Kurniawan PRAMBUDI UTOMO • Muhammad AZIZ WINARDI N • SUHARDOYO • Mic FINANTO ARIO BANGUN • Devy SOFYANTY

SUSTAINABILITY OF MSMEs FROM THE IPAT PERSPECTIVE: ECONOMETRIC ANALYSIS OF THE IMPACT OF INFRASTRUCTURE AND THE ENVIRONMENT ON PROFITABILITY AND INSOLVENCY

Kurniawan PRAMBUDI UTOMO (ORCID: 0000-0003-3363-9196) – Bina Sarana Informatika University
Muhammad AZIZ WINARDI N (ORCID: 0009-0009-5506-9236) – GICI Business School
SUHARDOYO (ORCID: 0000-0003-1508-4844) – Bina Sarana Informatika University
Mic FINANTO ARIO BANGUN (ORCID: 0009-0006-0624-8463) – Bhayangkara University
Devy SOFYANTY (ORCID: 0000-0002-9855-6693) – Bina Sarana Informatika University

Correspondence address:
Kramat Raya, Street 98, Bina Sarana Informatika University, Jakarta, Indonesia
e-mail: Kurniawan.kpu@bsi.ac.id

ABSTRACT: This study aims to analyze the impact of the sustainability of MSMEs affected by infrastructure development and environmental factors on financial performance, especially profitability and insolvency in the Nusantara Capital City (IKN) in East Kalimantan. MSMEs have an important role in the national and local economies, but they are vulnerable to structural changes. The development of the IKN driven by infrastructure, technology, and sustainability provides strategic opportunities to increase the competitiveness and resilience of MSMEs within the framework of IPAT (Impact, Population, Affluence, Technology). This study uses a quantitative approach with the Partial Least Squares–Structural Equation Modelling (PLS-SEM) method to analyze the direct and indirect relationships between variables. The research sample consisted of 85 MSMEs that met the research criteria. The results of the study show that the sustainability of MSMEs does not have a significant direct influence on financial performance. On the contrary, infrastructure and environmental factors have a positive and significant influence. In addition, environmental factors significantly mediate the relationship between infrastructure and financial performance, while the mediating role in the relationship between MSME sustainability and financial performance is not proven. These findings show that the sustainability of MSMEs is highly dependent on the quality of infrastructure and environmental management. The application of the IPAT perspective at the micro level shows that the technological and environmental dimensions are able to transform MSME activities into improved financial performance. Policy implications emphasize the importance of integrating infrastructure development and environmental policies in strengthening the sustainable resilience of MSMEs.

KEYWORDS: Sustainability of MSMEs, infrastructure development, IPAT perspective, environmental impact, profitability, insolvency

Introduction

National infrastructure acceleration is aimed at creating new growth centres, with the development of the Ibu Kota Nusantara (IKN) in East Kalimantan as the main strategy for regional development transformation (Paramananda & Iskandar, 2024). The development area reaches 199,962 ha, covering 56,180 ha of the IKN area and 6,596 ha of the Central Government Core Area (KIPP) as the centre of state administration (Supratman et al., 2025). This is part of the national strategy to optimise resource management while encouraging national economic growth (Utomo, Hawari, et al., 2025). The construction of toll roads is the main infrastructure supporting logistics mobilisation (Ghaisani et al., 2016). In line with this, supporting infrastructure such as airports, ports and dams continues to be developed based on technological advances to increase connectivity and economic efficiency (Cheng et al., 2023; Saleh et al., 2025; Zhou et al., 2025). The cities of Balikpapan and Samarinda serve as strategic buffer zones for the IKN (Hidayat et al., 2024). Strengthening connectivity is realized through the construction of the 99.02 km Balikpapan–Samarinda Toll Road and the 47 km Balikpapan–IKN Toll Road to increase accessibility and regional economic integration (Rezky et al., 2023), although toll roads facilitate the distribution of economic logistics between cities, toll roads also have a negative impact on the environmental ecosystem (Hua et al., 2021). The positive impact of development can also boost the economic growth of MSMEs. As a strategic sector, MSMEs encompass more than 64 million business units and contribute approximately 60.5% to the national Gross Domestic Product (GDP) (Dira et al., 2023; Rodríguez-Gulías et al., 2024; Wibowo & Aumeboonsuke, 2020), but also face competitive pressures in the context of infrastructure development.

According to Law No. 20 of 2008, MSMEs include micro-enterprises (assets ≤Rp50 million; turnover ≤Rp300 million), small-enterprises (assets Rp50–500 million; turnover Rp300 million–Rp2.5 billion), and medium-sized enterprises (assets Rp500 million–Rp10 billion; turnover Rp2.5–Rp50 billion). The growth of MSMEs in the IKN is dominated by micro-enterprises (80.0%), followed by small businesses, which initially accounted for 20% of the population, down to 17.6%, and medium-sized businesses, which initially accounted for 0%, up to 2.4%. Several MSMEs in the IKN area, such as Pawon Prona, Mamapapa Bakery, and Chumbucked, have begun to emerge and will collaborate with local MSMEs, including producers of amplang, a typical East Kalimantan food (Purba, 2024). The producer of Jo Noleh's signature brand of amplang has experienced an increase in sales since the construction of the IKN, some MSMEs in the IKN area face vulnerability due to infrastructure expansion and environmental degradation, including pollution, land-use change, and ecosystem decline. These pressures reduce productivity, increase operational costs, and may trigger business closures(Chetty et al., 2024; Meng et al., 2025). It should be noted that without effective risk mitigation, MSMEs are at risk of not being able to survive in the long term (Joy-Camacho & Thornhill, 2024).

Although various studies have discussed MSMEs in the context of access to capital and digitalisation, studies that empirically analyse the relationship between infrastructure development, environmental degradation, and the risk of MSME bankruptcy in the context of the IKN are still limited (Anisa et al., 2021; Loureiro et al., 2020; Zhao, 2024). Furthermore, the use of an IPAT-based econometric approach to explain the dynamics of sustainability and financial stress in MSMEs has not been widely implemented. Therefore, this study fills this gap by analysing the impact of infrastructure development on MSME sustainability by considering how environmental degradation affects profitability and bankruptcy risk, which are research gaps (Chontanawat, 2018). Therefore, this study also applies the IPAT perspective approach by using Return on Assets (ROA), Net Profit Margin (NPM) and Altman Z-Score to assess the performance and bankruptcy risk of MSMEs, especially in the context of sustainability and local economic growth (Nguyen et al., 2024; Winardi et al., 2024), by trying to integrate ecological modernization theory, financial distress cost theory, and regional development theory to explain the dynamics of sustainability, financial stress, and local economic growth of MSMEs (Dawkins, 2003; Julkovski et al., 2021; Li et al., 2018; Purnanandam, 2008).

Based on the IPAT perspective framework, this study aims to analyse the influence of infrastructure development and environmental impacts on MSME sustainability, profitability, and bankruptcy risk in the IKN region. Specifically, this study tests hypotheses regarding the direct influence of infrastructure development and environmental impacts on MSME financial performance, as well as the mediating role of environmental impacts in this relationship. Furthermore, this study evaluates the

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role of MSME sustainability orientation in influencing infrastructure utilisation and environmental responsiveness.

Theoretical Background and Hypothesis Development

MSME Sustainability and IPAT Perspective

(Dietz & Rosa, 1997) that IPAT theory (Impact = Population × Affluence × Technology) explains that environmental impact is a function of economic activity and technology use. The sustainability of MSMEs is influenced not only by economic aspects but also by technological efficiency, resource use, and environmental pressures resulting from production activities. Raharjo & Elida(2024) explain that MSME sustainability is a business's ability to maintain long-term economic performance while still considering resource efficiency and ecological impact. The IPAT perspective explains that increasing business capacity (affluence) and adopting environmentally friendly technology (technology) can reduce negative impacts while increasing cost efficiency and competitiveness, ultimately impacting profitability and bankruptcy risk.

H1: Sustainability of MSMEs (X1) has a positive effect on financial performance (profitability/insolvency) (Y).

Infrastructure, Environmental Impact and Financial Performance

Regional economic growth confirms that infrastructure is a productivity factor that reduces transaction costs, expands market access, and increases distribution efficiency. The construction of toll roads, transportation, and digital connectivity can accelerate the flow of goods and information (Dira et al., 2023). Good infrastructure access drives increased revenue and improves cost structures, thereby strengthening profitability and reducing the risk of bankruptcy. In environmental infrastructure, technology and business scale determine the magnitude of the resulting environmental impact. MSMEs that are able to manage their environmental impact through energy efficiency, waste management, and green innovation tend to have more efficient cost structures and lower regulatory risk (James, 2014). This has implications for increased profitability and financial sustainability. Business sustainability encourages MSMEs to adapt to external changes, including infrastructure development. Sustainable MSMEs tend to be more responsive in leveraging new market access, distribution efficiencies, and economic opportunities created by infrastructure development (Bohnenberger, 2020). Within the IPAT framework, increased economic capacity (affluence) and technology adoption enable MSMEs to respond to the pressures and opportunities resulting from infrastructure changes.

H2: The impact of infrastructure (X2) has a direct positive effect on financial performance (profitability/insolvency) (Y).

H3: Environmental impact (Z) has a positive effect on financial performance (Y).

H4: The sustainability of MSMEs (X1) influences the impact of infrastructure (X2).

The Role of Environmental Impact Mediation and the Relationship between Infrastructure and Performance

IPAT emphasises that technology and economic activity influence environmental impacts, which in turn impact economic performance. Jaluanto et al (2021) explain that environmental impact acts as a bridge between business sustainability and financial performance. Sustainability-oriented MSMEs tend to implement environmentally friendly practices, ultimately increasing operational efficiency and improving financial performance. Infrastructure development can boost economic activity, but it also has the potential to increase environmental pressures. Ahmed & Canarslan (2023). If MSMEs are able to manage environmental impacts effectively, the benefits of infrastructure on financial performance will be optimised. Thus, environmental impact serves as a mediating variable explaining how infrastructure influences profitability and bankruptcy risk.

H5: MSME sustainability (X1) has a positive effect on financial performance through the mediation of environmental impact (Z).

H6: The impact of infrastructure (X2) has a positive effect on financial performance (Y) through the mediation of environmental impact (Z).

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Methods and sampling

This study uses a quantitative explanatory approach with the PLS-SEM method to analyse the causal relationships between latent variables simultaneously, including direct influence, mediation, and moderation in the predictive model. The PLS-SEM analysis is conducted through two main stages. First, evaluation of the measurement model (outer model) to test the validity and reliability of the constructs, which includes testing convergent validity through outer loading values (>0.70) and Average Variance Extracted (AVE >0.50), as well as reliability testing through Composite Reliability and Cronbach's Alpha (>0.70). Discriminant validity is also tested using the HTMT or Fornell-Larcker criteria. Second, evaluation of the structural model (inner model) to test the relationships between constructs through path coefficients, t-statistic values and p-values obtained from the bootstrapping procedure, as well as testing the R^2 value, effect size (f^2), and predictive relevance (Q^2) to assess the model's predictive power (Hair et al., 2017). The sampling approach technique is purposive proportional sampling, selecting with the following criteria: (1) business actors are MSME owners, (2) operate permanently in the study area, and (3) are directly or indirectly impacted by the development of the IKN infrastructure. The research population consisted of 108 MSME actors operating around the development area of the Indonesian Capital City (IKN). A total of 23 business actors were excluded because they were nomadic or did not settle, so they could not provide stable information and had the potential to cause bias. Thus, the effective population analysed was 85 MSMEs that were settled and actively operating. This approach aims to ensure that the sample represents the characteristics of the population relevant to the research objectives..Data analysis aims to understand the relationship between environmental changes due to infrastructure development and MSME performance, by collecting data through observation, in-depth interviews, as well as documents, notes, audio-visual recordings, images, and questionnaires related to the research problem (Mackiewicz, 2018; Ringle et al., 2023). In determining sampling, the Slovin approach is also used to test the accuracy with Slovin's formula (Tejada & Punzalan, 2012).

$$n = N / (1 + N \times e^2).$$

where:
n = number of samples,
N = population size,
e = margin of error (level of error),

So, the calculation of the sample size is as follows:

$$n = 108 / (1 + 108 \times 0.0025)\ n = 108 / (1 + 0.27)\ n = 108 / 1.27 = 85.03.$$

Thus, the minimum number of respondents required is 85 MSMEs, ensuring the use of 85 respondents. Thus, the minimum number of respondents required is 85 MSMEs; data analysis was conducted using PLS-SEM to test the structural relationships between constructs, including direct and indirect influences (Henseler et al., 2015). The analysis stages include: (1) evaluation of the measurement model through convergent validity, discriminant validity, and construct reliability tests; (2) evaluation of the structural model through path coefficients, R^2 values, and effect sizes; and (3) testing of mediation effects using the PLS-SEM bootstrapping procedure (J. Hair & Alamer, 2022). The respondent table is presented below:

Based on Table 1, the respondent profile indicates that the majority of MSMEs in this study are owned by women (62.4%), while male ownership accounts for 37.6%. In terms of age distribution, entrepreneurs aged 41–50 years constitute the largest proportion (36.5%), followed by those aged 31–40 years (32.9%), whereas respondents under 30 years represent the smallest share (14.1%). Regarding educational attainment, senior high school graduates form the largest group (50.6%), followed by diploma/bachelor's degree holders (29.4%) and junior high school graduates or equivalent (20.0%). In terms of business experience, most enterprises have operated for 3–5 years (34.1%), followed by more than five years (29.4%) and 1–3 years (23.5%), while only 12.9% have been operating for less than one year. Sectorally, trade businesses account for the largest proportion (40.0%), followed by culinary enterprises (27.1%), service-based businesses (18.8%), and other sectors such as handicrafts and agriculture (14.1%). With respect to business scale at the time of the survey, the sample is predominantly composed of micro-enterprises (80.0%), with small enterprises accounting

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for 17.6% and medium-sized enterprises representing 2.4%. This distribution indicates that the empirical context of the study primarily reflects micro-scale MSMEs. Such a structure is consistent with the overall composition of MSMEs in Indonesia, which remain largely dominated by micro-enterprises, thereby reinforcing the relevance of this sample as the analytical context of the study. Previous research has emphasised access to capital, digitalisation, and digital technology as determinants of MSME sustainability, providing a relevant comparative framework for the analysis in this study (Zhao, 2024). Previous research has emphasised access to capital, digitalisation, and digital technology as determinants of MSME sustainability, providing a relevant comparative framework for the analysis in this study. However, research on environmental impacts on business sustainability has largely focused on large-scale industrial, plantation, and infrastructure sectors, including dams, buildings, and toll roads (Anisa et al., 2021; Loureiro et al., 2020). In contrast to previous research, this study integrates environmental impacts with profitability and insolvency quantitatively, which is still limited for MSMEs in Indonesia. (Nguyen et al., 2024). This research has a novel value, namely, focusing on the development of IKN infrastructure that supports the sustainability of MSMEs and local economic growth (Winardi et al., 2024). The following is the research model in Figure 1 below:

Table 1. Research Respondent Data

Variables	Category	Respondents	Percentage (%)
Gender	Man	32	37.6%
	Woman	53	62.4%
Age	< 30 years	12	14.1%
	31–40 years	28	32.9%
	41–50 years	31	36.5%
	> 50 years	14	16.5%
Educational background	Junior high school or below	17	20.0%
	Senior High School	43	50.6%
	Diploma/Bachelor's Degree	25	29.4%
Length of Operation	< 1 year	11	12.9%
	1–3 years	20	23.5%
	3–5 years	29	34.1%
	> 5 years	25	29.4%
Type of Business	Trade (shop/kiosk)	34	40.0%
	Culinary (food and drink)	23	27.1%
	Services (workshop, laundry, etc.)	16	18.8%
	Others (handicrafts, agriculture, etc.)	12	14.1%
Business Scale	Micro	68	80.0%
	Small	15	17.6%
	Currently	2	2.4%

The research model shows that MSME sustainability (X1) has a direct influence on financial performance, both profitability and insolvency risk (Y). In addition, MSME sustainability is also suspected to influence infrastructure impact (X2), which in turn has a direct impact on financial performance. Environmental impact (Z) acts as a variable that mediates this relationship, with a direct influence on financial performance and an interaction path with MSME sustainability and infrastructure impact. Thus, this model can simultaneously analyse the influence of MSME internal factors, infrastructure, and the environment on profitability and insolvency risk, while also explaining MSME sustainability towards local economic growth.

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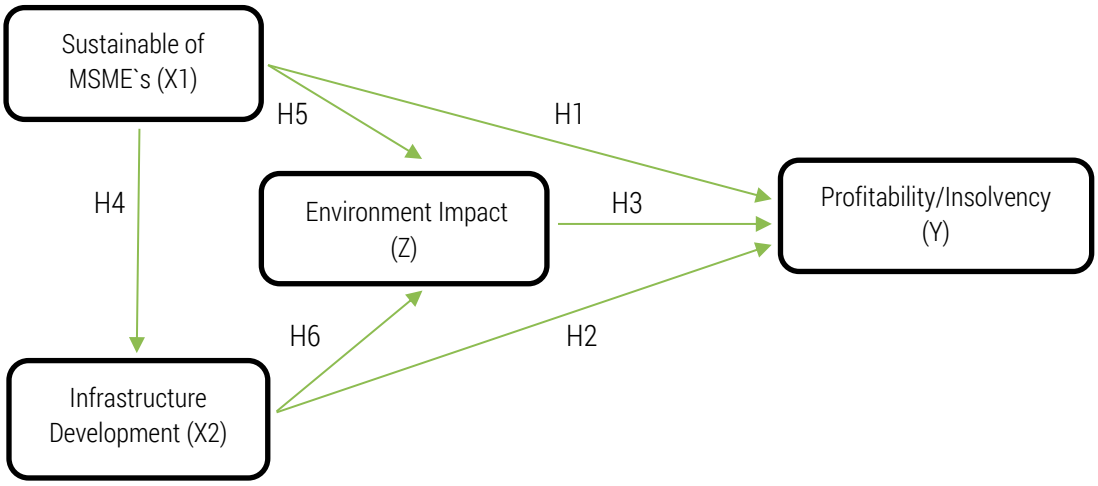

Figure 1. The results of the entire model

Source: processed data, 2025.

Result of the research

The outer loading test aims to assess the convergent validity of indicators in reflecting latent constructs through their level of correlation with the measured variables presented in Table 2.

Table 2. Outer Loading

	Environmental impact	Infrastructure development	Profitability and Insolvency	Sustainability of MSMEs	VIF
DVI.5		0.800			1,673
DVI.6		0.810			1,651
DVI.7		0.749			1,412
DVI.9		0.789			1,776
ENVI.11	0.800				1,607
ENVI.12	0.844				1,839
ENVI.13	0.734				1,434
ENVI.14	0.751				1,536
MSME.1				0.762	1,576
MSME.2				0.770	1,740
MSME.3				0.811	1,888
MSME.4				0.885	1,886
PFIN.16			0.865		2,320
PFIN.17			0.871		2,479
PFIN.19			0.845		2,130
PFIN.20			0.856		2,159

ENVI: Environmental impact; MSME: Sustainability of MSME; ENVI: Environmental impact; PFIN: Profitability and Insolvency

Source: processed data, 2025.

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Table 2 shows that all indicators in each construct have outer loadings > 0.70, confirming strong convergent validity. Meanwhile, the VIF value is below the critical threshold, indicating the absence of multicollinearity. (Fornell & Larker, 1981). Therefore, the measurement model is declared reliable and valid. The construct reliability and validity table presents the results of reliability and convergent validity tests to ensure each construct has internal consistency and the ability to explain the following indicator variance:

Table 3. Reliability and Convergent Validity Test Table

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Environmental impact	0.789	0.798	0.864	0.614
Infrastructure development	0.796	0.799	0.867	0.620
Profitability and Insolvency	0.882	0.883	0.918	0.738
Sustainability of MSMEs	0.828	0.908	0.883	0.654

Source: processed data, 2025.

Table 3 shows that all constructs meet the criteria for reliability and convergent validity. Cronbach's Alpha, rho_A, and Composite Reliability values are above the 0.70 threshold, indicating strong consistency. In addition, the AVE values for all constructs exceed 0.50, confirming that the indicator variance is adequately explained by the latent construct.(Hair et al., 2019). Thus, the measurement model is declared valid and reliable. The following is the structural equation model:

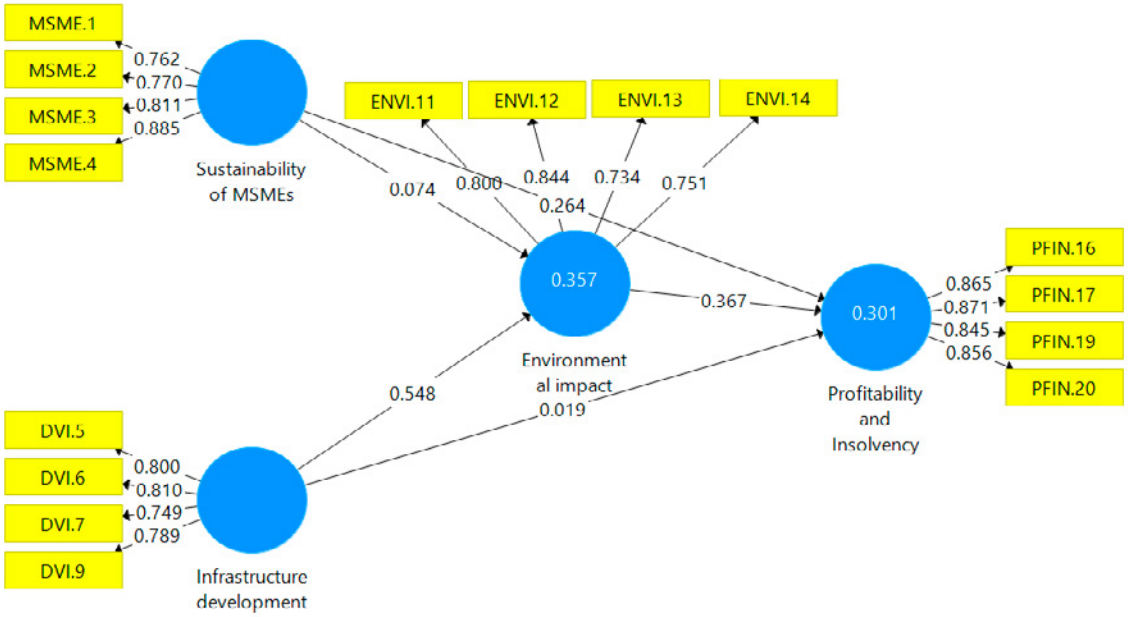

Figure 2. Structural equation model diagram

Source: processed data, 2025.

Figure 2 shows that the relationship between the latent constructs of Infrastructure Development has a strong influence on Environmental Impact (β = 0.548), while Environmental Impact has a moderate influence on Profitability and Insolvency (β = 0.367), and the influence of Sustainability of MSMEs on Environmental Impact is weak (β = 0.074). The coefficient of determination (R^2) indicates a moderate model for Environmental Impact (R^2 = 0.357) and Profitability and Insolvency (R^2 = 0.301). Overall, the structural model shows crucial relationships in the study.

Table 4 shows that discriminant validity is met based on the cross-loading criteria, all indicators have the highest loading value on their constructs (> 0.70) and lower on other constructs (< 0.60), the ENVI.12 indicator loads strongly on Environmental Impact (0.844) compared to other constructs

(0.328–0.552), while PFIN.17 has the highest loading on Profitability and Insolvency (0.871). The same thing is shown by the MSME indicator with a dominant loading on the Sustainability of MSMEs (0.762–0.885).

Table 4. Discriminant validity

	Environmental impact	Infrastructure development	Profitability and Insolvency	Sustainability of MSMEs
DVI.5	0.471	0.800	0.350	0.500
DVI.6	0.536	0.810	0.296	0.430
DVI.7	0.466	0.749	0.338	0.588
DVI.9	0.382	0.789	0.280	0.461
ENVI.11	0.800	0.552	0.331	0.328
ENVI.12	0.844	0.516	0.436	0.328
ENVI.13	0.734	0.387	0.395	0.323
ENVI.14	0.751	0.391	0.371	0.339
MSME.1	0.308	0.464	0.281	0.762
MSME.2	0.186	0.428	0.286	0.770
MSME.3	0.239	0.514	0.312	0.811
MSME.4	0.504	0.592	0.453	0.885
PFIN.16	0.385	0.355	0.865	0.404
PFIN.17	0.454	0.315	0.871	0.261
PFIN.19	0.373	0.325	0.845	0.432
PFIN.20	0.466	0.387	0.856	0.373

Source: processed data, 2025.

Table 5 shows the R-square value for Environmental Impact of 0.357 (Adjusted R^2 = 0.342) and Profitability and Insolvency of 0.301 (Adjusted R^2 = 0.275). An R^2 value of 0.75 is categorised as strong, 0.50 as moderate, and 0.25 as weak. Therefore, both endogenous constructs are in the moderate category, indicating that exogenous variables are able to explain 35.7% of the variation in Environmental Impact and 30.1% of the variation in Profitability and Insolvency, while the remainder is influenced by other factors outside this study.

Table 5. R-squared test

	R Square	R Square Adjusted
Environmental impact	0.357	0.342
Profitability and Insolvency	0.301	0.275

Source: processed data, 2025.

Based on Table 6 showing the results of bootstrapping direct effects, hypothesis testing shows that H1 is rejected, because MSME Sustainability (X1) does not have a significant effect on financial performance (profitability/insolvency) (Y). This is indicated by the path coefficient value of β = 0.264 with a t-statistic value of 1.848 (<1.96) and a p-value of 0.065 (>0.05). Furthermore, H2 is rejected, because Infrastructure Impact (X2) does not have a significant direct effect on financial performance (Y). The analysis results show a very low path coefficient (β = 0.019), with a t-statistic of 0.136 (<1.96) and a p-value of 0.892 (>0.05). Conversely, H3 is accepted, because Environmental Impact (Z) has a

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positive and significant effect on financial performance (Y). This is evidenced by the coefficient value β = 0.367, t-statistic 3.036 (> 1.96), and p-value 0.003 (< 0.05). Meanwhile, H4 is accepted, where the impact of infrastructure (X2) has a positive and significant effect on environmental impact (Z). This finding is indicated by the path coefficient β = 0.548, t-statistic value 4.997 (> 1.96), and p-value < 0.001. Thus, the test results show that the influence of infrastructure on the financial performance of MSMEs does not occur directly, but through increased environmental impact.

Table 6. Bootstrapping internal model testing of direct effects.

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values	Explanation
Environmental impact -> Profitability and Insolvency	0.367	0.379	0.121	3,036	0.003	Significant
Infrastructure development -> Environmental impact	0.548	0.546	0.110	4,997	0,000	Significant
Infrastructure development -> Profitability and Insolvency	0.019	0.013	0.140	0.136	0.892	Not Significant
Sustainability of MSMEs -> Environmental impact	0.074	0.098	0.119	0.620	0.535	Not Significant
Sustainability of MSMEs -> Profitability and Insolvency	0.264	0.256	0.143	1,848	0.065	Not Significant

Source: processed data, 2025.

Based on Table 7, it shows that the indirect influence of MSME Sustainability (X1) on financial performance (Y) through environmental impact (Z) is not significant (β = 0.027; t = 0.499; p = 0.618), so the H5 hypothesis is rejected because the mediating role of environmental impact is not statistically proven. On the other hand, H6 is accepted because the infrastructure impact (X2) has a positive and significant effect on financial performance (Y) through the mediation of environmental impact (Z) (β = 0.201; t = 2.984; p = 0.003), which indicates that environmental impact plays a significant mediating role in the relationship between infrastructure and financial performance. Evaluation of the suitability of the model based on the results of the empirical tests built has an adequate level of suitability and feasibility as follows:

Table 7. Bootstrapping internal model testing of indirect effects.

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values	Explanation
Environmental impact -> Profitability and Insolvency						
Infrastructure development -> Environmental impact						
Infrastructure development -> Profitability and Insolvency	0.201	0.203	0.067	2,984	0.003	Significant
Sustainability of MSMEs -> Environmental impact						
Sustainability of MSMEs -> Profitability and Insolvency	0.027	0.042	0.054	0.499	0.618	Not Significant

Source: processed data, 2025.

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Table 8. Model Fit with Test Results

	SSO	SSE	Q^2 (=1-SSE/SSO)
Environmental impact	340,000	269,475	0.207
Infrastructure development	340,000	340,000	
Profitability and Insolvency	340,000	271,492	0.201
Sustainability of MSMEs	340,000	340,000	

	Saturated Model	Estimated Model
SRMR	0.080	0.080
d_ULS	0.860	0.860
d_G	0.376	0.376
Chi-Square	175,269	175,269
NFI	0.755	0.755
rms Theta		0.184

Source: processed data, 2025.

Based on Table 8, the results of the evaluation of the suitability of the structural model, the Q^2 value for the environmental impact variable is 0.207, and financial performance (profitability and insolvency) is 0.201, which explains that the model has moderate relevance to the endogenous variables (Hu & Bentler, 1999). Furthermore, the results of the model fit test show an SRMR value of 0.080, which is still within the acceptance limits, thus indicating a good level of model fit. The d_ULS (0.860) and d_G (0.376) values in the estimated model are also consistent with the saturated model, indicating good estimation stability. In addition, the NFI value of 0.755 indicates an adequate level of fit, while the rms Theta of 0.184 indicates an acceptable quality of the measurement model specification.

Discussion

The empirical findings of this study show that MSME sustainability does not have a linear effect on financial performance, but rather through a mechanism mediated by infrastructure and environmental factors. Within the IPAT perspective, these results indicate that the economic impact of MSMEs is not solely determined by business activity (population and affluence), but is highly dependent on technology through infrastructure and business environment management. Directly, MSME sustainability does not show a significant effect on profitability and insolvency (Handyastono et al., 2025; Sunindyo et al., 2024). These findings reinforce the argument that sustainable MSME practices are still primarily oriented toward compliance or government regulations and have not been well-socialised as a strategy for creating economic value in the Indonesian Capital City (IKN). Limited production scale, lack of technological intensity, and limited access to financing mean that investment is unable to generate a sustainable economy in the short term. From the IPAT perspective, this condition reflects the lack of transmission from affluence to positive economic impact, thus requiring full attention from the Indonesian IKN Authority. Conversely, the impact of infrastructure has been shown to have a direct and significant influence on the financial performance of MSMEs.

Adequate infrastructure improves logistics efficiency, lowers transaction costs, and expands MSME integration into the regional value chain within the IKN region (Susanti et al., 2023). Econometrically, this shows that the infrastructure variable functions as an enabling technology in IPAT, which increases the elasticity of MSME output to economic input (Nursini, 2020). so that infrastructure improvements not only increase profitability, but also play a role in reducing the risk of bankruptcy by stabilising MSME finances and increasing medium-term business competitiveness. Furthermore, environmental impacts have a positive effect on MSME financial performance, indicating

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that environmental management practices can generate good and measurable economic benefits. Thus, waste reduction, energy efficiency, and environmental compliance contribute to lower operational costs and increase market share. Within the IPAT framework, these results confirm that environmental impacts do not necessarily negatively impact economic growth, but can actually strengthen the financial resilience of MSMEs.

The indirect effect analysis indicates that environmental impact significantly mediates the relationship between infrastructure development and financial performance, but does not mediate the relationship between MSME sustainability and financial performance. These findings highlight that infrastructure development without adequate environmental management may lead to diminishing returns. Therefore, fostering a shared understanding of ecological principles and social responsibility among stakeholders is essential to ensure that economic growth remains aligned with environmental sustainability (Chen, 2025). Conversely, when infrastructure encourages the adoption of environmentally friendly technologies, the resulting economic effects are more stable and sustainable (Suriyankietkaew et al., 2025; Zainuri et al., 2025). In the context of IKN development, the government and relevant authorities need to prioritise the optimisation of spatial planning and industrial zone layout while adhering to ecological carrying capacity limits to maintain long-term economic and environmental balance (Wang et al., 2025). Where the role of the environment is a major factor in making infrastructure investment into financial benefits for MSMEs.

The implication of this research is to expand the IPAT framework at the micro level, especially for MSMEs. The results of the study indicate that the technology and impact components cannot be treated as single exogenous variables, but rather as endogenous mechanisms that determine the success of economic sustainability. Therefore, this finding confirms that the strategy to strengthen MSMEs is not enough to only encourage MSME sustainability internally, but must be accompanied by infrastructure development that is integrated with external environmental policies (Egere et al., 2025). Overall, this study confirms that the sustainability of MSMEs is path-dependent and is greatly influenced by the attention of policy makers, both central and regional governments, to organize and review infrastructure and the environment, which serve as the main catalysts that determine whether MSME economic activity can be converted into sustainable profitability while reducing the risk of bankruptcy (Mateus et al., 2024). Thus, in applying the IPAT model to formalise the relationship between environmental impact and its driving factors, it is important to incorporate relevant structural, technological, and policy variables. Accordingly, the IPAT framework offers a robust analytical basis for understanding the interaction between MSME economic growth, environmental pressure, and long-term financial resilience (da Silva et al., 2021).

Conclusions, further research directions and research limitations

This study examines MSME sustainability from an IPAT perspective by investigating the effects of infrastructure and environmental impacts on profitability and bankruptcy risk. The empirical findings indicate that MSME sustainability does not exert a direct effect on financial performance, suggesting that sustainability practices have not yet been fully integrated as a value creation strategy within MSMEs. In contrast, infrastructure development and the quality of environmental management demonstrate significant positive effects in enhancing profitability and reducing bankruptcy risk. The mediation analysis further reveals that environmental impact significantly links infrastructure development to financial performance, implying that the economic benefits of infrastructure expansion are conditional upon the effectiveness of environmental management. Theoretically, this study extends the application of the IPAT framework to the MSME level by demonstrating that technological dimensions and economic activity must be analysed in conjunction with environmental management capacity to explain financial resilience. Practically, the findings underscore that infrastructure development, particularly in the context of IKN development, must be integrated with environmental governance policies and ecological carrying capacity considerations under the authority of the IKN Authority. For MSME actors, sustainability should not merely be positioned as administrative compliance, but rather embedded within business models through resource efficiency, eco-innovation, and adaptive responses to environmental regulations. For the IKN Authority, fiscal incentives, green technology support, and strong institutional coordination are essential to ensure that infra-

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structure expansion generates long-term economic benefits without intensifying ecological pressure. This study has several limitations. First, the measurement of MSME sustainability remains aggregated and does not fully capture sectoral heterogeneity. Second, the use of cross-sectional data restricts the ability to examine long-term dynamics and limits strong causal inference, as the identified relationships are primarily associative. Third, the environmental indicators employed do not incorporate technical measures such as emission intensity or energy efficiency. Future research is encouraged to employ longitudinal or panel data to assess long-term sustainability effects and to integrate institutional and public policy variables within the IPAT framework. Operationally, policymakers should incorporate financially grounded environmental impact assessments into infrastructure planning and implement compliance-based environmental incentive mechanisms for MSMEs in development-affected areas. Without measurable policy instruments, infrastructure expansion risks generating ecological pressures that may ultimately weaken MSME financial resilience in terms of both profitability and insolvency risk.

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The contribution of the authors

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