustainability has become an integral part of development strategies and business activities. This situation is driving companies to no longer focus solely on achieving economic profits, but also to consider the social and environmental impacts of their operational activities. In this context, digital transformation, green technology, green finance and green innovation are becoming increasingly important as they can help companies improve efficiency, foster innovation, strengthen financial performance, whilst also supporting the achievement of sustainable development goals (Shayan et al., 2022; Swaty, 2023).

The urgency of applying these sustainability principles is becoming increasingly apparent in the manufacturing sector. As one of the sectors making a significant contribution to the Indonesian economy, the manufacturing sector also faces considerable environmental consequences, including high energy consumption, carbon emissions and industrial waste. Consequently, the application of Environmental, Social and Governance (ESG) principles supported by green technology, digital transformation and green finance is increasingly viewed as a strategic approach to enhancing corporate competitiveness whilst supporting sustainable development. Green technology enables companies to develop more efficient and environmentally friendly production processes; digital transformation can improve operational efficiency, transparency and data management capabilities; whilst green finance provides financial support for environmentally oriented activities and investments (Gurumurthy et al., 2020; Hossain et al., 2024).

Nevertheless, the implementation of sustainable development in Indonesia's manufacturing sector still faces various challenges. These challenges include overlapping regulations, weak enforcement of environmental laws, infrastructure constraints, limited fiscal incentives, low digital literacy, and restricted access to green finance (Nițescu et al., 2023). These conditions highlight a gap between the sustainability

policies designed by the government and their implementation at the corporate level. Indonesia's manufacturing sector does indeed play a major economic role, but at the same time it is one of the sectors facing significant environmental pressures. Limited adoption of digital technology and the still-low proportion of green financing indicate that the transition towards a more sustainable industry has not yet taken place evenly. Green technology also continues to face obstacles in the form of high initial investment costs and limited incentives, meaning that companies must strike a balance between long-term investment needs and short-term financial performance (Al-Saedi & Syakir, 2023; Otoritas Jasa Keuangan, 2016).

This trend towards sustainability is not confined to the manufacturing sector alone, but has evolved into a cross-sectoral phenomenon. The services sector is beginning to integrate energy efficiency, waste reduction and the use of more environmentally friendly materials into its operational activities (Mehmood et al., 2023). In the technology sector, the use of artificial intelligence (AI), the Internet of Things (IoT), big data and other digital technologies is driving operational efficiency and enhancing the transparency of sustainability reporting (Zhu et al., 2024). Meanwhile, infrastructure sectors such as transport and construction are beginning to develop business models focused on energy efficiency, emissions reduction and the use of more environmentally friendly materials (Zhou et al., 2022). In the financial sector, the development of green finance through instruments such as green bonds, green loans and ESG-based financing provides support for the funding of various environmentally-oriented projects. These developments demonstrate that sustainable development has become a universal principle requiring the involvement of various sectors and stakeholders (Shahzad et al., 2022; (Chen et al., 2024)).

However, the success of sustainable development cannot rely solely on the capabilities of individual sectors (Bataineh et al., 2023). Synergy is required between businesses, the government, civil society organisations, financial institutions and academia to accelerate the development and implementation of sustainable solutions. Such collaboration can be achieved through the development of renewable energy, the circular economy, environmentally friendly product innovation, improved resource efficiency and the strengthening of green finance (Masfiatun et al., 2023). Thus, sustainable development is a multidimensional process that requires the integration of digital technology, green finance, innovation, multi-stakeholder collaboration, and public policies that support the transition to a green economy. However, various obstacles such as limited financing, low digital capabilities, and sub-optimal regulatory alignment mean that the implementation of sustainable practices remains slow and uneven.

In the Indonesian context, the urgency of research into sustainable development is growing ever stronger, as the manufacturing sector has a significant environmental footprint. Several large companies have demonstrated that sustainability principles can be integrated through the implementation of energy efficiency measures, waste management, the use of alternative energy sources, and the development of more environmentally friendly production processes (Demir et al., 2023). These practices demonstrate that sustainability need not always be viewed as a cost burden, but can also serve as a strategy to enhance efficiency, reputation, competitiveness and corporate value. Nevertheless, the gap between companies' readiness and the demands of sustainability remains a significant issue (Lu & Xia, 2024). The government has developed various policies and regulations to support sustainable development and green finance, but their implementation still faces obstacles in the form of regulatory overlaps, weaknesses in digital infrastructure, limited fiscal incentives, and institutional unpreparedness (Cai & Hong, 2024). Therefore, a study is required to identify the factors that drive or hinder the successful adoption of green technology, digital transformation and green finance in supporting sustainable development within Indonesia's manufacturing sector (Al-Saedi & Syakir, 2023; Judijanto et al., 2023).

In light of these circumstances, green finance, digital transformation and green technology can be regarded as three key pillars in supporting the achievement of sustainable development (Hasanah & Hariyono, 2022). Green finance plays a role in providing sources of funding for environmentally-oriented activities and has the potential to reduce risks and operational costs (Tan et al., 2024). Digital transformation enables companies to improve efficiency, innovation, transparency and their ability to adapt to changes in the business environment (Holden et al., 2014). Meanwhile, green technology drives the development of products, processes and business models capable of reducing environmental impact whilst creating economic value (Yurdakul & Kazan, 2020). These three factors not only have the potential to influence sustainable development directly, but can also influence a company's internal mechanisms through green innovation and financial performance (Shayan et al., 2022).

In this study, green innovation is viewed as a mechanism that can bridge the implementation of green

technology, digital transformation and green finance with the achievement of sustainable development. Through innovations in products, production processes and business models that are more environmentally friendly, companies can transform green resources and investments into a competitive advantage that delivers both economic and environmental benefits. On the other hand, financial performance is a crucial aspect, as a company's sustainability is ultimately also influenced by its ability to maintain financial performance. Thus, green innovation and financial performance are not merely positioned as the outcomes of implementing green and digital strategies, but also as mediating mechanisms that can explain how these strategies are translated into the achievement of sustainable development. Testing these two mediating variables simultaneously is expected to provide a more comprehensive understanding of the internal mechanisms within a company for achieving sustainability (Khan et al., 2022; Escobar et al., 2023).

Although research on green technology, digital transformation, green finance, green innovation, financial performance and sustainable development has expanded both internationally and regionally, there remains a research gap within the context of Indonesia's manufacturing sector (Serdarušić et al., 2024; Zhuo et al., 2024). Previous research has tended to examine the relationships between variables in isolation; consequently, there has been little research developing an integrative empirical model that simultaneously tests the effects of green technology, digital transformation and green finance on sustainable development, whilst considering green innovation and financial performance as mediating variables. Furthermore, the simultaneous mediating role of these two variables remains relatively under-explored (Hisar & Suharna, 2020). This gap is all the more relevant given that the characteristics of Indonesia's manufacturing sector differ from those of developed countries, particularly in terms of infrastructure readiness, institutional capacity, access to green finance, and technological adoption capabilities (Hanna, 2024).

This gap also highlights the importance of employing research approaches capable of capturing the complex relationships between variables (Handayani & Rokhim, 2023). The existing literature still requires the development of models that consider not only direct effects but also indirect pathways via mediating mechanisms (Bahri & Zamzam, 2015). Therefore, this study proposes an integrative empirical model that combines institutional theory, the resource-based view, stakeholder theory and dynamic capabilities to explain the relationship between technology, financing, innovation, financial performance and sustainability (CSIS, 2022). The use of the Structural Equation Modelling (SEM) approach Edeh et al. (2023), together with the System-GMM approach for longitudinal panel data as designed in this study, is expected to provide a more comprehensive understanding of the dynamics of the relationships between variables and to address methodological issues such as endogeneity and the dynamics of both short-term and long-term relationships (Foltynowicz et al., 2024; Mo et al., 2024).

Based on these empirical findings and research gaps, the main research question of this study centres on the lack of clarity regarding the mechanisms by which green technology, digital transformation and green finance can drive sustainable development, either directly or through green innovation and financial performance (Mo et al., 2024). Specifically, it is necessary to determine whether green technology is capable of enhancing sustainable development through green innovation and financial performance; whether digital transformation can contribute to sustainability by improving innovation and corporate performance; and whether green finance is capable of contributing to sustainable development through the same mechanisms. Furthermore, it is also important to understand the relationship between green innovation and financial performance, and how these two variables jointly form a mediating pathway towards sustainable development (Handayani & Rokhim, 2023).

In light of these issues, this study aims to analyse the direct and indirect effects of green technology, digital transformation and green finance on sustainable development. The study also aims to examine the role of green innovation and financial performance as mediating variables, both individually and jointly, and to identify differences in the strength of the influence of each independent variable through different mediation pathways (UNDP et al., 2024). Thus, this study not only seeks to explain whether technology, digitalisation and green finance influence sustainability, but also to elucidate the mechanisms through which these influences are mediated by green innovation and financial performance (Fathihani, 2023). Conceptually, this study is expected to produce a model that explains the dynamics of green and digital transformation in simultaneously enhancing both financial performance and corporate sustainability (Westerman et al., 2014).

This research is expected to provide practical insights for companies, particularly in the manufacturing sector, in designing more integrated sustainability strategies. The research findings can serve

as a basis for companies to develop investments in green technology, accelerate digital transformation, utilise green finance schemes, and enhance their capacity for green innovation as part of their core business strategy (Brundtland, 2017). Such integration is expected not only to support the achievement of environmental and social objectives, but also to help companies create efficiencies, enhance competitiveness, strengthen business resilience, and generate long-term economic value (Johri et al., 2024). Companies can also develop sustainability measurement systems that link ESG aspects, green innovation, and financial performance, thereby enabling sustainability strategies to be measured and directed more effectively (Vincent & Brandellero, 2023).

In addition to its practical contributions, this study is expected to make a theoretical contribution through the development of an empirical model that integrates green finance, digital transformation, green technology, green innovation, financial performance and sustainable development within a single research framework. The novelty of this study lies in the simultaneous testing of causal and mediating relationships by combining several theoretical perspectives and incorporating green innovation and financial performance as mediators within a single model. The focus on Indonesia's manufacturing sector also provides contextual value, as this sector plays a strategic role in the national economy whilst facing specific challenges in the transition towards a green economy. Consequently, this study is expected to provide an empirical foundation for the development of corporate strategies and public policies that are more adaptive, innovative and practical in supporting the achievement of sustainable development, the SDGs and the transition agenda towards a green economy in Indonesia (Luo et al., 2023).

Research hypothesis

- H1. Green technology has a positive and significant impact on financial performance.**
- H2. Green technology has a positive and significant impact on green innovation.**
- H3. Green technology has a positive and significant impact on sustainable development.**
- H4. Digital transformation has a positive and significant impact on financial performance.**
- H5. Digital transformation has a positive and significant impact on green innovation.**
- H6. Digital transformation has a positive and significant impact on sustainable development.**
- H7. Green finance has a positive and significant impact on financial performance.**
- H8. Green finance has a positive and significant impact on green innovation.**
- H9. Green finance has a positive and significant impact on sustainable development.**
- H10. Financial performance has a positive and significant impact on sustainable development.**
- H11. Green innovation has a positive and significant impact on sustainable development.**
- H12. Green innovation has a positive and significant impact on financial performance.**
- H13. Financial performance mediates the relationship between green technology and sustainable development.**
- H14. Financial performance mediates the relationship between digital transformation and sustainable development.**
- H15. Financial performance mediates the relationship between green finance and sustainable development.**
- H16. Financial performance mediates the relationship between green innovation and sustainable development.**
- H17. Green innovation mediates the relationship between green technology and sustainable development.**
- H18. Green innovation mediates the relationship between digital transformation and sustainable development.**
- H19. Green innovation mediates the relationship between green finance and sustainable development.**

II. RESEARCH METHODS

This study employs an explanatory quantitative approach using a survey method supported by qualitative data. This approach is used to explain and test the causal relationships and mediating effects between green technology, digital transformation, green finance, green innovation, financial performance, and sustainable development in manufacturing companies in Indonesia. The units of analysis in this study are manufacturing companies in Indonesia that implement or are involved in sustainability practices through the use of green technology, digital transformation and green finance. Meanwhile, the units of observation are managers and directors who are considered to play a strategic role in decision-making and the implementation of sustainability practices within the companies.

Primary data collection was carried out using a structured questionnaire administered to

respondents who met the study criteria. The research instrument employed an ordinal scale of 1–4, namely 1 = do not understand at all, 2 = do not understand, 3 = understand, and 4 = understand very well, without providing a neutral option so that respondents would give clearer answers (Koo & Yang, 2025). In addition to primary data, the study also utilised secondary data relating to the implementation of digital transformation, green innovation, and corporate sustainability practices (Sisriany & Fatimah, 2017). This secondary data was then used to support the findings and was confirmed through respondents' answers. To strengthen the understanding of the implementation of sustainable development, the study also utilised in-depth interviews as supporting data.

Prior to being used in the main data collection, the research instrument underwent pre-testing and pilot testing to ensure that each indicator was capable of measuring the construct under investigation accurately and consistently. The instrument testing included validity and reliability tests, as well as Confirmatory Factor Analysis (CFA) using AMOS software (Bahri & Zamzam, 2015). The suitability of the measurement model was assessed using factor loadings, construct reliability, average variance extracted (AVE), and several goodness-of-fit indices such as RMSEA, GFI, AGFI, CFI and TLI. Once the instrument was deemed to meet the criteria for validity and reliability, the questionnaire was used for the main research data collection.

Subsequently, the data obtained were analysed using Structural Equation Modelling (SEM) with the aid of AMOS. SEM analysis was used to test the direct and indirect effects between variables and to determine the role of green innovation and financial performance as mediating variables in the relationship between green technology, digital transformation, green finance, and sustainable development. As the data obtained from the questionnaire was ordinal, data transformation was carried out using the Method of Successive Intervals (MSI) to convert the ordinal data into interval data so that it could be used in parametric analysis and SEM testing.

III. RESULTS AND DISCUSSION.

This study involved 202 respondents selected through purposive sampling based on the research criteria. The respondents were managers and directors of manufacturing companies in Indonesia, selected because they play a strategic role in decision-making, resource management and the implementation of corporate strategy. Consequently, the information provided is considered representative of the organisation's practices and policies.

Table 1 Respondent Profile

Characteristics	Category	Number	Percentage
Position	Manager	182	90,1%
	Directors	20	9,9%
Length of Service	< 5 year	60	29,7%
	5–10 year	90	44,6%
	> 10 year	52	25,7%
Education	Bachelor's degree	120	59,4%
	Master's/PhD	82	40,6%

Source: processed data (2026)

The unit of analysis for the study was manufacturing companies in Indonesia, whilst the unit of observation comprised the companies' managers and directors. Based on the respondents' characteristics, the majority were managers (90.1%), whilst directors accounted for 9.9%. In terms of length of service, the largest group had 5–10 years' experience (44.6%), followed by those with less than 5 years' service (29.7%) and more than 10 years' service (25.7%). In terms of educational attainment, the majority of respondents held a D3/S1 qualification (59.4%), whilst 40.6% held an S2/S3 qualification. This composition indicates that the respondents hold strategic positions, possess diverse work experience, and have a relatively adequate level of education to provide information regarding the conditions and practices of manufacturing companies.

Validity Test

Validity testing is carried out to ensure that the research instrument actually measures what it is intended to measure. Validity testing aims to assess the degree of precision and accuracy with which a measurement tool represents the concept or variable under investigation. A valid instrument will produce data that corresponds to reality, ensuring that the research findings are reliable and relevant to the research objectives. Without validity testing, there is a risk that the data collected will not reflect the actual phenomenon, meaning that the research conclusions may be biased or erroneous.

Tabel 2 Green Technology (X1)

Variable	Indicator	Standardised Factor Loading
X1	X1_4	0.566
X1	X1_5	0.635
X1	X1_6	0.772
X1	X1_7	0.707
X1	X1_9	0.750

Tabel 3 Digital Transformation (X2)

Variable	Indicator	Standardised Factor Loading
X2	X2_2	0.729
X2	X2_3	0.712
X2	X2_4	0.637
X2	X2_6	0.688
X2	X2_8	0.725
X2	X2_9	0.738

Tabel 4 Green Finance (X3)

Variable	Indicator	Standardised Factor Loading
X3	X3_2	0.732
X3	X3_3	0.749
X3	X3_4	0.716
X3	X3_6	0.759
X3	X3_7	0.765
X3	X3_8	0.744
X3	X3_10	0.703

Tabel 5 Financial Performance (X4)

Variable	Indicator	Standardised Factor Loading
X4	X4_1	0.582
X4	X4_3	0.695
X4	X4_5	0.761
X4	X4_6	0.698
X4	X4_8	0.666
X4	X4_10	0.587

Tabel 6 Green Innovation (X5)

Variable	Indicator	Standardised Factor Loading
X5	X5_2	0.555
X5	X5_3	0.549
X5	X5_5	0.539
X5	X5_6	0.631
X5	X5_8	0.508
X5	X5_9	0.587

Tabel 7 Sustainability Development (Y)

Variable	Indicator	Standardised Factor Loading
Y	y_1	0.586
Y	y_2	0.634
Y	y_3	0.707
Y	y_4	0.617
Y	y_5	0.592
Y	y_6	0.618
Y	y_7	0.559
Y	y_9	0.589
Y	y_10	0.587

Source: processed data (2026)

The results of the analysis show that all research variables Green Technology (X1), Digital Transformation (X2), Green Finance (X3), Financial Performance (X4), Green Innovation (X5), and Sustainable Development (Y) have indicators with Standard Loading Factor (SLF) values above the minimum acceptance threshold (≥ 0.50). This indicates that each construct can be deemed valid, although there are variations in strength amongst the indicators. The Green Finance and Digital Transformation variables demonstrate stronger consistency with relatively high SLF values, and can therefore be considered the most representative constructs. Conversely, the Green Innovation and Sustainable Development variables show more moderate SLF values; consequently, the interpretation of the research results must take into account the relatively low contribution of these indicators. Overall, this research instrument is suitable for further analysis as it is capable of representing the defined constructs; however, researchers are advised to pay attention to indicators with SLF values approaching the lower limit to avoid compromising the quality of the research findings.

Reliability Test

The Construct Reliability (CR) test aims to assess the internal consistency of indicators in measuring a latent construct. CR indicates the extent to which the indicators used actually produce stable and consistent results when measuring the same construct. If the CR value is ≥ 0.7 , the construct is considered reliable, meaning that the indicators are capable of consistently representing the latent variable. Thus, the CR test ensures that the research instrument is not only valid but also possesses a high level of reliability, so that the results of the SEM analysis can be trusted.

Table 8 Construct Validity Test

Variable	SLF	SLF2	Std Error	CR	Notes
X1	3.43	2.381914	1.329	0.898502	Reliable
X2	3.593	2.592999	1.322	0.907108	Reliable
X3	3.67	2.696718	1.118	0.923356	Reliable
X4	3.535	2.506503	1.136	0.916668	Reliable
X5	3.516	2.479998	1.122	0.916792	Reliable
Y	3.491	2.443123	1.094	0.917627	Reliable

Source: processed data (2026)

The results of the reliability analysis showed that all research variables (X1 to X5 and Y) had a Composite Reliability (CR) value above 0.90 with a relatively low standard error; it can therefore be concluded that the instrument used possesses good internal consistency. The high Standardised Loading Factor (SLF) values for each indicator strengthen the evidence that these variables are capable of validly representing the constructs being measured. Consequently, all indicators in this study can be categorised as reliable and suitable for use in the subsequent stages of analysis.

Normality Test

A normality test is carried out to determine whether the research data are normally distributed, as this is one of the assumptions underlying parametric statistical analysis. The test can be performed using the Kolmogorov–Smirnov or Shapiro–Wilk tests. The decision criterion is that the data are normally distributed if the significance level (p-value) is greater than 0.05, whilst a p-value less than 0.05 indicates that the data are not normally distributed.

Table 9 Normality Test Results

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Green Technology	.122	202	.000	.933	202	.000
Digital ransformaion	.210	202	.000	.890	202	.000
Green Finance	.138	202	.000	.953	202	.000
Financial Performance	.215	202	.000	.890	202	.000
Green Innovation	.187	202	.000	.902	202	.000
Sustainability Development	.193	202	.000	.891	202	.000

Source: processed data (2026)

Based on the results of the normality tests conducted on 202 respondents, all variables had a significance value of 0.000 (< 0.05) in both the Kolmogorov–Smirnov and Shapiro–Wilk tests. Consequently, Green Technology, Digital Transformation, Green Finance, Financial Performance, Green

Innovation and Sustainable Development do not follow a normal distribution. These results indicate that the assumption of normality has not been met for all research variables.

Multicollinearity Test

The multicollinearity test showed that none of the independent variables exhibited high correlation with one another, as indicated by Variance Inflation Factor (VIF) values below the threshold of 10 and tolerance values above 0.10. This indicates that each independent variable makes a unique contribution to explaining the dependent variable without any overlap in information between the variables. Consequently, the regression model used can be considered free from multicollinearity, meaning that the results of the analysis are more accurate, stable and can be validly interpreted within the context of the research.

Table 10 Results of the Multicollinearity Test

	Tolerance	VIF
Green Technology	.378	2.648
Digital ransformaion	.200	5.011
Green Finance	.981	1.019
Financial Performance	.186	5.386
Green Innovation	.846	1.182

Source: processed data (2026)

Based on the results of the multicollinearity test, all variables had a Tolerance value > 0.10 and a VIF < 10 . It can therefore be concluded that there is no evidence of multicollinearity in the research model, and so all variables are suitable for use in the regression analysis.

Goodness-of-Fit Test

In SEM analysis using AMOS, the Model Goodness-of-Fit test is used to assess whether the theoretical model constructed fits the empirical data. This assessment is carried out by examining various model fit indices. Each index provides a different perspective on the quality of the model, so the interpretation is carried out comprehensively.

Table 11 Results of the Goodness-of-Fit Test

Goodness-of-Fit Index	Simulation Values	Cut-off Criteria	Interpretation
Chi-square (χ^2)	112,465 (p = 0,055)	Low	Not significant; the model fits the empirical data.
P	0,055	> 0.05	
RMSEA	0,035	$\leq 0,08$ (good), $\leq 0,05$ (very good)	Very good; indicates that the difference between the model and the data is very small.
TLI	0,968	$\geq 0,90$	Very good; the model is efficient and fits the data well.
NFI	0,893	$\geq 0,90$	Slightly below the threshold, indicating a reasonably good fit but not yet optimal.
IFI	0,977	$\geq 0,90$	Very good; the model has a high degree of fit.
PCFI	0,732	$\geq 0,50$	Meets the criteria, indicating a good fit for the model whilst taking complexity into account.
PNFI	0,670	$\geq 0,50$	Meets the criteria, indicating that the model is reasonably efficient.

Source: processed data (2026)

The goodness-of-fit results indicate that the research model generally fits the empirical data well. The RMSEA value of 0.035, the TLI of 0.968 and the IFI of 0.977 indicate an excellent model fit. Although the NFI of 0.893 is slightly below the 0.90 criterion, this value still indicates a reasonably good fit. Meanwhile, the PCFI of 0.732 and the PNFI of 0.670 have met the criteria. Consequently, the research model is deemed to fit the data and is suitable for further analysis.

Standardized Direct Effects

Table 12 Results of the Standardized Direct Effects

Hypothesis	Path			P	Lower	Upper	Conclusion
H1	XI	==>	X ₄	0.001	0.049	0.158	Significant and Positive
H2	X1	==>	X ₅	0.049	0	0.086	Significant and Positive
H3	X1	==>	Y	0.046	0.001	...	Significant and Positive
H4	X2	==>	X ₄	0.002	0.244	0.667	Significant and Positive
H5	X2	==>	X ₅	0.788	-0.25	0.244	Not Significant
H6	X2	==>	Y	0.007	0.148	...	Significant and Positive
H7	X3	==>	X ₄	0.447	-0.141	0.069	Not Significant
H8	X3	==>	X ₅	0.252	-0.243	0.087	Not Significant
H9	X3	==>	Y	0.796	-0.274	0.222	Not Significant
H10	X4	==>	Y	0.024	...	-0.115	Significant and Positive
H11	X5	==>	X ₄	0.747	-0.3	0.215	Not Significant
H12	X5	==>	Y	0.174	-0.265	0.599	Not Significant

Source: processed data (2026)

Based on the results of the direct effect tests, H1, H2, H3, H4, H6 and H10 were accepted, whilst H5, H7, H8, H9, H11 and H12 were rejected. X1 was found to have a significant effect on X4, X5 and Y, whilst X2 had a significant effect on X4 and Y but not on X5. X3 did not show a significant effect on X4, X5 or Y. Furthermore, X4 had a significant negative effect on Y, whilst X5 did not have a significant effect on either X4 or Y. Overall, X1 and X2 were the variables with the most dominant influence, whilst X3 and X5 did not play a significant role in the research model.

Standardized Indirect Effects

Table 13 Results of the Standardized Indirect Effects

Hypothesis	Path					Indirect Effect Coefficient	P-Value	Conclusion	Meaning
H13	XI	==>	X4	==>	Y	-0.58	0.043	Significant	Full mediation
H14	X1	==>	X5	==>	Y	0.032	0.216	Not Significant	Partial mediation
H15	X2	==>	X4	==>	Y	-0.544	0.033	Significant	Full mediation
H16	X2	==>	X5	==>	Y	0.032	0.216	Not Significant	Partial mediation
H17	X3	==>	X4	==>	Y	0.006	0.535	Not Significant	Partial mediation
H18	X3	==>	X5	==>	Y	0.006	0.535	Not Significant	Partial mediation
H19	X5	==>	X4	==>	Y	0	—	Not Significant	Partial mediation

Source: processed data (2026)

Based on the results of the indirect effect test, only H13 and H15 were accepted, whilst H14, H16, H17, H18 and H19 were rejected. These results indicate that X4 significantly mediates the effects of X1 and X2 on Y, with a negative direction of indirect effect. Meanwhile, X5 was not found to act as a mediator, and X3 also had no significant indirect effect on Y. Consequently, X4 plays a more significant role as a mediator in the research model than X5.

V. Discussion

The research findings indicate that the implementation of Green Technology and Digital Transformation plays a significant role in supporting corporate performance and sustainability. Green Technology has been empirically shown to contribute to Financial Performance, Green Innovation and Sustainable Development, whilst Digital Transformation contributes to Financial Performance and Sustainable Development. These findings suggest that the utilisation of green technology and digital transformation can serve as strategic resources for companies in improving efficiency, optimising business processes, and supporting the achievement of sustainability goals. However, the benefits of green technology are not always immediately apparent, as its implementation requires a relatively large initial investment and the benefits tend to be long-term in nature (Elkington, 2013).

Furthermore, Green Finance and Green Innovation have not yet shown a significant influence on several relationships within the research model. This suggests that the availability of green finance and the implementation of environmentally friendly innovations do not automatically lead to improved corporate performance or sustainability. The effectiveness of these two factors depends heavily on a company's ability to integrate them into its business and operational strategies. Consequently, the availability of financial resources and innovations must be supported by organisational capabilities in order to generate more tangible economic and environmental benefits (Mehmood et al., 2023).

The results of the mediation analysis indicate that Financial Performance acts as a mediator in the relationship between Green Technology and Sustainable Development, and between Digital Transformation and Sustainable Development. These findings suggest that the benefits of green technology and digital transformation for sustainability may be realised through improved financial performance. However, this indirect effect is negative in direction, indicating a potential trade-off between a focus on financial performance and the achievement of sustainability. In other words, improved financial performance does not necessarily automatically strengthen sustainable development if a company is more focused on short-term financial gains.

Meanwhile, the mediation pathway via Green Innovation has not yet shown a significant effect. This suggests that green innovation has not yet been able to act as a strong mediating mechanism between the independent variables and Sustainable Development in the context of this study. Overall, the research findings confirm that the achievement of sustainability does not depend on a single factor, but rather is the result of the interaction between green technology, digital transformation, green finance, green innovation, and financial performance. These findings are consistent with the Resource-Based View and the Triple Bottom Line perspectives, which regard strategic resources, economic performance, and social and environmental aspects as interrelated components in achieving corporate sustainability.

IV. CONCLUSION

This study aims to analyse the role of Green Technology, Digital Transformation, Green Finance, Green Innovation and Financial Performance in supporting Sustainable Development, both through direct effects and via mediation pathways. The research findings confirm that Green Technology and Digital Transformation are key factors capable of driving sustainability. These two variables have been shown to be significant in enhancing sustainable development, both directly and through specific mediation pathways. However, the mediation pathway via Financial Performance often yields a negative direction, indicating a potential trade-off between a focus on short-term profitability and a commitment to sustainability.

On the other hand, Green Finance and Green Innovation have not yet been shown to have a significant impact on either financial performance or sustainable development. The majority of hypotheses involving these two variables were rejected, indicating limitations in the effectiveness of green finance as a tool to support sustainability, as well as the weak role of green innovation in driving the achievement of sustainability. External factors such as government regulations, fiscal incentives, market readiness, and organisational culture that do not yet fully support the green agenda may be the main causes.

This study concludes that achieving sustainable development requires a comprehensive approach that harmoniously integrates technological, financial and innovation aspects. Green technology and digital transformation have been shown to be key drivers, whilst green finance and green innovation require external support to be more effective. These findings reinforce the Resource-Based View and Dynamic Capabilities Theory, whilst also highlighting the 'paradox of sustainability' a phenomenon that enriches the literature. In practical terms, this study emphasises the need for an integrative strategy that balances

profitability and sustainability so that companies can consistently achieve their sustainable development goals.

REFERENCES

- [1] UNDP, UNHCR, and UNODC, "Global Progress Report on Sustainable Development Goal 16 Indicators At the Crossroads: Breakdown or Breakthrough for Peace, Justice and Strong Institutions Global progress report on Sustainable Development Goal 16 indicators: SDG 16 SDG A wake-up call," 2024.
- [2] N. F. Shayan, N. Mohabbati-Kalejahi, S. Alavi, and M. A. Zahed, "Sustainable Development Goals (SDGs) as a Framework for Corporate Social Responsibility (CSR)," *Sustain.*, vol. 14, no. 3, pp. 1–27, 2022, doi: 10.3390/su14031222.
- [3] R. Gurumurthy, D. Schatsky, and J. Camhi, "Uncovering the connection between digital maturity and financial performance: How digital transformation can lead to sustainable high performance.," *Deloitte Insights*, 2020.
- [4] D. C. Nițescu, V. Murgu, and S. B. Manolache, "Multilateral development banks – Strategic actors in the new economy?," *E a M Ekon. a Manag.*, vol. 26, no. 3, pp. 145–157, 2023, doi: 10.15240/tul/001/2023-3-009.
- [5] T. K. Al-Saedi and M. I. Syakir, "An overview of economic valuation of ecosystem services in protected areas and its roles in achieving Sustainable Development Goals (SDGs)," *IOP Conf. Ser. Earth Environ. Sci.*, vol. 1167, no. 1, 2023, doi: 10.1088/1755-1315/1167/1/012052.
- [6] Otoritas Jasa Keuangan, "Laporan Kajian Pengembangan Green Bond Di Indonesia," *Otoritas Jasa Keuang.*, pp. i–iii, 1–162, 2016.
- [7] S. Mehmood, F. Abbas Abdi, and R. Ali, "Green Finance Green Technology Innovation and Financial Development and their Role in SDG," *J. Account. Financ. Emerg. Econ.*, vol. 9, no. 3, pp. 421–436, 2023, doi: 10.26710/jafee.v9i3.2799.
- [8] H. Zhu, T. Feng, and X. Li, "Green finance, green development and decarbonization of the energy consumption structure," *PLoS One*, vol. 19, no. 4 April, pp. 1–18, 2024, doi: 10.1371/journal.pone.0300579.
- [9] G. Zhou, J. Zhu, and S. Luo, "The impact of fintech innovation on green growth in China: Mediating effect of green finance," *Ecol. Econ.*, vol. 193, p. 107308, 2022, doi: 10.1016/j.ecolecon.2021.107308.
- [10] M. Shahzad, Y. Qu, S. U. Rehman, and A. U. Zafar, "Adoption of green innovation technology to accelerate sustainable development among manufacturing industry," *J. Innov. Knowl.*, vol. 7, no. 4, p. 100231, 2022, doi: 10.1016/j.jik.2022.100231.
- [11] A. Chen, L. Li, and W. Shahid, "Digital transformation as the driving force for sustainable business performance: A moderated mediation model of market-driven business model innovation and digital leadership capabilities," *Heliyon*, vol. 10, no. 8, p. e29509, 2024, doi: 10.1016/j.heliyon.2024.e29509.
- [12] M. J. Bataineh, P. Sánchez-Sellero, and F. Ayad, "The role of organizational innovation in the development of green innovations in Spanish firms," *Eur. Manag. J.*, no. October 2022, 2023, doi: 10.1016/j.emj.2023.01.006.
- [13] Masfiatun, M. Supriyadi, and M. Nahdila, "Dampak Ekonomi Digital dan Tingkat Inflasi terhadap Pertumbuhan Sektor Ekonomi di Indonesia," *Fair Value J. Ilm. Akunt. dan Keuang.*, vol. 5, no. 6, pp. 2745–2750, 2023.
- [14] A. Demir, J. Santos, S. Miller, R. Diele, and G. Naarding, "Multi-objective optimization of flexible pavement design from an environmental and economic perspective," *J. Clean. Prod.*, vol. 430, no. January, p. 139441, 2023, doi: 10.1016/j.jclepro.2023.139441.
- [15] Y. Lu and Z. Xia, "Digital inclusive finance, green technological innovation, and carbon emissions from a spatial perspective," *Sci. Rep.*, vol. 14, no. 1, pp. 1–16, 2024, doi: 10.1038/s41598-024-59081-9.
- [16] T. Cai and Z. Hong, "Exploring the structure of the digital economy through blockchain technology and mitigating adverse environmental effects with the aid of artificial neural networks," *Front. Environ. Sci.*, vol. 12, no. March, pp. 1–20, 2024, doi: 10.3389/fenvs.2024.1315812.
- [17] L. Judijanto, V. K. Putri, T. Ansori, and K. Khamaludin, "Analisis Dampak Penggunaan Energi Terbarukan, Efisiensi Energi, dan Teknologi Hijau pada Pengurangan Emisi Karbon di Industri Manufaktur Kota Tangerang," *J. Multidisiplin West Sci.*, vol. 2, no. 12, pp. 1127–1138, 2023, doi: 10.58812/jmws.v2i12.860.
- [18] N. Hasanah and S. Hariyono, "Analisis Implementasi Green Financing Dan Kinerja Keuangan Terhadap Profitabilitas Perbankan Umum Di Indonesia," *J. Ekobis Ekon. Bisnis Manaj.*, vol. 12,

- no. 1, pp. 149–157, 2022, doi: 10.37932/j.e.v12i1.444.
- [19] X. Tan, S. Cheng, and Y. Liu, “Green digital finance and technology diffusion,” *Humanit. Soc. Sci. Commun.*, vol. 11, no. 1, 2024, doi: 10.1057/s41599-024-02902-z.
- [20] E. Holden, K. Linnerud, and D. Banister, “Sustainable development: Our Common Future revisited,” *Glob. Environ. Chang.*, vol. 26, no. 1, pp. 130–139, 2014, doi: 10.1016/j.gloenvcha.2014.04.006.
- [21] M. Yurdakul and H. Kazan, “Effects of eco-innovation on economic and environmental performance: Evidence from Turkey’s manufacturing companies,” *Sustain.*, vol. 12, no. 8, p. 3167, 2020, doi: 10.3390/SU12083167.
- [22] M. A. Khan, H. Riaz, M. Ahmed, and A. Saeed, “Does green finance really deliver what is expected? An empirical perspective,” *Borsa Istanbul Rev.*, vol. 22, no. 3, pp. 586–593, 2022, doi: 10.1016/j.bir.2021.07.006.
- [23] H. Serdarušić, M. Pancić, and Ž. Zavišić, “Green Finance and Fintech Adoption Services among Croatian Online Users: How Digital Transformation and Digital Awareness Increase Banking Sustainability,” *Economies*, vol. 12, no. 3, 2024, doi: 10.3390/economies12030054.
- [24] R. Hisar and J. Suharna, “Pengaruh Wct, Der Terhadap Roe Pada Industri Manufaktur Di Bursa Efek Indonesia Yang Go Publik,” *J. Ekon. J. Econ.*, vol. 11, no. 1, 2020, doi: 10.47007/jeko.v11i1.3263.
- [25] N. K. Hanna, “Economic Development in the Digital Age,” *Econ. Dev. Digit. Age*, pp. 1–156, 2024, doi: 10.1007/978-3-031-54569-6.
- [26] A. Handayani and R. Rokhim, “A Comparative Study of Financial Performance between Sustainable and Conventional Investment,” *J. Entrep. Bus.*, vol. 4, no. 2, pp. 114–124, 2023, doi: 10.24123/jeb.v4i2.5691.
- [27] S. Bahri and F. Zamzam, “Model Penelitian Kuantitatif Berbasis Sem-Amos Mengenal Sem-Amos,” *Deepublish*, 2015.
- [28] CSIS, “Ekonomi Hijau dalam Visi Indonesia 2045 Penulis Asisten Penulis,” pp. 1–142, 2022.
- [29] E. Edeh, W.-J. Lo, and J. Khojasteh, “Review of Partial Least Squares Structural Equation Modeling (PLS-SEM) Using R: A Workbook,” *Struct. Equ. Model. A Multidiscip. J.*, vol. 30, no. 1, pp. 165–167, 2023, doi: 10.1080/10705511.2022.2108813.
- [30] Z. Foltynowicz, A. Łupicka-Fietz, A. M. Jeszka, and D. Kowalczyk, “Evolution of Social Competencies in Sustainable Supply Chains,” *Sustain.*, vol. 16, no. 6, 2024, doi: 10.3390/su16062581.
- [31] Y. Mo, J. Mu, and H. Wang, “Impact and Mechanism of Digital Inclusive Finance on the Urban–Rural Income Gap of China from a Spatial Econometric Perspective,” *Sustain.*, vol. 16, no. 7, 2024, doi: 10.3390/su16072641.
- [32] Fathihani, “MANAJEMEN KEUANGAN (Financial Management in the Era of Digitalization),” no. January, p. 110, 2023.
- [33] G. Westerman, D. Bonnet, and A. McAfee, “Leading Digital,” *Harvard Bus. Rev. Press*, 2014.
- [34] G. H. Brundtland, “Our Common Future (‘The Brundtland Report’): World Commission on Environment and Development,” *Top 50 Sustain. Books*, pp. 52–55, 2017, doi: 10.4324/9781351279086-15.
- [35] A. Johri, M. Asif, P. Tarkar, W. Khan, Rahisha, and M. Wasiq, “Digital financial inclusion in micro enterprises: understanding the determinants and impact on ease of doing business from World Bank survey,” *Humanit. Soc. Sci. Commun.*, vol. 11, no. 1, 2024, doi: 10.1057/s41599-024-02856-2.
- [36] O. Vincent and A. Brandellero, “Transforming work: A critical literature review on degrowth, post-growth, postcapitalism and craft labor,” *J. Clean. Prod.*, vol. 430, no. November, p. 139640, 2023, doi: 10.1016/j.jclepro.2023.139640.
- [37] G. Luo, Y. Yang, and L. Wang, “Driving rural industry revitalization in the digital economy era: Exploring strategies and pathways in China,” *PLoS One*, vol. 18, no. 9 September, pp. 1–22, 2023, doi: 10.1371/journal.pone.0292241.
- [38] M. Koo and S. Yang, “Likert-Type Scale,” pp. 1–11, 2025.
- [39] S. Sisriany and I. S. Fatimah, “Green Campus Study by using 10 UNEP’s Green University Toolkit Criteria in IPB Dramaga Campus,” *IOP Conf. Ser. Earth Environ. Sci.*, vol. 91, no. 1, pp. 0–7, 2017, doi: 10.1088/1755-1315/91/1/012037.
- [40] J. Elkington, “Enter the triple bottom line,” *Triple Bottom Line Does it All Add Up*, vol. 1, no. 1986, pp. 1–16, 2013, doi: 10.4324/9781849773348.

**Corresponding Author: Royhisar Martahan Simanungkalit*

¹Economics and Business Departement, Universitas Esa Unggul, Indonesia