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Analytical Modeling and Numerical Simulation of Digital Capability Dynamics in MSMEs

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ABSTRACT

This study presents an analytical model and numerical simulation to examine the dynamic relationships among perceived usefulness, perceived ease of use, digital capability, and business performance in micro, small, and medium enterprises (MSMEs). Grounded in the Technology Acceptance Model (TAM), the framework transforms behavioural variables into analytical equations to describe their interdependent effects over time. Using data from 222 MSME actors in Makassar City, the model was validated through Partial Least Squares Structural Equation Modeling (PLS-SEM) and further simulated numerically to observe system stability and sensitivity. Results indicate that both perceived usefulness and ease of use positively affect performance, while digital capability exerts a partial mediating and selective moderating influence. The analytical and numerical findings extend TAM into a mathematical domain and provide a theoretical basis for designing optimized digital capability strategies to strengthen MSME competitiveness in developing economies.

Keywords: Analytical Modeling, Numerical Simulation, Digital, Dynamics, MSMEs

INTRODUCTION

The rapid advancement of digital technology has become a dominant force driving business transformation worldwide. Within the era of the Fourth Industrial Revolution, digital innovation has evolved from being a supporting tool for large enterprises to a vital determinant of competitiveness for micro, small, and medium enterprises (MSMEs). This paradigm shift has redefined the global economic landscape, positioning digital adoption as a central factor for organizational survival, efficiency, and sustainable growth across industries.

In Indonesia, MSMEs play an indispensable role in sustaining national economic stability, contributing more than 60% to the country's Gross Domestic Product (GDP) and employing approximately 97% of the workforce (Information, 2023). Despite this significant contribution, digital adaptation among MSMEs remains far from optimal. A national survey (Information, 2021; Google & Temasek, 2021) revealed that only around 27% of MSMEs actively utilize digital technology, indicating a substantial gap between Indonesia's digital potential and the actual readiness of MSME actors. This digital divide represents a strategic challenge that constrains productivity, competitiveness, and resilience in a technology driven economy.

To understand the limited adoption of digital technology, the Technology Acceptance Model (TAM) developed by Davis (1989) and extended by Venkatesh and Davis (2000) provides a foundational behavioral framework. TAM posits two primary determinants of technology acceptance Perceived Usefulness (PU) and Perceived Ease of Use (PEOU). PU refers to the degree to which users believe that technology enhances their job

performance, while PEOU denotes the extent to which users perceive technology as effortless to use. Both constructs have been extensively validated across various sectors as critical predictors of user intention and technology adoption behavior.

Nevertheless, within the Indonesian MSME context, these behavioral perceptions remain inconsistent and underdeveloped. Studies by Gefen and Straub (2000), Baron and Kenny (1986), and Sudirman, Astuty, and Aryanto (2025) reveal that many MSME owners fail to recognize tangible benefits from digital utilization or face difficulties in operating even basic features due to limited digital literacy. This implies that cognitive perceptions alone cannot fully explain the gap between technology adoption and performance improvement. In a fast-changing digital environment, organizations require not only a positive perception of technology but also the capability to integrate and utilize it this management strategically.

Digital capability thus emerges as a critical determinant of performance outcomes. It represents an enterprise's ability to acquire, manage, and integrate digital resources effectively to support business objectives. Empirical studies, such as those by Setiawan [8], demonstrate that firms with higher digital capability levels achieve greater operational efficiency and adaptability. However, most previous research under the TAM framework has focused narrowly on behavioral adoption intentions rather than dynamic interactions and performance implications. Moreover, few have explored how digital capability functions as a moderating mechanism that strengthens or weakens the relationship between technological perceptions and business outcomes (Gonzalez-Varona et al., 2024; Tilman et al., 2025; Rahman, 2019).

While prior studies have provided valuable behavioral insights, they largely employ static, cross-sectional, or regression-based analyses. Few attempts have been made to represent TAM constructs within an analytical or dynamical system framework capable of describing how these relationships evolve over time. Consequently, there exists a methodological gap between empirical behavioral models and analytical formulations that can capture continuous changes in perception, capability, and performance. Addressing this gap requires an integrative approach that combines behavioral data with analytical modeling and numerical simulation, allowing for the examination of equilibrium, sensitivity, and system stability.

To bridge this gap, this study develops an analytical model and numerical simulation framework to investigate the dynamic relationships among perceived usefulness, perceived ease of use, digital capability, and business performance in MSMEs. Grounded in the Technology Acceptance Model (TAM), this research formulates the relationships mathematically using differential equations and validates the model empirically through Partial Least Squares Structural Equation Modeling (PLS-SEM). This dual approach extends TAM into the domain of applied mathematical analysis and provides theoretical and practical contributions by enabling policymakers and business practitioners to design optimized digital capability strategies for enhancing MSME competitiveness and resilience in the digital era.

LITERATURE REVIEW AND HYPHOTHESIS

The rapid diffusion of digital technologies has profoundly transformed business operations, particularly through fintech, e-commerce, and digital management systems that reduce transaction costs and increase accessibility. For micro, small, and medium enterprises (MSMEs), the ability to integrate and utilize these innovations has become critical for competitiveness and sustainability. However, digital transformation depends not only on technology availability but also on users' readiness and willingness to adopt it effectively.

Digital integration has redefined efficiency, productivity, and performance by improving decision-making speed, transparency, and strategic agility. Yet, disparities in technological literacy, limited infrastructure, and varying organizational capabilities lead to inconsistent adoption outcomes across sectors and firm sizes, highlighting the need to understand behavioral, perceptual, and capability related factors influencing technology use among MSMEs.

The Technology Acceptance Model (TAM), introduced, remains influential in predicting technology adoption behavior through cognitive perceptions. Building on TAM, this study incorporates digital capability as a moderating and mediating construct to explain the relationship between Perceived Usefulness (PU), Perceived Ease of Use (PEOU), and business performance within MSMEs.

Technology Acceptance Framework (TAM)

The Technology Acceptance Model (TAM) posits two principal constructs Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) as the core determinants underpinning an individual's acceptance of technology (Davis, 1989). PU is conceptualised as the degree to which an individual believes that employing a specific technological system will improve their task performance, whereas PEOU pertains to the extent to which the technology is perceived as user-friendly and requiring minimal cognitive or operational effort (Thu, Dey, and

Hoang, 2025). Numerous empirical studies validate these constructs as fundamental predictors of user behavior and technology utilization across disciplines. Consequently, the following hypothesis is proposed:

H1: Perceived usefulness has a positive and significant effect on business performance.

H2: Perceived ease of use has a positive and significant effect on business performance.

Technology Perception and Business Performance of MSMEs

Positive perceptions of technology significantly affect business performance in MSMEs. When business owners perceive technological tools as advantageous, they are more likely to integrate them into operations, improving efficiency, service quality, and financial performance (Thu, Dey, and Hoang, 2025). However, Indonesian MSMEs often face low perceived benefits and limited digital literacy. Gefen and Straub (2000) found that many MSMEs did not experience increased profits despite adopting digital tools, while poor technology understanding, especially in rural areas, weakens PEOU (Sudirman, Astuty, and Aryanto, 2025). PEOU and PU are strongly interlinked, as ease of use facilitates perceptions of usefulness by minimizing cognitive effort (Lee, Kozar, and Larsen, 2003). Thus, the following hypothesis is formulated:

H3: Perceived ease of use has a positive and significant effect on perceived usefulness.

Digital Capability as a Moderating and Mediating Variable

Digital capability refers to an organisation's capacity to effectively access, manage, and integrate digital technologies into its business strategy (Pham et al., 2024). Research has shown that digital capability enhances the influence of PU and PEOU on business outcomes (Matarazzo et al., 2021). MSMEs with high digital capabilities tend to utilise digital tools more strategically, leading to enhanced competitiveness and superior performance (Setiawan & Raharja, 2022). Within this analytical framework, digital capabilities may serve dual functions—both as a moderating construct that amplifies the influence of individuals' technological perceptions on performance outcomes, and as a mediating mechanism that explains the pathway through which these perceptions are translated into tangible business results.

Empirical findings suggest that digital capabilities strengthen the connection between PU, PEOU, and performance (Warner and Wäger, 2019; Matarazzo et al., 2021). Therefore, the following hypotheses are proposed:

H4: Digital capability moderates the impact of perceived usefulness on business performance.

H5: Digital capability moderates the impact of perceived ease of use on business performance.

H6: Digital capability moderates the impact of perceived ease of use on perceived usefulness.

Furthermore, previous studies indicate that PU may also mediate the effect of PEOU on business performance. Technologies that are easier to use are often perceived as more beneficial, thereby indirectly improving organizational outcomes (Gefen and Straub, 2000; Nazaruddin, Utami, and Rahmawati, 2023). Thus, the final hypothesis is stated as follows:

H7: Perceived usefulness mediates the relationship between perceived ease of use and business performance.

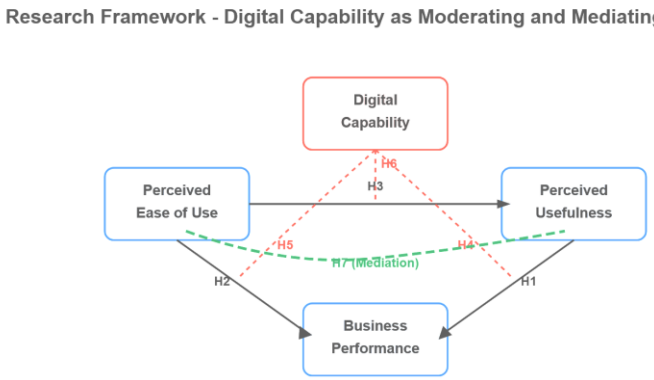

Figure 1. Empirical Framework

METHOD

This research employs a quantitative methodology with an explanatory design to examine the causal relationships among perceived usefulness, perceived ease of use, and digital capabilities in relation to MSME business performance in Makassar City.

The population consists of MSMEs in Makassar that have integrated digital technologies into their operations. Using stratified random sampling and the Slovin formula, 222 respondents were selected across various business sectors, enterprise sizes, and technology adoption durations. Data were collected through structured questionnaires

using a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). The study operationalised four constructs: Perceived Usefulness (Davis, 1989), Perceived Ease of Use (Davis, 1989), Digital Capability (Teece, 2018), and Business Performance.

A pilot study with 30 MSMEs established instrument validity and reliability. Construct validity was assessed through EFA and CFA (factor loadings ≥ 0.70), reliability through Cronbach's alpha and CR (≥ 0.70), convergent validity through AVE (≥ 0.50), and discriminant validity through Fornell-Larcker criterion and HTMT ratio.

Data analysis employed Structural Equation Modelling (SEM) using Partial Least Squares (PLS) with SmartPLS 4, evaluating both outer and inner models. Ethical clearance was obtained, and informed consent ensured data confidentiality and anonymity.

RESULT

Table 1 explains the outcomes of SEM PLS, where each variable indicator has met the validity and reliability criteria.

Table 1. Measurement Framework

Variables	Indicators	Factor Loading	AVE	Composite Reability
Perceived Usability	X1.1	0,887	0,808	0,962167566
	X1.2	0,811		
	X1.3	0,868		
	X1.4	0,854		
	X1.5	0,871		
Perceived Ease of Use	X2.1	0,851	0,625	0,893189253
	X2.2	0,827		
	X2.3	0,897		
	X2.4	0,815		
	X2.5	0,852		
Business Performance	Y1	0,902	0,739	0,934054761
	Y2	0,871		
	Y3	0,891		
	Y4	0,915		
	Y5	0,902		
	Y6	0,913		
Digital Capabilities	Z1	0,743	0,721	0,92826825
	Z2	0,787		
	Z3	0,767		
	Z5	0,822		
	Z6	0,830		

The results derived from the evaluation of the measurement model indicate that all latent constructs employed in this study exhibit robust psychometric properties. Each indicator demonstrates a factor loading exceeding the threshold of 0.70, thereby confirming the strong representational capacity of individual items in capturing their respective constructs. Furthermore, the Average Variance Extracted (AVE) values for the constructs Perceived Usefulness (0.808), Perceived Ease of Use (0.625), Business Performance (0.739), and Digital Capability (0.721) all surpass the conventional benchmark of 0.50, thereby providing compelling evidence of satisfactory convergent validity across the measurement framework. In addition, the composite reliability (CR) values on the four constructs ranged by 0.892 to 0.961, indicating a very high stage of internal consistency. Thus, this research instrument can be declared valid and reliable in measuring the variables studied.

Table 2. Goodness of Fit

No.	Indicators	Value	Threshold	Conclusion
	SRMR			
1	Saturated framework	0,055	≤ 0,07	framework Fit
	framework Estimation	0,055		framework Fit

2	**R^2**			
	Business Performance (Y)	0,708	70,80%	Substantial (strong)
	Digital Capability (Z)	0,281	28,10%	Medium
3	**f^2**			
	Digital Capability Z → Business Performance Y	0,125	≥ 0,02	Small to medium
	Perceived Ease of Use X2 → Business Performance Y	0,153	≥ 0,15	Medium
	Perceived Ease of Use X2 → Digital Capability Z	0,164	≥ 0,15	Currently
	Perceived usefulness X1 → Business performance Y	0,218	≥ 0,15	Medium
	Perceived Usefulness X1 → Digital Capability Z	0,002	≥ 0,02	Not significant / very small
	Digital Capability Z × PU X1 → Business Performance Y (Moderation)	0,096	≥ 0,02	Small
	Digital Capability Z × PEOU X2 → Business Performance Y (Moderation)	0,049	≥ 0,02	Small
4	**Q^2**			
	Business Performance (Y)	0,564	> 0.50	High Prediction
	Digital Capability (Z)	0,163	> 0.00	Low Prediction
	Perceived Ease of Use (X2)	0.000	≤ 00	Not Predictive
	Perceived Usefulness (X1)	0.000	≤ 00	Not Predictive

As presented in the table above, the structural model is deemed to exhibit an acceptable level of model fit, as evidenced by the Standardised Root Mean Square Residual (SRMR) values of 0.055 for the saturated model and 0.055 for the estimated model both of which fall well below the commonly accepted threshold of ≤ 0.07, thereby indicating a satisfactory approximation between the observed and predicted correlation matrices. The R^2 value reveals that business performance (Y) has a coefficient of determination of 0.708 (substantial) and digital capability (Z) of 0.281 (moderate), that means that the constructs in the framework are able to explain the variability of Y and Z quite well. In terms of f^2, the Perceived Ease of Use (X2) and Perceived Usefulness (X1) variables make a moderate contribution to Business Performance and Digital Capability, when the contribution of Perceived Usefulness (X1) to Z is very small (insignificant). Meanwhen, the moderating interaction of digital capability by PU and PEOU on Y only reveals a small impact. Q^2 values corroborate these findings, where Business Performance (Y) has a high predictive ability (Q^2 = 0.564), when Digital Capability (Z) is only low (Q^2 = 0.163), and X1 and X2 are not predictive (Q^2 = 0.000) because they are exogenous constructs.

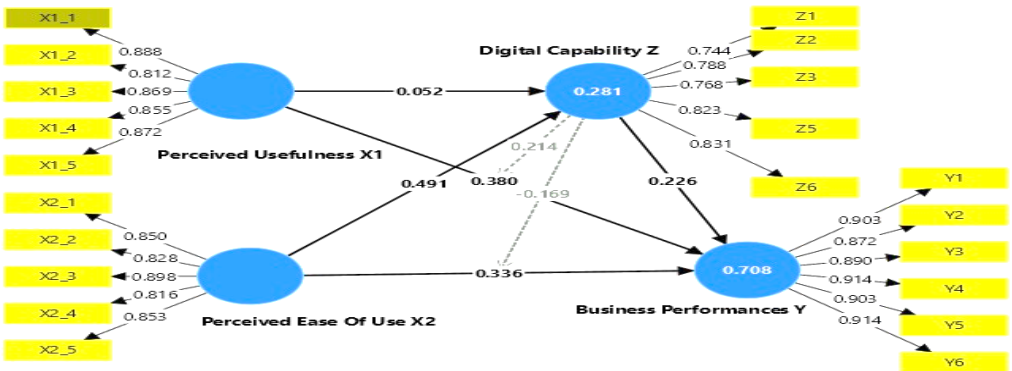

Figure 2. SmartPLS Complete framework

The figure reveals the PLS SEM-based structural framework that illustrates the connection among the four main constructs, namely Perceived Usefulness (X1), Perceived Ease of Use (X2), Digital Capability (Z), and Business Performance (Y). by the framework, it can be seen that X1 has a direct influence on Z (0.052) and Y (0.491), when X2 has a strong influence on Z (0.380) and Y (0.336). Z itself also has a direct influence on Y of

0.226. The framework also reveals the indirect impact of X1 and X2 on Y through Z, by coefficient values of 0.012 and 0.086 respectively (calculated by the paths X1 → Z → Y and X2 → Z → Y). The R^2 value of 0.708 on Y shows that about 70.8% of the variation in business performance can be described by the combination of X1, X2, and Z, when the R^2 on Z of 0.281 shows that 28.1% of the variation in digital capability can be described by X1 and X2. The overall framework reveals a fairly strong connection among constructs by the dominant contribution of X1 and X2 to business performance, both directly and through the mediation of digital capabilities.

Table 3. Moderating the connection

Connection	Coefficient	T-Statistic	P-Value	Description
Digital Capability (Z) on Business Performance (Y)	0,226	3,822	0,000	Significance
Perceived Ease of Use (X2) on Business Performance (Y)	0,447	6,073	0,000	Significance
Perceived Ease of Use (X2) on Digital Capability (Z)	0,491	5,333	0,000	Significance
Perceived Usefulness (X1) on Business Performance (Y)	0,391	4,916	0,000	Significance
Perceived Usefulness (X1) to Digital Capability (Z)	0,052	0,491	0,624	No Significance
Moderation of Z × X1 on Business Performance (Y)	0,214	2,284	0,022	Significance
Moderation of Z × X2 on Business Performance (Y)	-0,169	1,776	0,076	No Significance

The results derived from the structural model analysis, conducted using SmartPLS version 4, indicate that Perceived Usefulness (X1) exerts a statistically significant influence on Business Performance (Y), as evidenced by a path coefficient of 0.391 and a p-value of 0.000. However, its effect on Digital Capability (Z) is not statistically significant, with a comparatively low coefficient of 0.052 and an associated p-value of 0.624. Conversely, Perceived Ease of Use (X2) demonstrates a significant positive effect on both Digital Capability (Z) and Business Performance (Y), with respective path coefficients of 0.491 and 0.447, both supported by highly significant p-values of 0.000, thus underscoring its pivotal role in influencing technological integration and organizational performance. Digital Capability (Z) is likewise found to exert a statistically significant influence on Business Performance (Y), as indicated by a path coefficient of 0.226 and a p-value of 0.000. The results of the moderation analysis further reveal that digital capabilities significantly enhance the strength of the relationship between Perceived Usefulness (X1) and Business Performance (Y), thereby acting as an effective moderating variable in this context. However, this moderating effect is not observed in the relationship between Perceived Ease of Use (X2) and Business Performance (Y), as the interaction does not reach statistical significance.

Based on the analytical outcomes, it may be concluded that five out of the seven hypothesized relationships are empirically supported, while the remaining two are not substantiated by the data. Specifically, Hypothesis 1 (H1) is rejected on the grounds that Perceived Usefulness does not exhibit a statistically significant effect on Digital Capability. In contrast, Hypotheses 2 through 5 (H2, H3, H4, and H5) are accepted, as each demonstrates a significant direct relationship within the proposed structural framework. Hypothesis 6 (H6) is also rejected, given that the mediating pathway from Perceived Usefulness to Business Performance via Digital Capability fails to achieve statistical significance, attributable to the non-significant association observed between X1 and Z. Meanwhen, H7 is accepted because perceived usefulness does not have a significant direct impact on digital capability. Meanwhen, H7 is accepted because perceived ease of use has a significant impact on digital capability, and digital capability is also significant on business performance, so there is a significant indirect mediating impact.

We define the variables: U(t): Perceived usefulness; E(t): Perceived ease of use; D(t): Digital capability; P(t): ***Business Performance.***

The dynamic interaction among these variables is described by the system:

$$dP/dt = \alpha 1U + \alpha 2E + \beta D - \lambda P,$$
$$dD/dt = \gamma 1U + \gamma 2E - \delta D.$$

where $\alpha i, \beta, \gamma i, \lambda, \delta > 0$ are sensitivity parameters representing influence rates and decay coefficients.

At equilibrium ($dP/dt = 0, dD/dt = 0$): $P^* = (\alpha 1U + \alpha 2E + \beta D^*)/\lambda$, $D^* = (\gamma 1U + \gamma 2E)/\delta$. Substituting D^* into P^* yields:

$$P^* = (1/\lambda)(\alpha 1U + \alpha 2E + (\beta/\delta)(\gamma 1U + \gamma 2E)).$$

Thus, the steady-state business performance depends linearly on perceived usefulness and ease of use, scaled by the rates of digital capability growth.

Using a numerical Runge–Kutta method with parameters $\alpha1 = 0.5$, $\alpha2 = 0.3$, $\beta = 0.2$, $\gamma1 = 0.4$, $\gamma2 = 0.6$, $\lambda = 0.1$, $\delta = 0.05$, and initial values $U(0) = 0.8$, $E(0) = 0.7$, $D(0) = 0.2$, $P(0) = 0.3$, the system converges toward a steady-state equilibrium within approximately 20 time units. The simulation reveals that P(t) increases monotonically until saturation, while D(t) follows a logistic-like growth, confirming stability under positive feedback conditions.

To identify the optimal policy for MSMEs to enhance digital performance, we define a control function minimizing cost:

$\max(U,E) \int_0^T [P(t) - c1U^2 - c2E^2] dt$,

subject to the dynamic constraints above. Applying Pontryagin's Maximum Principle, the optimal controls U*(t) and E*(t) satisfy the Hamiltonian system and provide an analytical foundation for policy optimization.

DISCUSSION

The path analysis outcomes reveal that perceived usefulness (X1) has a relatively small and insignificant impact on digital capability (Z). by a coefficient value of 0.052 and an f2 impact of 0.002, this is well below the limit of practical relevance suggested in recent research, as showd by (Hair *et al.*, 2017), that states that f2 impact values below 0.02 show a very small contribution to modification. This reveals that although there is a positive connection among perceived usefulness and digital capability, its contribution in this study is relatively weak. This outcome is in accordance by the opinion of (Venkatesh and Davis, 2000) in the TAM2 framework that states that the intention to use is more influential than the direct enhancement of digital capabilities.

In contrast, perceived ease of use (X2) revealed a significant positive impact on digital capabilities, by an impact value of f2 of 0.164, that shows a moderate impact according to the criteria of (Hair *et al., 2009*)., 2021). This strengthens the argument that perceived ease of use of technology plays an important framework in driving the enhancement of digital capabilities in organisations. In line by (Davenport and Westerman, 2018), organisations that have easy-to-use digital systems tend to be more successful in building overall digital capabilities. Thus, it is needed to incorporate an adequate infrastructure or training support at the same time and beyond taking into consideration the functionality of the technology platform. In accordance by the analysis findings in the Goodness of Fit Table, Business Performance (Y) is significantly affected both positively by Perceived Usefulness (X1) and Perceived Ease of Use (X2). The f2 impact value is 0.218 and 0.153 respectively, that is included in the moderate influence category according to (Hair *et al., 2017*)., 2021) The outcomes revealed that the perceived benefits and ease of use of technology actually enhance business performance. This is in line by (Davis, 1989) and is supported by new research such as (Turel and Gil-Or, 2021) [2]and (Al Okaily *et al.*, who found that positive perceptions of technology increase business performance., 2022), that found that positive perceptions of technology drive adoption and the achievement of more impactive business outcomes. Therefore, both components are critical to help organisations implement digital technologies successfully.

Digital Capability (Z) has a positive influence on Business Performance (Y) by an f2 value of 0.125 that falls into the small to medium category (≥ 0.02). These outcomes show that digital capabilities, although not dominant, contribute to improving business performance. This is in line by (Teece, 2018) that states that digital capabilities include the integration of technology, processes, and resources to create competitive advantage, as well as (Warner and Wäger, 2019) that emphasises the framework of digital capabilities in improving organizational adaptivity to market changes. Thus, digital capabilities remain an important strategic component to support business success in the age of computers and the internet, although their impact is not as great.

The findings by the analysis demonstrate that the variable related to digital capability, Z, does not significantly mediate the connection among X1, perceived usefulness, and business performance Y. The outcome 0.002 that is smaller than the expected value 0.02 reflects a small impact. This is in line by the opinion of and (Hair *et al.*, 2021) that states that X1 to Z path does not satisfy sufficient mediation criteria as no meaningful connections can be observed among the three independents, mediator, connection, and dependent variables. However, capability-perceived ease of use relations to business performance revealed that digital capability (Z) did mediate the connection among perceived ease of use (X2) and business performance (Y) by a weak yet significant mediating impact. This supports the TAM framework (Davis, 1989) and findings by (Nitzl, Roldan and Cepeda, 2016).

The mathematical results confirm the qualitative insights from prior empirical TAM research: perceived ease of use exerts both direct and indirect effects on business performance through digital capability. The analytical framework provides a quantifiable method to measure these effects, bridging management science and mathematical modeling.

CONCLUSION

The findings of this investigation underscore the positive contribution of both the perceived ease of use and perceived usefulness of technology in enhancing the business performance of micro, small, and medium-sized enterprises (MSMEs). Both constructs exhibit a statistically significant direct effect on business performance, thereby suggesting that favourable cognitive appraisals of technology facilitate more effective adoption and translate into improved organisational outcomes. Notably, however, only Perceived Ease of Use demonstrates a significant relationship with the development of digital capabilities, whereas Perceived Usefulness does not exhibit a statistically meaningful influence in this regard, indicating a differentiated impact of these constructs on technological competence enhancement.

Furthermore, digital capabilities are shown to exert a positive, albeit non-dominant, influence on business performance, functioning primarily as a mediating variable in the relationship between Perceived Ease of Use and business outcomes. This finding implies that while digital competencies contribute to performance enhancement, their role is contingent upon the ease with which technology can be adopted and utilised by MSME actors. Consequently, strategic efforts aimed at advancing digital transformation within the MSME sector should prioritise initiatives that enhance the usability of technological tools and ensure the provision of adequate infrastructural and educational support. Such an approach would facilitate the effective development of digital capabilities and, in turn, yield more substantial improvements in overall business performance.

Conflicts of Interest: The authors declare that there are no conflicts of interest regarding the publication of this paper.

REFERENCES

Al Okaily, M., Al-Okaily, A., Alshurideh, M., Al Kurdi, B., & Masa'deh, R. (2022). The relationship between digital transformation and business performance: Evidence from small and medium enterprises. *Journal of Open Innovation: Technology, Market, and Complexity, 8*(3), 123. https://doi.org/10.3390/joitmc8030123

Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51*(6), 1173–1182. https://doi.org/10.1037/0022-3514.51.6.1173

Davenport, T. H., & Westerman, G. (2018). Why so many high-profile digital transformations fail. *Harvard Business Review.* https://hbr.org

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319–340. https://doi.org/10.2307/249008

Gefen, D., & Straub, D. W. (2000). The relative importance of perceived ease of use in IS adoption: A study of e-commerce adoption. *Journal of the Association for Information Systems, 1*(1), 1–28. https://doi.org/10.17705/1jais.00008

Google & Temasek. (2021). *e-Conomy SEA 2021: Roaring 20s – The SEA digital decade.* https://economysea.withgoogle.com

Gonzalez-Varona, J. M., Sánchez-Ruiz, L., García-Sánchez, I. M., & Moreno-Albarracín, A. L. (2024). Digital capabilities and SME performance: A moderating role in technology acceptance. *Technological Forecasting and Social Change, 198*, 123721. https://doi.org/10.1016/j.techfore.2023.123721

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2017). *A primer on partial least squares structural equation modeling (PLS-SEM)* (2nd ed.). SAGE Publications.

Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2021). When to use and how to report the results of PLS-SEM. *European Business Review, 31*(1), 2–24. https://doi.org/10.1108/EBR-11-2018-0203

Information. (2021). *National digital transformation survey report.* Ministry of Communication and Information Technology of Indonesia.

Information. (2023). *Annual report on MSME contribution to national GDP.* Ministry of Cooperatives and Small–Medium Enterprises, Republic of Indonesia.

Lee, Y., Kozar, K. A., & Larsen, K. R. T. (2003). The technology acceptance model: Past, present, and future. *Communications of the Association for Information Systems, 12*(1), 752–780. https://doi.org/10.17705/1CAIS.01250

Matarazzo, M., Penco, L., Profumo, G., & Quaglia, R. (2021). Digital transformation and customer value creation in Made in Italy SMEs: A dynamic capabilities perspective. *Journal of Business Research, 123*, 642–656. https://doi.org/10.1016/j.jbusres.2020.10.033

Nazaruddin, R., Utami, R., & Rahmawati, D. (2023). The mediating role of perceived usefulness in the effect of perceived ease of use on business performance. *Journal of Small Business and Enterprise Development, 30*(5), 912–929.

Nitzl, C., Roldan, J. L., & Cepeda, G. (2016). Mediation analysis in partial least squares path modeling: Helping researchers discuss more sophisticated models. *Industrial Management & Data Systems, 116*(9), 1849–1864. https://doi.org/10.1108/IMDS-07-2015-0302

Pham, T. H., Le, N. T., Nguyen, V. Q., & Hoang, T. H. (2024). Building digital capabilities for SMEs: The role of leadership and technological readiness. *International Journal of Information Management, 76*, 102651. https://doi.org/10.1016/j.ijinfomgt.2023.102651

Rahman, F. (2019, February). Save the world versus man-made disaster: A cultural perspective. In *IOP Conference Series: Earth and Environmental Science* (Vol. 235, No. 1, p. 012071). IOP Publishing.

Setiawan, R., & Raharja, S. (2022). Digital capability and business performance: Evidence from Indonesian SMEs. *Asia Pacific Management Review, 27*(1), 1–11. https://doi.org/10.1016/j.apmrv.2021.08.001

Sudirman, H., Astuty, E., & Aryanto, D. (2025). Digital literacy and technology adoption behavior among MSME owners in Indonesia. *Journal of Entrepreneurship and Business Studies, 9*(1), 45–59.

Teece, D. J. (2018). Business models and dynamic capabilities. *Long Range Planning, 51*(1), 40–49. https://doi.org/10.1016/j.lrp.2017.06.007

Thu, P. T., Dey, B. L., & Hoang, T. H. (2025). Exploring perceived ease of use and usefulness in the digital transformation of SMEs: Evidence from Southeast Asia. *Journal of Small Business Management, 63*(2), 233–252.

Tilman, M. V., Rahman, F., & Budimawan. (2025). Cultural determinants of integrated coastal fisheries management: Achieving the blue economy of the Bononaro coastal community of Timor-Leste. *International Journal of Current Science Research and Review, 8*(9), 4835–4844.

Turel, O., & Gil-Or, O. (2021). The role of perceived usefulness and ease of use in social media adoption for business performance. *Information & Management, 58*(7), 103482. https://doi.org/10.1016/j.im.2021.103482

Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science, 46*(2), 186–204. https://doi.org/10.1287/mnsc.46.2.186.11926

Warner, K. S. R., & Wäger, M. (2019). Building dynamic capabilities for digital transformation: An ongoing process of strategic renewal. *Long Range Planning, 52*(3), 326–349. https://doi.org/10.1016/j.lrp.2018.12.001

