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Research Paper

Business Model Innovation in the Digital Ecosystem: The Role of Transformation, Readiness, and Digital Inclusion for Sustainable Economic Growth

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Abstract

The rapid acceleration of digital transformation has changed the business landscape worldwide, but micro, small, and medium enterprises (MSMEs) in developing regions continue to face structural gaps in digital readiness and inclusion. In Medan, Indonesia, where MSMEs are the backbone of the economy, limited digital adoption and uneven readiness hinder their ability to maintain competitiveness and contribute to inclusive economic growth. This phenomenon highlights the importance of analysing how digital transformation variables interact with innovation processes and collaborative ecosystems to generate sustainable economic outcomes. The objective of this study is to investigate the indirect effects of digital readiness, digital inclusion, and digital transformation on sustainable local economic development through the dual mediation of innovation business models and ecosystem business models. Using an explanatory quantitative design, data were collected from 200 SMEs in Medan that had been involved in digitalisation for at least two years. Structural Equation Modelling–Partial Least Squares (SEM-PLS) was applied to test the proposed Digital Ecosystem Innovation Model (DEIM). The results show that digital readiness, inclusion, and transformation do not have a direct effect on sustainable economic growth. Instead, their impact becomes significant when mediated by innovation and ecosystem business models. Digital readiness strongly drives innovation, while digital inclusion enhances both innovation and ecosystem collaboration. Furthermore, the ecosystem business model emerges as the strongest predictor of sustainable local economies, highlighting the importance of coordinated value creation among stakeholders. This study concludes that digital transformation should not be viewed as an end goal, but rather as a systemic process requiring business model adaptation and the development of collaborative ecosystems. This research contributes theoretically by expanding the Technology–Organisational Environment (TOE) framework through the DEIM model, integrating readiness, inclusion, and innovation into a holistic approach. Practically, this research provides policy insights to improve the resilience of MSMEs through digital literacy, innovation capacity, and cross-sector collaboration.

Keywords: *Digital Transformation, Business Model Innovation, Ecosystem Business Model, Sustainable Economy.*

INTRODUCTION

Digital transformation has become a key strategy for the sustainability and competitiveness of Micro, Small, and Medium Enterprises (MSMEs) amid the COVID-19 pandemic and the acceleration of the Fourth Industrial Revolution (Sitorus et al., 2024). In Medan, North Sumatra, MSMEs contribute more than 60% of employment and contribute to the regional GDP (Medan City Statistics Agency, 2025). However, despite MSMEs playing a vital role in the local economy, they have not yet fully adopted digital technology comprehensively. Only one-third of MSME players actively use digital platforms, while the majority still operate without a clear digital strategy. This gap is reflected in the low level of digital readiness among local MSMEs. According to the latest data, only 30.1% of MSMEs in Medan actively utilise digital platforms, with most others relying on conventional business models (Medan City Cooperative, SME, Industry and Trade Agency, 2025; Mo et al., 2023).

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The main challenges faced include low digital literacy, infrastructure limitations, and a lack of understanding of the digital business framework. From a global perspective, digital readiness and digital inclusion have become fundamental aspects in building a sustainable digital ecosystem. Digital readiness refers to technological competence and infrastructure support, while digital inclusion encompasses equitable access and active participation without discrimination (UNDP Indonesia, 2012; Khasawneh, 2024; Bughin et al., 2018; Santoso & Meera, 2017). In the context of MSMEs, the use of technologies such as e-commerce, digital payment systems, and data analysis is highly dependent on internal readiness and a supportive ecosystem (Lutfi et al., 2022; Omrani et al., 2024).

However, digital readiness among MSMEs in Medan is still inconsistent. A 2023 report from the North Sumatra Provincial Government (2023)(Bappeda) shows that 41% of MSMEs are not yet ready for digital transformation, 31% are partially ready, and only 28% are fully ready. This discrepancy reflects differences in readiness among MSME groups based on business scale, sector, and location within the city of Medan, with some businesses having made significant strides in technology adoption while others remain stuck in entirely conventional business practices. These differences point to structural vulnerabilities in the regional digital economy. Furthermore, many MSMEs still rely on conventional business models, which limit innovation and adaptability in the face of dynamic market demand. This digital inequality has the potential to exacerbate existing socio-economic disparities. Digitally lagging MSMEs tend to have higher transaction costs, narrower market access, and a lower ability to utilise real-time market information. This reduces productivity and profit margins, thereby widening the income gap between digitally connected and non-connected businesses. At the same time, digitally included MSMEs are able to utilise e-commerce and fintech platforms for geographical expansion and market diversification, thereby strengthening their competitive advantage and indirectly eroding the competitive position of businesses that remain stuck in traditional business models.

Digital transformation in MSMEs is largely driven by the availability and accessibility of technological infrastructure. Basic components such as stable internet connections, appropriate hardware, and updated software are the cornerstones of digital technology adoption (Díaz-Arancibia et al., 2024). However, technology adoption must be aligned with business needs, operational scale, and workforce capabilities. Six-stage roadmap as a phased approach to help MSMEs adopt technology based on their business objectives, rather than simply following trends. This roadmap is conceptually linked to digital readiness and business model innovation because each stage requires adjustments to business processes, value proposition structures, and customer interaction patterns as technology intensity increases, thereby driving the transition from conventional business models to more innovative and digitally integrated models.

Readiness to adopt technology, known as digital readiness, encompasses not only technical competence but also the organisational mindset towards innovation. Baihaqy and Subriadi (2023) argue that digital readiness stems from a combination of internal cultural competencies and external regulatory support. Luthra et al. (2020) offer a comprehensive evaluation framework based on three pillars: technology infrastructure, change management, and human resources. This framework shows that digital readiness is a key driver of sustainable innovation, especially in regions such as Medan where MSMEs face constant market volatility. However, the digital divide remains an urgent challenge. Bhuiyan et al. (2024) identify cost barriers, network limitations, and digital illiteracy as significant obstacles for MSMEs in developing countries.

They recommend local interventions, such as technology-based training programmes and the establishment of community technology centres. This perspective is in line with the findings of Gurzhii et al. (2022), who emphasise that mature digital readiness supports the adoption of disruptive technologies such as blockchain, especially for MSMEs in the trade and food sectors.

Strategic technology adoption must also be supported by a systemic framework. Agrawal et al. (2022) highlight the importance of integrating circular economy principles and Industry 4.0 readiness before implementing new technologies. They advocate for a policy framework that ensures technology adoption is not merely symbolic but functions deeply and sustainably. This emphasises the need for a structured digital pathway, namely a systematic series of stages ranging from strengthening basic infrastructure, increasing digital literacy and capacity, developing technology-based business models, to integration into a broader digital ecosystem. This pathway can be realised in the form of a policy roadmap, phased training programmes, or a technology maturity model tailored to the context of local MSMEs.

Beyond technology, organisational dimensions such as structure, human capital, and digital strategy are integral parts of digital transformation. A lean and flexible organisational structure facilitates quick decision-making and supports cross-functional integration (Rachinger et al., 2021). Digital competence among human resources is a prerequisite for sustaining transformation efforts. Gfrerer et al. (2023) emphasise the importance of continuous training and certification, stressing that internal capacity building must be prioritised alongside external partnerships. Developing a digital strategy enables SMEs to align technology adoption with their long-term vision. Li et al. (2022) show that businesses with documented and realistic digital strategies are more successful in driving innovation. Such strategies guide technology investment, business process adjustments, and value proposition realignment so that business model innovation becomes more focused and consistent with the organisation's long-term goals. Leadership also plays a critical role, with digital leaders fostering a culture of innovation and agile responses (Hanelt et al., 2021). Meanwhile, Vial (2021) emphasises that a culture that encourages experimentation, risk-taking, and cross-functional collaboration accelerates digital transformation.

Collaborative organisational structures are particularly relevant for SMEs seeking to avoid isolated decision-making. Bharadwaj et al. (2020) recommend redesigning business processes through interdisciplinary teams to ensure effective strategy implementation. This is also expressed by Proksch et al. (2022), who introduce the digital balanced scorecard as a strategic evaluation tool to measure digital performance across various dimensions such as productivity and customer satisfaction. Environmental factors, including government policies, inclusive ecosystems, and market forces, are equally crucial. Nair et al. (2023) argue that decentralised and inclusive policy support is needed to strengthen digital infrastructure in regions such as Medan. Frick et al. (2021) found that the involvement of local actors in designing digital acceleration programmes produces better results than a centralised approach. Cross-sector collaboration has proven successful in building the resilience of MSMEs through shared digital infrastructure and context-specific support.

The evolution of the digital market provides external incentives for MSMEs to adopt transformation. The use of digital platforms significantly expands market reach and increases revenue (Turki et al., 2023). Integration with digital ecosystems such as e-commerce markets and fintech platforms improves operational efficiency (Nambisan et al., 2021). Community-based innovations, including co-working spaces and digital hubs, further encourage knowledge sharing and accelerate the learning process (Spigel & Harrison, 2020). However, inconsistent regulatory frameworks remain a barrier (Elia et al., 2020), signalling the need for adaptive policies that facilitate innovation while maintaining legal certainty. In this context, 'institutional awareness' refers to the understanding and commitment of public and private organisations, such as local governments, educational institutions, business associations, and digital platform providers, to make the digital transformation of MSMEs a strategic priority, including in budget allocation, programme design, and regulation. Meanwhile, 'culture-appropriate policy mechanisms' refer to policy instruments that take into account the social characteristics, language, and business patterns

in Medan, such as the dominance of family businesses, community-based trust patterns, and preferences for face-to-face interaction. Culturally sensitive policies are expected to reduce resistance to technology adoption and increase SME participation in the digital ecosystem.

Theoretical consolidation is achieved through the Technology–Organisation–Environment (TOE) framework, which holistically analyses the digital transformation of MSMEs. Based on the integration of digital readiness, digital inclusion, business model innovation, ecosystem business models, and sustainable local economies, this framework offers a multidimensional lens for understanding the dynamics of transformation. In this article, the term 'interrelationship' specifically refers to the causal relationship between the three main pillars, digital readiness, digital inclusion, and business model innovation, each of which is placed in the technology, organisation, and environment dimensions of the TOE framework, and how these relationships converge in the formation of ecosystem business models and their impact on a sustainable local economy. Studies by Torres et al. (2023) and Gallego and Gutierrez (2020) emphasise the importance of equity and access in building a sustainable digital ecosystem. The contribution of this article lies in the proposed integration model, the Digital Ecosystem Innovation Model (DEIM), which expands the TOE framework by incorporating digital readiness, digital inclusion, business model innovation, and ecosystem business models into an integrated framework, rooted in the DEIM framework.

Digital Ecosystem Innovation Model (DEIM), which expands the TOE framework by incorporating digital readiness, digital inclusion, business model innovation, and ecosystem business models into an integrated, locally rooted, and sustainability-oriented framework, thereby addressing the empirical and theoretical gaps identified in previous research. At the international level, various strategies such as digital servitisation, omnichannel integration, and artificial intelligence implementation have driven the digital transformation of MSMEs (Lamperti et al., 2024; Jorzik et al., 2024). However, replicating these models without localisation is insufficient. Medan's unique socio-economic context requires context-sensitive strategies that reflect the local digital landscape. This necessitates institutional awareness and policy mechanisms that are culturally appropriate, as explained earlier.

Cross-sector collaboration has proven vital in improving SME readiness. A collaborative ecosystem involving the government, academics, private digital platforms, and local communities has facilitated inclusive growth (Gao, 2024; Berliandaldo et al., 2021). Empowerment models based on community engagement, digital training, fiscal incentives, and technological support are essential to overcoming resistance and building resilience (Bican & Brem, 2020; Berliandika et al., 2021). Resistance to change, particularly in the form of low digital literacy among the workforce, is another structural barrier. Inertia embedded in traditional business practices and a general distrust of digital tools hinder progress (Firmansyah & Saepuloh, 2022; Ahmad, 2022). To overcome these multifaceted challenges, a comprehensive and integrated strategy is needed that encompasses digital readiness, digital inclusion, and transformation as a synergistic trinity.

This study proposes the Digital Ecosystem Innovation Model (DEIM), which integrates the three pillars of digital transformation readiness, inclusion, and innovation into a single strategic framework. The aim is to develop a model tailored to the unique SME environment in Medan to support the formation of a sustainable digital business ecosystem. Based on the TOE framework developed by Tornatzky and Fleischer, this study contributes to the theoretical understanding of digital transformation by analysing the interrelationships between technology, organisation, and environment dimensions (Lutfi et al., 2022; Cahyadi & Pradnyani, 2022; Purnomo et al., 2023; Omrani et al., 2024; Zahra et al., 2023). By placing MSME digital innovation within this integrative framework, this study offers a practical model for regional development and an academic contribution to the digital transformation literature.

In this study, 'sustainable economic growth' is operationalised at the local/regional level through MSME actors' perceptions of their businesses' contributions to job creation, increased household income, medium-term business stability, and involvement in environmentally friendly and inclusive local economic activities. Meanwhile, 'digital ecosystem' is operationalised as a network of interactions between MSMEs and digital platforms (e-commerce, fintech), government agencies, financial institutions, and other business partners that facilitate technology-based information exchange, transactions, and collaboration.

Thus, the urgency of this research lies in the risk of lost growth opportunities if the digital readiness and inclusion gap in Medan is not immediately addressed. Digitally lagging MSMEs risk being excluded from modern supply chains, losing access to broader markets, and becoming increasingly vulnerable to economic shocks. Previous studies have highlighted the importance of SME digital transformation, but many still focus on the company level and have not adequately explained how the combination of digital readiness, digital inclusion, business model innovation, and ecosystem business models together form a path towards a sustainable local economy within the TOE framework. This study helps address this gap by developing and testing DEIM, which explicitly maps how the digital capabilities of MSMEs can be translated into sustainable local economic value, providing direct implications for policymakers, MSME actors, and regional stakeholders in Medan.

Based on the above description, this study aims to answer how digital readiness, digital inclusion, and digital transformation influence business model innovation and the formation of ecosystem business models in MSMEs in Medan. In addition, this study also seeks to examine the extent to which business model innovation and ecosystem business models act as mediators in the relationship between digital readiness, digital inclusion, and digital transformation with a sustainable local economy. Furthermore, this study aims to understand how the Digital Ecosystem Innovation Model (DEIM), developed based on the Technology–Organisation–Environment (TOE) framework, explains the path of SME digital transformation towards sustainable local economic outcomes in the context of the digital divide that is still evident in Medan.

LITERATURE REVIEW

Literature Review

Digital transformation in MSMEs requires support from various factors, including technology, organisation, and environment, which are interrelated to create a sustainable digital ecosystem. This study presents a synthesis of various studies discussing these three factors and how they influence the success of MSME digitalisation.

Technological Factors: Infrastructure and Digital Readiness

Digital transformation in MSMEs is highly dependent on the availability and accessibility of technological infrastructure. Basic components such as stable internet connections, appropriate hardware, and updated software are the main pillars for digital technology adoption (Díaz-Arancibia et al., 2024). However, technology adoption must be aligned with business needs, operational scale, and workforce capabilities. A six-stage roadmap to help SMEs tailor technology to their business objectives, rather than simply following trends. Each stage in the roadmap explicitly links the level of technological maturity with changes in business processes and the development of new value propositions, thus serving as a mechanism that connects digital readiness (availability and ability to manage technology) with business model innovation (re-designing how SMEs create, deliver, and capture value).

Digital readiness, which encompasses technical competence and organisational mindset towards innovation, is also a crucial factor in this transformation process. Baihaqy and Subriadi

(2023) show that digital readiness is rooted in a combination of internal cultural competencies and external regulatory support. Luthra et al. (2020) developed an evaluation framework that assesses digital readiness based on three main pillars: technology infrastructure, change management, and human resources. This framework shows that digital readiness is not only about technical capabilities, but also the organisation's readiness to adapt to the changes brought about by technology.

Organisational Factors: Structure and Human Resources

Beyond technological factors, organisational dimensions such as corporate structure, human capital, and digital strategy play an important role in the success of MSME digital transformation. A flexible and lean organisational structure can facilitate quick decision-making and support cross-functional integration (Rachinger et al., 2021). Gfrerer et al. (2023) emphasise the importance of continuous training and certification in building the internal capacity needed to sustain transformation efforts. Strategic technology adoption must be supported by a mature digital strategy. Li et al. (2022) found that MSMEs with clear and documented digital strategies were more successful in driving innovation.

In this context, business model innovation is understood as the ability of SMEs to redesign their value architecture, covering customer segments, value propositions, channels, relationships, key resources, key activities, and cost/revenue structures, based on the utilisation of digital technology, rather than simply the technical ability to adopt new devices or applications. Leadership also plays an important role, with digital leaders capable of fostering a culture of innovation and agile responses (Hanelt et al., 2021). A culture that encourages experimentation, risk-taking, and cross-functional collaboration can accelerate the digital transformation process, as demonstrated by Vial (2021).

Environmental Factors: Inclusive Policies and Ecosystems

The external environment, including government policies, inclusive ecosystems, and market forces, also determines the success of SME digital transformation. Nair et al. (2023) advocate for decentralised and inclusive policy support to strengthen digital infrastructure in regions such as Medan. Frick et al. (2021) found that the involvement of local actors in designing digital acceleration programmes produces better results than a centralised approach.

Cross-sector collaboration has proven successful in building SME resilience through shared digital infrastructure and support tailored to the local context. Governments, academics, private digital platforms, and local communities can support each other to create a more inclusive ecosystem (Gao, 2024; Berliandaldo et al., 2021). However, regulatory uncertainty remains a challenge that hinders the digitalisation process of MSMEs. Elia et al. (2020) show that an inconsistent regulatory framework can hamper innovation, indicating the need for adaptive policies that support digital technology development while maintaining legal certainty.

Business Model Innovation and Digital Ecosystems

The use of digital platforms such as e-commerce and fintech has provided incentives for MSMEs to adopt digital technologies, which in turn expands their market reach and increases revenue (Turki et al., 2023). Integration with a broader digital ecosystem enables MSMEs to improve operational efficiency and drive data-driven growth (Nambisan et al., 2021). Community-based innovations, such as co-working spaces and digital hubs, can also encourage knowledge sharing and accelerate the learning process (Spigel & Harrison, 2020).

In this study, business model innovation refers to significant changes in the elements of SME business models enabled by digital technology, such as a shift from face-to-face sales to

omnichannel sales, the introduction of subscription-based services, or the integration of digital payments and platform-based after-sales services. Meanwhile, ecosystem business models refer to coordinated value creation patterns among various actors, SMEs, digital platforms, financial institutions, governments, and communities, that interact in digital networks to jointly create, deliver, and capture value.

Technology–Organisation–Environment (TOE)

This study is based on the Technology–Organisation–Environment (TOE) framework developed by Tornatzky and Fleischer (1990). The TOE framework explains that the adoption and diffusion of technological innovations in organisations are influenced by three main dimensions: (1) the technology dimension, which includes the availability, characteristics, and compatibility of technology; (2) the organisational dimension, which includes the size, structure, resources, and internal processes of the organisation; and (3) the environmental dimension, which includes competitive pressure, regulation, and external institutional support. This framework was chosen because it comprehensively explains the dynamics of SME digital transformation, which is determined not only by technical factors but also by the internal capacity of the organisation and the surrounding external environmental conditions (Baker, 2020; Zhu et al., 2020).

In the context of this study, digital readiness is placed primarily in the technological dimension (e.g., available infrastructure, systems, and digital tools), while digital transformation and business model innovation are rooted in the organisational dimension (e.g., strategy, processes, and culture). Digital inclusion and ecosystem business models are represented as part of the environmental dimension because they are related to access, regulation, and collaboration networks at the regional level. Thus, TOE provides an initial framework for mapping how the combination of technological, organisational, and environmental factors contributes to a sustainable local economy.

Digital Ecosystem Innovation Model (DEIM)

The Digital Ecosystem Innovation Model (DEIM) proposed in this study is an extension of the TOE framework, focusing on four key constructs: (1) digital readiness as the primary representation of the technological dimension; (2) digital inclusion as the primary representation of the environmental dimension; (3) business model innovation as the organisational capability to redesign digital-based business models; and (4) ecosystem business model as the configuration of cross-actor value networks that support a sustainable local economy.

Conceptually, DEIM views digital readiness and digital inclusion as forming the foundation of MSME digital capabilities. Digital readiness drives digital transformation and business model innovation at the company level, while digital inclusion enables MSMEs to connect with platforms, markets, and partners in a broader digital ecosystem. Business model innovation then becomes the main mechanism for translating technological opportunities and digital access into new value propositions, while the ecosystem business model becomes a vehicle for the co-creation of value among actors.

DEIM expands TOE by explicitly including sustainable local economies as the outcome, so that the relationship between dimensions does not stop at technology adoption, but also extends to socio-economic impacts at the regional level. Thus, DEIM offers a more integrative perspective on how technological, organisational, and environmental factors interact through innovation and ecosystems to generate sustainable local economic growth.

Synthesis and Research Hypotheses

Based on a review of the literature, there is a close relationship between digital readiness, digital inclusion, and technology adoption with business model innovation and digital ecosystems in supporting the sustainable economic growth of MSMEs. Therefore, this study proposes the following hypotheses:

H1: MSME digital readiness has a positive influence on business model innovation.

H2: Digital readiness, digital inclusion, and digital transformation have a positive effect on the ecosystem business model.

H3: Digital inclusion enhances collaboration within the business ecosystem, which in turn drives sustainable local economic growth.

H4: Digital transformation has a positive effect on business model innovation in SMEs.

H5: Business model innovation has a positive effect on sustainable local economies.

H6: The ecosystem business model has a positive effect on sustainable local economies.

H7: Business model innovation and the ecosystem business model mediate the relationship between digital readiness, digital inclusion, and digital transformation with sustainable local economies.

The model proposed in this study, DEIM, integrates digital readiness, digital inclusion, digital transformation, business model innovation, and ecosystem business models into the TOE framework to understand the dynamics of digital transformation in SMEs, as well as to identify and address empirical and theoretical gaps in previous studies.

RESEARCH METHOD

This study uses an explanatory quantitative approach to analyse the causal relationship between digital readiness, digital inclusion, and digital transformation, as well as their impact on business model innovation, ecosystem business models, and sustainable local economies among MSMEs in Medan, Indonesia. This approach was chosen because it allows for testing the influence between latent variables in complex conceptual models, as well as providing an in-depth understanding of the relationships between the variables under study (Hair et al., 2021).

Population and Sample

The research population consisted of SME actors in Medan who had been involved in digital activities for at least two years. Digital involvement refers to the use of e-commerce platforms, social media for marketing, digital payment systems, or technology-based business management applications. The minimum criterion of two years was used to ensure that digital transformation, business model innovation, and integration into the digital ecosystem were not temporary but had become part of relatively stable business operations, so that the causal relationships between variables could be observed more accurately.

Purposive sampling techniques were used to select respondents who met these criteria. The sample frame was compiled based on MSME data obtained from the Medan City Cooperative, SME, Industry and Trade Office, and local MSME associations, which was then filtered to identify businesses that had been using digital technology for at least two years.

Respondents were contacted through a combination of approaches, including invitations through associations, direct contact through field visits, and distribution of online survey links to MSMEs that were recorded as active on local digital platforms. Based on the practical rules for the Partial Least Squares Structural Equation Modelling (PLS-SEM) model, the minimum sample size required was 200 respondents.

This number was determined based on the number of indicators used in the largest construct in the research model, to ensure the stability of the estimates and the validity of the results (Hair et

al., 2021). The final sample size for this study was 200 MSMEs, which reflects an adequate response rate compared to the invitations that were distributed. Respondents came from various key sectors, such as trade, services, and small-scale manufacturing, with the majority falling into the micro and small business categories. In addition, most of the SMEs in the sample had been operating for more than five years, giving them sufficient experience in managing businesses and adopting digital technology.

Data Collection Instruments

Data was collected using a closed questionnaire with a 5-point Likert scale, ranging from 1 = 'strongly disagree' to 5 = 'strongly agree'. The instrument was developed by adapting indicators from previous studies and adjusting them to the context of MSMEs in Medan (Hair et al., 2021).

Specifically, the number of indicators for each construct is as follows: digital readiness (5 indicators), digital inclusion (5 indicators), digital transformation (5 indicators), business model innovation (5 indicators), ecosystem business model (5 indicators), and sustainable local economy (5 indicators). The number of indicators was used as the basis for determining sample adequacy and evaluating the measurement model in PLS-SEM.

Digital readiness indicators were adapted from Torres et al. (2023), Lutfi et al. (2022), and Saputra et al. (2021), covering access to necessary technology, technical workforce capabilities, and infrastructure support. Digital inclusion was adapted from Gallego and Gutierrez (2020), Christofi et al. (2022), and Taufiqurrahman and Subekti (2023), which measure equitable access to digital technologies and platforms, affordability, and policy support that opens access for vulnerable business groups. Digital transformation is adapted from Vial (2021), Omrani et al. (2024), and Ulas (2022), which assess the level of integration of digital technology into core business processes.

Business model innovation is measured using indicators adapted from Chesbrough (2006), Bican and Brem (2020), Setiawan and Haryono (2020), and Prasetyo and Kistanti (2020), such as the ability to redesign technology-based value propositions, introduce new digital distribution channels, and integrate data-based value-added services. The ecosystem business model is adapted from Autio et al. (2022), Spigel and Harrison (2020), and Suryanto and Wulandari (2022), such as the intensity of collaboration with partners, participation in shared platforms, and involvement in shared value creation schemes. The sustainable local economy is adapted from Kraus et al. (2022), Popkova and Sergi (2020), and Prasetyo and Kistanti (2020), such as contributions to local job creation, income stability, and medium-term business sustainability in an inclusive digital ecosystem.

Before full implementation, the questionnaire was piloted with a small number of MSME actors to ensure clarity of language, relevance of indicators, and completion time. The pilot results were used for editorial adjustments so that each item could be understood by respondents with varying levels of digital literacy.

Data Collection Procedure

Data collection was conducted through online and offline surveys, with the assistance of field officers to reach participants who were digitally underserved. For 'digitally underserved' respondents, for example, MSMEs with limited access to the internet or who were unfamiliar with filling out online forms, field officers made direct visits, provided paper forms, or assisted with filling out the questionnaire using the officers' digital devices. This approach aims to minimise exclusion bias against businesses that are not yet fully included in the digital ecosystem, while still meeting the minimum criteria of two years of involvement in the use of basic digital technology.

Data Analysis Techniques

The collected data was then analysed using Partial Least Squares Structural Equation Modelling (PLS-SEM) with SmartPLS 4.0 software. The term PLS-SEM (Partial Least Squares Structural Equation Modelling) is used consistently in this paper to refer to a variance-based structural equation modelling approach that is suitable for complex conceptual models with relatively moderate sample sizes and data distributions that do not have to be normal (Hair et al., 2021). PLS-SEM was chosen for its ability to test complex models with latent variables, as well as its flexibility in handling data that does not meet the normality assumption.

Model Evaluation

The measurement model (outer model) was evaluated for convergent validity, construct reliability, and discriminant validity. Convergent validity was tested using Average Variance Extracted (AVE), with an accepted threshold value of AVE > 0.50 (Fornell & Larcker, 1981). Construct reliability is measured using Composite Reliability (CR), with a threshold value of CR > 0.70 considered to indicate adequate reliability (Hair et al., 2021). Discriminant validity is tested by comparing the square root of AVE with the correlation coefficient between constructs, and using the HTMT criterion when necessary.

The structural model (inner model) was evaluated using the R-square (R^2) value for each endogenous construct, which indicates the proportion of variation in the dependent variable that can be explained by the independent variables. In addition, the f-square (f^2) effect size was used to assess the strength of each predictor's effect on the dependent variable, with the criteria $f^2 > 0.35$ indicating a large effect, between 0.15–0.35 a moderate effect, and between 0.02–0.15 a small effect (Cohen, 1988).

The predictive relevance of the model was tested through the Q-square (Q^2) value using a blindfolding procedure; a Q^2 value greater than zero indicates that the model has good predictive ability. Mediation analysis was performed using a bootstrapping procedure to estimate indirect effects and test their significance (Preacher & Hayes, 2008).

In this context, business model innovation and ecosystem business model are treated as mediators linking digital readiness, digital inclusion, and digital transformation with sustainable local economy. The mediation structure tested includes parallel mediation, where business model innovation and ecosystem business model each mediate the relationship between digital variables (readiness, inclusion, transformation) and sustainable local economy. Digital transformation is also tested as a mediating variable in the relationship between digital readiness and other downstream constructs. The names of the constructs and their respective roles are kept consistent throughout the manuscript, namely digital readiness, digital inclusion, digital transformation, business model innovation, ecosystem business model, and sustainable local economy.

FINDINGS AND DISCUSSION

Findings

Respondent Characteristics

Before presenting the table, it is important to note that the demographic characteristics of the respondents in this study are important to provide a clearer context regarding the background of the MSME actors involved. This demographic data helps us understand the profile of the participants, which will enable us to more accurately interpret the research results and how the findings relate to the characteristics of the individuals running MSMEs.

The following is a summary table of the demographics of the respondents who participated in this study, which includes information on the gender, age, and digital experience of the respondents. This table provides an overview of the sample composition based on these

demographic characteristics:

Table 1. Respondent Characteristics

Characteristics	Frequency	Percentage
Gender		
Male	120	60
Female	80	40
Age		
18–30 years	45	22.5
31–40 years	95	47.5
41–50 years	40	20
51 years and above	20	10
Digital experience		
< 2 years	40	20
2–5 years	120	60
> 5 years	40	20

The table above shows that the majority of respondents are men (60%), with women accounting for 40% of the total respondents. In terms of age, most respondents were in the 31-40 age group (47.5%), followed by the 18-30 age group (22.5%), 41-50 age group (20%), and 51 years and above (10%). Regarding digital experience, the majority of respondents have between 2 and 5 years of digital experience (60%), while 20% have less than 2 years of digital experience, and the other 20% have more than 5 years. This demographic data provides important information for understanding the context of the respondents participating in this study, and may influence how they respond to and adopt digital technology in the context of MSMEs.

In addition to these demographic characteristics, respondents came from various business sectors, predominantly trade and services, followed by small-scale manufacturing. The majority of MSMEs in the sample were micro and small businesses that had been operating for more than five years. This composition indicates that respondents had sufficient experience in managing businesses and had relatively stable exposure to the use of digital technology in their daily business activities.

Descriptive Statistics

Before testing structural relationships using PLS-SEM, the initial stage of analysis focused on understanding the general characteristics of the data through descriptive statistics. This analysis aimed to provide an overview of respondents' perceptions of each construct studied, while ensuring sufficient data variation for further analysis.

Table 2. Descriptive Statistics of Constructs

Construct	Code	Mean (M)	SD
Digital readiness	KD	3.62	0.59
Digital inclusion	ID	3.48	0.63
Digital transformation	DT	3.55	0.61
Business model innovation	IMB	3.44	0.65
Ecosystem business model	MBE	3.51	0.60
Sustainable local economy	ELB	3.58	0.57

Based on Table 2, all constructs have an average value above the midpoint of the Likert scale (M > 3.00), indicating that, in general, MSME actors in Medan have a relatively positive perception of their digital readiness and practices. Digital readiness (M = 3.62; SD = 0.59) and digital transformation (M = 3.55; SD = 0.61) indicate that most respondents already have fairly good basic technology infrastructure and utilisation. However, moderate standard deviation values across all constructs indicate heterogeneity in the level of digital adoption and capabilities among MSMEs, which is relevant for further analysis in the structural model.

Measurement Model Evaluation (Outer Model)

The measurement model evaluation was conducted to ensure that the research instruments met the reliability and validity criteria before testing the causal relationships between constructs. This evaluation included an analysis of outer loadings, internal reliability, convergent validity, and discriminant validity.

Outer Loadings of Indicators

Table 3 presents the outer loading values for all indicators used in this study.

Table 3. Outer Loadings of Indicators

Construct	Item	Outer Loading
KD	KD1	0.78
KD	KD2	0.81
KD	KD3	0.76
KD	KD4	0.83
KD	KD5	0.79
ID	ID1	0.75
ID	ID2	0.80
ID	ID3	0.77
ID	ID4	0.82
ID	ID5	0.74
TD	TD1	0.79
TD	TD2	0.84
TD	TD3	0.80
TD	TD4	0.77
TD	TD5	0.81
IMB	IMB1	0.82
IMB	IMB2	0.79
IMB	IMB3	0.85
IMB	IMB4	0.78
Building Permit	IMB5	0.81
MBE	MBE1	0.80
MBE	MBE2	0.83
MBE	MBE3	0.79
MBE	MBE4	0.84
MBE	MBE5	0.76
ELB	ELB1	0.81
ELB	ELB2	0.78
ELB	ELB3	0.83

ELB	ELB4	0.79
ELB	ELB5	0.82

The results in Table 3 show that all indicators have outer loading values above the threshold of 0.70. This indicates that each indicator has a strong contribution in representing the latent construct being measured. Thus, there are no indicators that need to be eliminated from the measurement model.

Construct Reliability and Convergent Validity

Reliability and convergent validity tests were conducted using Composite Reliability (CR) and Average Variance Extracted (AVE). The test results are presented in Table 4.

Table 4. CR and AVE

Construct	CR	AVE
KD	0.89	0.62
ID	0.88	0.60
TD	0.91	0.67
IMB	0.92	0.69
MBE	0.90	0.65
ELB	0.91	0.66

Based on Table 4, all constructs show CR values above 0.70 and AVE values above 0.50. These findings confirm that each construct has good internal consistency and is able to explain more than 50% of the variance in its indicators. Thus, the convergent validity and internal reliability of the measurement model have been fulfilled in accordance with the criteria recommended in the PLS-SEM literature.

Discriminant Validity

Discriminant validity was tested using the Heterotrait–Monotrait Ratio (HTMT) approach. The HTMT values for all construct pairs are presented in Table 5.

Table 5. HTMT Matrix

	KD	ID	TD	IMB	MBE	ELB
KD	—	0.71	0.68	0.74	0.63	0.58
ID		—	0.66	0.72	0.78	0.61
TD			—	0.80	0.75	0.60
IMB				—	0.82	0.64
MBE					—	0.77
ELB						—

The results in Table 5 show that all HTMT values are below the threshold of 0.85. This confirms that each construct in the model has sufficient empirical distinction and does not overlap conceptually. Thus, the measurement model meets all criteria for discriminant validity.

Structural Model Evaluation (Inner Model)

After the measurement model has been declared valid and reliable, the next step is to evaluate the structural model to test the causal relationships between the latent constructs

hypothesised in the DEIM.

Model (R^2)

The R-square (R^2) value is used to assess the model's ability to explain the variance of endogenous constructs. The R^2 test results are presented in Table 6.

Table 6. R^2 of Endogenous Constructs

Endogenous Construct	R
Business Model Innovation (BMI)	0.62
Ecosystem business model (EBM)	0.58
Sustainable local economy (SLE)	0.55

Based on Table 6, the R^2 values for business model innovation (0.62), ecosystem business model (0.58), and sustainable local economy (0.55) indicate that the model has moderate to strong explanatory power. This means that the combination of independent variables in DEIM can explain a substantial proportion of variance in each endogenous construct.

Model (Q^2)

The predictive relevance of the model was tested using the Q-square (Q^2) value through a blindfolding procedure. The test results are presented in Table 6.

Table 7. Q^2 (Blindfolding)

Endogenous Construct	Q^2
IMB	0.3
MBE	0.33
ELB	0.29

All Q^2 values in Table 7 are positive, indicating that the model has good predictive power. This shows that DEIM not only has structural fit but is also capable of adequately predicting observational data.

Effect Size (f^2)

To assess the strength of the contribution of each structural path, the effect size f-square (f^2) is used. The test results are presented in Table 8.

Table 8. f^2 for Structural Paths

Path	f^2	Interpretation
KD → IMB	0.08	small
KD → TD	0.14	small–medium
KD → ELB	0.06	small
ID → IMB	0.1	small–medium
ID → MBE	0.19	medium
ID → ELB	0.07	small
TD → IMB	0.28	medium
TD → MBE	0.16	Moderate
TD → ELB	0.01	very small
IMB → MBE	0.17	moderate
IMB → ELB	0.01	very small

Path	f^2	Interpretation
MBE → ELB	0.22	moderate

The results in Table 8 show that the greatest influence on the sustainable local economy comes from the ecosystem business model (f^2 = 0.22), while the influence of business model innovation on the sustainable local economy is very small (f^2 = 0.01). These findings indicate that the impact of sustainable economics is more strongly mediated by collaborative mechanisms across actors than by innovation at the company level alone.

Hypothesis Testing

The following table summarises the results of the hypothesis testing in this study, showing the relationship between the variables studied and the significance of their influence on each other. This table provides information on the t-statistic and p-value for each hypothesis tested, as well as the results of the test.

Table 9. Hypothesis Testing Results

Hypothesis	t-Statistic	p-Value	Results
Digital readiness → Business model innovation	2.486	< 0.05	Significant
Digital readiness → Digital transformation	3,344	< 0.05	Significant
Digital readiness → Sustainable local economy	2,119	< 0.05	Significant
Digital inclusion → Business model innovation	3,473	< 0.05	Significant
Digital inclusion → Ecosystem business model	3,622	< 0.05	Significant
Digital inclusion → Sustainable local economy	2,144	< 0.05	Significant
Digital transformation → Business model innovation	5,272	< 0.05	Significant
Digital transformation → Ecosystem business model	4,099	< 0.05	Significant
Digital transformation → Sustainable local economy	1,029	> 0.05	Not significant
Innovative business model → Ecosystem business model	3,447	< 0.05	Significant
Innovation business model → Sustainable local economy	1,003	> 0.05	Not significant
Ecosystem business model → Sustainable local economy	3.121	< 0.05	Significant

Table 9 shows that most of the causal paths hypothesised in DEIM are supported by the data, with t-statistic values above 1.96 and p-values below 0.05. Digital readiness, digital inclusion, and digital transformation have a significant effect on business model innovation and ecosystem business models, but the direct effect of digital transformation on the sustainable local economy is not significant (t = 1.029; p > 0.05). Similarly, business model innovation does not have a significant direct effect on the sustainable local economy (t = 1.003; p > 0.05), while the ecosystem business model has a significant effect (t = 3.121; p < 0.05).

The R^2 value for endogenous constructs (business model innovation, ecosystem business model, and sustainable local economy) indicates that the combination of predictors in the model has moderate to strong explanatory power. The f^2 value indicates that digital readiness, digital inclusion, and digital transformation have a small to moderate effect on business model innovation and ecosystem business model, while the ecosystem business model has a relatively greater effect on the sustainable local economy compared to business model innovation. The positive Q^2 value in all endogenous constructs indicates that the model has good predictive relevance.

Mediation Analysis

To test the mediating role of business model innovation and ecosystem business model, an indirect effect analysis was conducted using bootstrapping. The complete results of the mediation analysis are presented in Table 10.

Table 10. Mediation: Indirect Effects, Bootstrap CI, Total Effects

Mediation Relationship	β Indirect	95% CI (LL; UL)	β Direct	Significance Direct?	β Total	Mediation Category
KD → IMB → ELB	0.04	(0.01; 0.09)	0.1	Yes	0.22	Partial
KD → MBE → ELB	0.07	(0.03; 0.12)	0.18	Yes	0.25	Partial
KD → IMB → MBE → ELB (serial)	0.02	(0.01; 0.05)	—	—	—	(Additional route)
ID → IMB → ELB	0.05	(0.02; 0.10)	0.19	Yes	0.24	Partial
ID → MBE → ELB	0.10	(0.05; 0.16)	0.19	Yes	0.29	Partial
ID → IMB → MBE → ELB (serial)	0.03	(0.01; 0.07)	—	—	—	(Additional route)
TD → IMB → ELB	0.08	(0.04; 0.14)	0.06	No	0.14	Full
TD → MBE → ELB	0.09	(0.04; 0.15)	0.06	No	0.15	Full
TD → IMB → MBE → ELB (serial)	0.04	(0.02; 0.08)	—	—	—	(Additional pathway)

Based on Table 10, the relationship between digital readiness and sustainable local economy as well as between digital inclusion and sustainable local economy shows partial mediation, as both direct and indirect effects are significant. Conversely, the relationship between digital transformation and sustainable local economy shows full mediation, as the direct path is insignificant while the indirect path through business model innovation and ecosystem business model is significant. These findings confirm that digital transformation contributes to local economic development primarily through changes in business models and strengthening ecosystems, rather than directly.

Overall, the PLS-SEM analysis results show that DEIM successfully explains the path of MSME digital transformation towards a sustainable local economy. Hypotheses related to digital readiness and digital inclusion are largely supported, while hypotheses assuming the direct influence of digital transformation and business model innovation on a sustainable local economy are not fully confirmed. These findings do not contradict the DEIM framework, but rather refine it by

emphasising that the ecosystem business model is a key mechanism that converts the digital capabilities of MSMEs into sustainable local economic impacts.

Discussion

Digital Readiness and Business Model Innovation

The results of the study confirm that digital readiness is an important foundation for the development of business model innovation in MSMEs. This readiness includes the availability of digital infrastructure, the ability of organisations to utilise technology, and the competence of human resources in integrating technology into business activities. When these prerequisites are met, MSMEs have more room to redesign their value propositions, distribution channels, and ways of interacting with customers. These findings reinforce the view that digital readiness serves as an initial capability that enables MSMEs to shift from conventional business practices to more adaptive and technology-based business models.

However, digital readiness cannot be understood as the ultimate goal. The findings of this study show that digital readiness only has strategic significance when it is processed through a business model innovation process and linked to the broader business environment. Without business model innovation and ecosystem connectivity, digital readiness risks resulting in only technical adoption with limited impact.

Digital Readiness and Digital Transformation

The research findings also show that digital readiness is closely related to digital transformation in MSMEs. MSMEs with better digital readiness tend to be more capable of integrating technology into their core business processes, rather than simply using it as a supporting tool. This confirms that digital transformation is an organisational process that requires adequate structural readiness and internal capabilities.

On the other hand, digital transformation does not take place in a vacuum. In the context of MSMEs in Medan, digital transformation that is not accompanied by policy support, inclusive digital market access, and adequate partnership networks has the potential to result in fragmented change. This type of transformation may increase internal efficiency, but it does not necessarily have a broad impact on the local economy.

Digital Inclusion, Business Model Innovation, and Ecosystem Business Models

Digital inclusion has proven to play an important role in driving business model innovation while strengthening the formation of ecosystem business models. More equitable digital access enables MSMEs to actively engage in digital platforms, obtain market information, and build relationships with other actors in the business network. This condition creates opportunities for MSMEs to not only innovate individually, but also collaborate in creating shared value.

In the context of Medan, digital inclusion is not only related to the availability of infrastructure, but also to the affordability of services, digital literacy, and policies that open access for small businesses. When these barriers are reduced, MSMEs are better able to integrate their business model innovations into a broader and more sustainable ecosystem.

Digital Transformation and Sustainable Local Economy

The results of the study show that digital transformation does not necessarily contribute directly to a sustainable local economy. These findings do not contradict the DEIM framework, but rather refine it by emphasising that digital transformation serves as a prerequisite and catalyst, not a direct determinant. The impact of digital transformation on the local economy tends to emerge indirectly, through changes in business models and the strengthening of ecosystem relationships.

In the context of MSMEs in Medan, digital transformation is often still in its early stages, such as the digitisation of marketing and transactions. These practices are important, but their economic benefits will be more pronounced when connected to an ecosystem structure that is capable of expanding scale, increasing stability, and strengthening business resilience.

Business Model Innovation, Ecosystem Business Models, and Local Economic Sustainability

This discussion shows that business model innovation acts as a strategic link to the formation of ecosystem business models. Innovation at the company level helps MSMEs adapt to the dynamics of the digital market, but its impact on the local economy becomes more significant when it strengthens the involvement of MSMEs in cross-actor value networks.

The ecosystem business model emerges as the primary mechanism that converts changes at the company level into collective economic benefits. Through collaboration, coordination, and co-creation of value, ecosystems enable MSMEs to contribute to job creation, income stability, and local economic resilience. These findings confirm that local economic sustainability is determined more by the strength of relationships between actors in the ecosystem than by individual innovation alone.

Theoretical Implications for the Digital Ecosystem Innovation Model (DEIM)

Theoretically, these research findings support and refine the DEIM. The technological, organisational, and environmental dimensions are proven to be interrelated and inseparable. However, the results show that the path to a sustainable local economy is mediated more by business model innovation, particularly the ecosystem business model, than by direct digital transformation.

Thus, DEIM expands the TOE framework by placing ecosystems as the main arena for value creation. The focus of analysis shifts from technology adoption at the company level to cross-actor interactions that enable the conversion of digital capabilities into sustainable socio-economic impacts. In a regional context such as Medan, this approach is particularly relevant for explaining how MSMEs can contribute to more inclusive and shock-resistant local economic development.

Overall, this discussion shows that most of the relationships proposed in DEIM are supported, while some direct relationships to a sustainable local economy are not empirically confirmed. These findings do not weaken the model, but rather clarify that ecosystems are a key mechanism that bridges readiness, inclusion, digital transformation, and business model innovation with local economic sustainability. Thus, DEIM offers a more realistic and contextual conceptual framework for understanding the digital transformation of MSMEs in developing regions.

CONCLUSIONS

The conclusion of this study shows that digital transformation among MSMEs cannot be viewed as the ultimate goal, but rather as a starting point for creating more inclusive and adaptive structural changes. The results of the study confirm that digital readiness and digital inclusion are important prerequisites for the development of business model innovation and ecosystem business models, while digital transformation acts as a catalyst that connects technological readiness with changes at the business model level. However, not all of these constructs have a significant direct impact on a sustainable local economy. A consistent and significant direct influence mainly comes from the ecosystem business model, while the influence of digital transformation and business model innovation on a sustainable local economy occurs mainly through mediation.

Thus, it is inaccurate to state that digital readiness, digital inclusion, business model innovation, and digital transformation all directly predict a sustainable local economy. It is more

accurate to view them as a set of capabilities and basic conditions that, through business model innovation and the formation of ecosystem business models, enable the achievement of sustainable local economic outcomes. Digital readiness and inclusion ensure that SMEs have basic access and capacity, digital transformation and business model innovation change the way SMEs create value, and ecosystem business models ensure that this value is distributed and reinforced at the local level.

The main theoretical contribution of this research lies in the development of the Digital Ecosystem Innovation Model (DEIM), which expands the TOE framework by incorporating business model innovation and ecosystem business models as key mechanisms that connect the dimensions of technology, organisation, and environment with a sustainable local economy. DEIM clarifies that the success of SME digital transformation is not only determined by the internal capabilities of the organisation or technological readiness, but also by their ability to participate in an inclusive and collaborative digital ecosystem. Thus, DEIM offers a systemic perspective that can be used to assess and design more targeted policy interventions at the regional level.

In practical terms, this study suggests several recommendations: (1) MSME development policies in Medan need to combine digital literacy enhancement programmes with concrete support for business model innovation, for example through digital business clinics, incubators, and business model design mentoring; (2) local governments and other stakeholders need to facilitate the formation and strengthening of ecosystem business models, for example through shared platforms, collaborative incentive schemes, and the strengthening of digital-based SME associations; and (3) digital transformation programmes should be designed as a structured, step-by-step pathway that integrates digital readiness, digital inclusion, and business model innovation, rather than just the distribution of devices or short-term training.

LIMITATIONS & FURTHER RESEARCH

This study has several limitations that need to be considered when interpreting the results and findings. Methodologically, this study uses a quantitative approach with surveys and closed questionnaires using a Likert scale. Although this method is effective for collecting structured data, it also limits the depth of understanding of the complex factors that influence digital transformation in MSMEs. Thus, the findings of this study should be viewed in the context of these methodological limitations, which do not allow for a deeper exploration of individual perceptions or experiences regarding barriers or opportunities in the adoption of digital technology.

From a contextual perspective, this study has limitations in that the sample is limited to 200 MSMEs in Medan with a minimum of two years of involvement in digitalisation. This limits the ability to generalise the research results to a wider area or to MSMEs with a lower level of digital readiness. The two-year criterion, while strengthening internal validity in measuring relatively stable digital transformation, may also reduce the representativeness of MSMEs that are just starting the digitalisation process and facing different obstacles. In addition, external factors such as government policies that do not fully support the MSME digital ecosystem may also influence the digital transformation process, but this aspect is not discussed in depth in this study.

From a theoretical perspective, although the selected variables are relevant, this study does not cover all dimensions that can influence digital transformation, such as detailed organisational cultural factors or the more specific role of the private sector in the MSME digitalisation process. Therefore, although the findings of this study provide important insights, the picture it paints of the factors influencing MSME digital transformation is not entirely comprehensive.

For further research, several knowledge gaps can be addressed. Firstly, qualitative approaches—such as in-depth interviews or case studies, can be used to explore in more detail the social, cultural, and psychological dynamics that influence the adoption of digital technology in

MSMEs. Second, subsequent research could expand the sample to include SMEs from various regions in Indonesia or other developing countries, as well as SMEs in the early stages of digitalisation, to test the generalisation and robustness of DEIM in various digital readiness contexts. Third, longitudinal research could be conducted to monitor the long-term dynamics of digital transformation and its impact on the sustainability and competitiveness of SMEs.

In addition, further research could develop DEIM by including moderator variables, such as sector type, business size, or policy support intensity, to understand how certain conditions strengthen or weaken the proposed pathways. Further exploration of the most effective forms of cross-sector collaboration in building inclusive ecosystem business models is also a promising area for study. Thus, further research is expected to enrich DEIM and provide broader insights into effective ways to support SME digitalisation and accelerate sustainable digital transformation in Indonesia and other developing countries.

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