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SUSTAINABILITY STRATEGY OF MSMES IN ASEAN THROUGH BLOCKCHAIN MANAGEMENT WITH THE MEDIATION ROLE OF DIGITALIZATION, FINANCIAL LITERACY, AND DIGITAL MARKET ACCESS

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Abstract: *The development of the digital economy in the ASEAN region requires Micro, Small, and Medium Enterprises (MSMEs) to adapt to new technologies to improve business sustainability. One technology with great potential is blockchain management, which is believed to be able to increase transparency, efficiency, and market accessibility. This study aims to analyze the influence of blockchain management on the sustainability of MSMEs in ASEAN by considering the mediating role of MSME digitalization, financial literacy, and digital market access. The research method uses a mixed methods approach, namely quantitative through Structural Equation Modeling-Partial Least Square (SEM-PLS) analysis of MSME survey data in ASEAN countries, and qualitative through in-depth interviews to strengthen the empirical findings. The results show that blockchain management significantly influences MSME digitalization, financial literacy, and digital market access. However, only digitalization is proven to play a strong role in mediating the relationship between blockchain management and MSME sustainability. Conversely, financial literacy and digital market access, although important, have not made a significant contribution to business sustainability due to limited capacity and structural barriers faced by MSMEs in the ASEAN region. The integration of the two research approaches confirms that blockchain has the potential to be a catalyst for sustainable innovation, but its successful implementation is highly dependent on the readiness for digitalization and the improvement of the managerial capacity of MSMEs.*

Keywords: **Blockchain Management; MSME Digitalization; Financial Literacy; Digital Market Access; MSME Sustainability; ASEAN**

1. INTRODUCTION

MSMEs in the ASEAN region play a strategic role as key drivers of economic growth, job providers, and a means of equitable social welfare. MSMEs account for over 90% of businesses in ASEAN, contributing significantly to Gross Domestic Product (GDP) and employment. However, the dynamics of globalization, regional economic integration, and technological disruption require MSMEs to increase their competitiveness and maintain their business sustainability.

One innovation with potential to strengthen the sustainability of MSMEs is Blockchain Management. This technology can provide transparency, efficiency, and transaction security, while increasing consumer and business partner trust. However, blockchain implementation requires supporting factors such as MSME digitalization, financial literacy, and digital market access. These three aspects act as crucial mediators that enable blockchain to optimally impact MSME sustainability.

To understand the role of blockchain and its mediating factors in the ASEAN context, it's important to look at the overall contribution of MSMEs in each country. The following table presents data on the proportion of MSMEs, their contribution to GDP and employment, as well as the level of digitalization and key challenges they face.

Table 1. The level of digitalization of MSMEs

Country	Proportion of MSMEs to Total Business	Contribution of MSMEs to GDP (%)	Contribution of MSMEs to the Workforce (%)	Level of Digitalization of MSMEs	Main Challenges
Indonesia	± 99%	± 61%	± 97%	Medium (e-commerce adoption is increasing, blockchain is still limited)	Low financial literacy, slow technology adoption
Malaysia	± 98.5%	± 38%	± 66%	High (many MSMEs adopt fintech & e-payment)	Access to blockchain-based financing is still limited
Thailand	± 99.7%	± 36%	± 78%	Medium (e-marketplace is growing rapidly)	Blockchain integration in the supply chain is still low
Singapore	± 99%	± 45%	± 72%	Very High (fintech, blockchain, and digital trade map advanced)	High implementation costs for small MSMEs
Philippines	± 99.5%	± 40%	± 63%	Medium (SMEs are starting to enter the digital market)	Uneven digital infrastructure
Vietnamese	± 98%	± 40%	± 50%	Medium-High (MSMEs active in cross-border e-commerce)	Limited digital HR capacity
Brunei Darussalam	± 97%	± 34%	± 60%	Intermediate (fintech is growing, blockchain is starting to be introduced)	Small scale MSMEs, limited domestic market
Laos	± 99%	± 30%	± 82%	Low (limited technology access)	Low financial infrastructure and literacy
Cambodia	± 99%	± 32%	± 73%	Low-Medium (e-commerce based MSMEs are still limited)	Lack of access to digital-based capital
Myanmar	± 99%	± 30%	± 70%	Low (digitalization is hampered by political conditions & infrastructure)	Regulatory barriers and economic stability

Source: 2025 observation results

The table shows that almost all ASEAN countries have a very high proportion of MSMEs to total business units, ranging from 97% to 99.7%. However, their contribution to GDP and employment varies, and the level of MSME digitalization shows disparities between countries. Countries like Singapore and Malaysia have relatively mature digital ecosystems, while Laos, Myanmar, and Cambodia still face limitations in infrastructure, financial literacy, and digital market access.

This gap demonstrates that blockchain-based MSME sustainability strategies cannot be implemented uniformly, but must consider each country's digital readiness, financial literacy levels, and digital market access opportunities. Therefore, research on "MSME Sustainability Strategies in ASEAN through Blockchain Management with the Mediating Role of Digitalization, Financial Literacy, and Digital Market Access" is crucial for providing a conceptual framework and practical recommendations for strengthening MSMEs in the region.

1.1. Formulation of the problem

1. What is the role of Blockchain Management in improving the sustainability of MSMEs in the ASEAN region?
2. How does digitalization of MSMEs affect business sustainability?
3. How does the level of financial literacy mediate the relationship between Blockchain Management and the sustainability of MSMEs?
4. How can digital market access strengthen the influence of Blockchain Management on the sustainability of MSMEs?
5. How do digitalization, financial literacy, and digital market access interact as mediators in strengthening the sustainability strategies of MSMEs in ASEAN?

1.2. Research purposes

1. Analyzing the role of Blockchain Management on the sustainability of MSMEs in ASEAN.
2. Examining the role of MSME digitalization in strengthening business competitiveness and sustainability.
3. Assessing the influence of financial literacy as a mediator in the relationship between Blockchain Management and the sustainability of MSMEs.
4. Evaluating the contribution of digital market access in expanding opportunities and supporting the sustainability of MSMEs.
5. Developing a sustainability strategy for MSMEs based on Blockchain Management by considering the mediation factors of digitalization, financial literacy, and digital market access.

1.3. Research Hypothesis

1. H1: Blockchain Management has a positive impact on the sustainability of MSMEs in ASEAN.
2. H2: Digitalization of MSMEs has a positive impact on the sustainability of MSMEs.
3. H3: Financial literacy has a positive effect on the sustainability of MSMEs.
4. H4: Digital market access has a positive effect on the sustainability of MSMEs.
5. H5: Digitalization of MSMEs mediates the influence of Blockchain Management on the sustainability of MSMEs.
6. H6: Financial literacy mediates the influence of Blockchain Management on the sustainability of MSMEs.
7. H7: Digital market access mediates the influence of Blockchain Management on the sustainability of MSMEs.

1.4. Conceptual model

1. Blockchain management is seen as a key factor driving the sustainability of MSMEs. Blockchain implementation enables supply chain transparency, transaction security, and the implementation of smart contracts. This improves operational efficiency, reduces the risk of fraud, and builds customer trust, thus directly contributing to MSME business sustainability.

Blockchain Management Relationship Flow → MSME Sustainability

2. Blockchain can only be effective if MSMEs first undergo digital transformation. Digitalization encompasses the adoption of information technology, the use of e-commerce, and the implementation of digital payment systems. With a high level of digitalization, blockchain is more easily integrated into operations, ultimately strengthening the sustainability of MSMEs.
   Relationship flow: Blockchain Management → MSME Digitalization → MSME Sustainability.
3. Financial literacy is the ability of MSMEs to understand, manage, and make wise financial decisions. Blockchain-based financial technology (fintech) can provide significant benefits, but without adequate financial literacy, MSMEs will struggle to capitalize on them. With good financial literacy, MSMEs can access financing, understand risks, and optimally utilize blockchain technology to support business sustainability.
   Relationship flow: Blockchain Management → Financial Literacy → MSME Sustainability.
   Access to digital markets is a strategic avenue for MSMEs to expand their business reach, both locally, regionally, and internationally. Blockchain supports secure cross-border transactions and global supply chain integration. However, these benefits are maximized when MSMEs have access to digital platforms. Therefore, digital market access strengthens the relationship between blockchain and MSME sustainability by increasing business scale and global competitiveness.
   Relationship flow: Blockchain Management → Digital Market Access → MSME Sustainability.
4. Overall Relationship
   This model shows that the influence of Blockchain Management on the sustainability of MSMEs is **direct** and **indirect** :
   Direct: Blockchain Management improves the sustainability of MSMEs by creating business efficiency and trust.
   Indirect (mediation): Blockchain strengthens the sustainability of MSMEs through increased digitalization, financial literacy, and digital market access.
   Thus, the sustainability strategy of MSMEs in ASEAN depends not only on the implementation of blockchain, but also on the extent to which MSMEs are able to digitally transform, improve financial literacy, and expand access to digital markets.

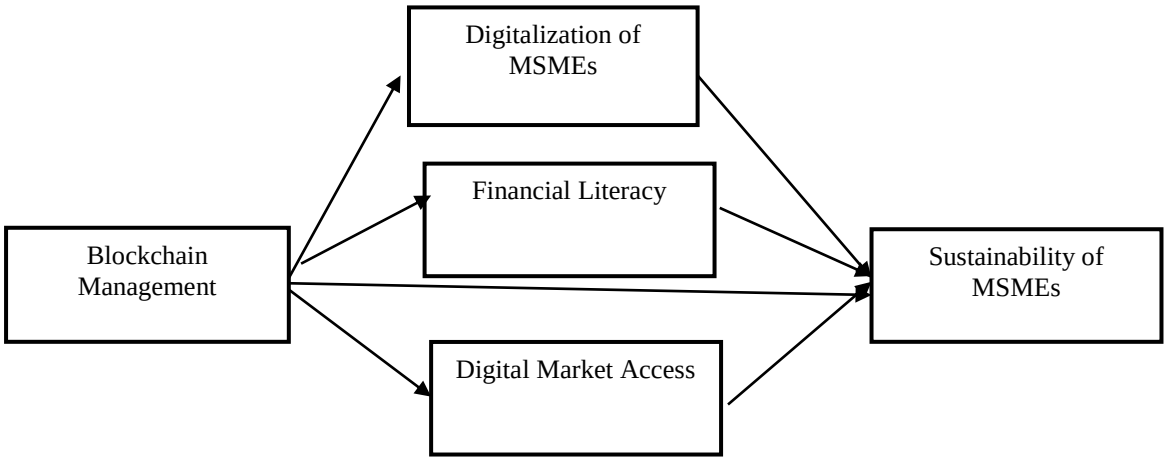

Figure 1. Conceptual model of the research

2. LITERATURE REVIEW

2.1. Blockchain Management (Independent Variable)

Blockchain Management refers to the application of distributed ledger technology and management mechanisms that utilize blockchain to manage transactions, supply chains, smart contracts, data accountability, and information security within an organization or business ecosystem.

Theoretical Basis Theory of competitive advantage in technology (technology-based view): new technology (blockchain) can be a source of competitive advantage through increased transparency, efficiency, and trust, Network theory and trust (network theory / trust theory): blockchain builds trust through decentralization and cryptography, thereby reducing information and monitoring costs.

Empirical Findings Studies show that blockchain can improve traceability and reduce fraud in the agricultural and food supply chain. Smart contract implementation can speed up payment processes and reduce transaction costs on trading platforms. However, adoption among MSMEs is still relatively low due to cost, skill, and regulatory barriers.

2.2. Digitalization of MSMEs (Mediator 1)

Digitalization of MSMEs is the process of transforming traditional business activities towards the use of digital technology (websites, e-commerce, mobile payments, digital management systems, cloud services) for operations, marketing, and management.

Theoretical Basis of Diffusion of Innovation: technology adoption follows a diffusion pattern; factors such as relative advantage, compatibility, complexity influence adoption, Resource-Based View (RBV): digital capabilities as resources that can enhance organizational capabilities.

Empirical Findings (summary) Digitalization is positively correlated with market access, productivity, and income of MSMEs. The level of digitalization is often influenced by local infrastructure, human resource capacity, and government policy support.

Digitalization–blockchain interaction: strong digitalization facilitates blockchain integration and the utilization of its benefits.

2.3. Financial Literacy (Mediator 2)

Financial literacy is the ability of MSME owners/managers to understand basic financial concepts (record keeping, budgeting, cash flow), financial products (credit, insurance), as well as the use of digital financial services and risk management.

Theoretical Basis Theory of consumer behavior and financial decisions: knowledge influences decisions to use financial products and services, Capability approach: ability (literacy) provides space for economic actors to take advantage of opportunities.

Empirical Findings (summary) Financial literacy is positively related to access to formal financing, maintaining liquidity, and the ability to invest in technology. MSMEs with higher literacy tend to utilize fintech and digital instruments more effectively, but there is a large disparity in literacy between regions.

2.4. Digital Market Access (Mediator 3)

Digital market access means the ability of MSMEs to sell products/services through digital platforms (marketplaces, social commerce), including access to new customers, digital logistics, and cross-border payment services.

Theoretical Basis Market and platform theory (platform economics): platforms reduce search and matching costs, thereby expanding markets.,

Internationalization process theory: digital channels facilitate cross-border expansion at relatively low costs.
Empirical Findings (summarized) Digital platforms increase the market reach of MSMEs, drive sales growth and micro-export potential, Challenges include logistics, export regulatory compliance, and digital customer acquisition costs, Blockchain has the potential to support cross-border transactions (security, payments) thereby strengthening digital market access

2.5. Sustainability of MSMEs (Dependent Variable)

The sustainability of MSMEs encompasses economic dimensions (long-term profitability, growth), social (workforce, community welfare), and environmental (eco-friendly production practices). This also includes resilience to economic shocks or technological disruption.
Triple bottom line theory (Elkington): sustainability combines economic, social and environmental aspects, Resource orchestration: the ability to organize resources (technology, knowledge, markets) determines sustainable capacity.
Empirical Findings (summarized) Digital technology increases efficiency and access that can support the economic sustainability of MSMEs, Initiatives that increase transparency (e.g. traceability) can add value to products, especially for premium/export markets, Supporting policies and MSMEs' internal capacity (management, HR) determine how much impact technology has on sustainability.

3. RESEARCH METHODOLOGY

3.1. Research Design

This study employed a mixed methods sequential explanatory design. In the first stage, a quantitative analysis was conducted to examine the relationships between variables using the SEM-PLS (Structural Equation Modeling – Partial Least Squares) approach. The quantitative results were then further substantiated through a qualitative approach, including in-depth interviews with MSMEs, experts, and relevant policymakers to gain a contextual understanding of the statistical findings.
This approach was chosen so that the research results not only show empirical relationships between variables, but also provide an in-depth interpretation of how blockchain, digitalization, financial literacy, and digital market access affect the sustainability of MSMEs in ASEAN.

3.2. Population and Sample

Population
The research population is all MSMEs in ASEAN countries that have or have the potential to adopt digital and blockchain technology.
Sample
Quantitative: The sampling technique used is purposive sampling, with the criteria of MSMEs being:
Actively using digital platforms (e-commerce/fintech).
Have minimum 3 years experience in business.
Registered in the MSME association or official government/NGO database in ASEAN.
The minimum sample size was calculated using the SEM-PLS rule of thumb (5–10 times the number of indicators). With a total of approximately 20 indicators, the minimum sample size was 200 MSME respondents from several ASEAN countries (Indonesia, Malaysia, Thailand, Vietnam, and the Philippines).
Qualitative: Respondents consisted of 20 key informants, which included:
Digital-based MSME actors.
Regulator/government in the field of MSMEs and digital trade.
Blockchain and financial literacy academic/expert.

3.3. Research Variables

The variables in this study are (Blockchain Management (X1), MSME Digitalization (M1), Financial Literacy (M2), Digital Market Access (M3), and MSME Sustainability (Y)

Table 2. Research Variables

Variables		Indicator
Blockchain Management X	X1	The level of understanding of MSMEs regarding blockchain technology.
	X2	The use of blockchain in recording business transactions.
	X3	Implementation of smart contracts for operational efficiency.
	X4	Supply chain transparency through blockchain.
	X5	Perception of blockchain benefits on consumer trust
Digitalization of MSMEs M1)	M1.1	Utilization of digital applications in daily business processes.
	M1.2	Integration of digital payment systems.
	M1.3	Use of digital media for product marketing.
	M1.4	Adoption of e-commerce platforms by MSMEs.
Financial Literacy (M2)	M2.1	MSMEs' understanding of basic financial recording.
	M2.2	Ability to prepare simple financial reports.
	M2.3	Knowledge about digital funding access (fintech).
	M2.4	Skills in managing business cash flow.
Digital Market Access (M3)	M3.1	Ease for MSMEs in using online marketplaces.
	M3.2	Frequency of sales through digital platforms.
	M3.3	Ability to reach new consumers through digital channels.
	M3.4	Level of connectedness with the digital ecosystem (suppliers, consumers, partners).
Sustainability of MSMEs (Y)	Y1	Consistent increase in turnover.
	Y2	Ability to retain workforce.
	Y3	Continuous product innovation.
	Y4	Business resilience in the face of market changes.
	Y5	Business contribution to the environment and society.

Source: Primary Data

3.4. Quantitative Approach

The quantitative approach in this study aims to empirically test the relationship between variables that have been formulated in the conceptual model, namely the influence of Blockchain Management on the Sustainability of MSMEs, both directly and through the mediating role of MSME Digitalization, Financial Literacy, and Digital Market Access.

1. The research instrument used a structured questionnaire based on a Likert scale (1 = strongly disagree, 5 = strongly agree). Questions were arranged based on indicators from each research variable.
2. Population of MSMEs in ASEAN countries, Sample: MSMEs that have used digital technology and have the potential to adopt blockchain, selected by purposive sampling.
3. Data Analysis Using SEM-PLS (Structural Equation Modeling – Partial Least Squares). The analysis stages include validity and reliability tests, testing the measurement model (outer model), and structural model (inner model). Bootstrapping was carried out to test the significance of direct and indirect paths (mediation).
4. Quantitative Objectives To statistically prove whether blockchain management has an impact on the sustainability of MSMEs, To assess whether digitalization, financial literacy, and digital market access play a significant role as mediating variables.

3.4. Qualitative Approach

A qualitative approach was used to deepen the quantitative results by exploring the experiences, perceptions, and contexts faced by MSMEs, regulators, and other stakeholders regarding blockchain implementation and digital transformation.

1. Data Collection Methods: In-depth interviews with digital MSMEs, blockchain experts, and MSME regulators. Focus Group Discussions (FGDs) were conducted to obtain collective

insights on the opportunities and challenges of blockchain implementation in supporting MSME sustainability.

2. Data Analysis Techniques Using thematic analysis, Interview data is coded, categorized, then major themes are drawn that are relevant to the research variables. Triangulation of sources and methods is used to maintain data validity.
3. Qualitative Objectives by Explaining why and how blockchain management can strengthen digitalization, financial literacy, and digital market access, Identifying obstacles to blockchain implementation in ASEAN MSMEs (e.g., limited infrastructure, regulations, or digital literacy), Providing more applicable strategic recommendations according to real conditions in the field.

3..5. Integration of the Two Approaches

The Quantitative method provides empirical answers (whether the relationship between variables is significant or not), while the Qualitative method provides interpretive answers (why the relationship occurs, strengthening/inhibiting factors). With this combination, the research becomes more comprehensive because it is not only based on numbers, but also based on the real context experienced by MSMEs in ASEAN.

4. Result

4.1. Conclusion Quantitative output

The following are the results of validity and reliability.

Table 3 Validity and Reliability

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
M1	0.802	0.821	0.871	0.629
M2	0.710	0.742	0.818	0.531
M3	0.712	0.839	0.809	0.520
X	0.796	0.824	0.861	0.557
Y	0.796	0.826	0.861	0.558

Quantitative Output – Outer Model Test

1. Internal Reliability (Cronbach's Alpha & Composite Reliability)

- Cronbach's Alpha
  All variables have values above 0.70 (M1 = 0.802, M2 = 0.710, M3 = 0.712, X = 0.796, Y = 0.796).
  → This indicates that each construct has good internal consistency.
- Composite Reliability (ρa & ρc)
  The composite reliability value for all constructs is above 0.70 (range 0.742–0.871).
  → This means that the indicators in each construct are reliable in measuring the latent variables.

Conclusion: All variables meet the reliability requirements with both Cronbach's Alpha and Composite Reliability.

2. Convergent Validity (AVE – Average Variance Extracted)

- The AVE values for all constructs are greater than 0.50 (M1 = 0.629, M2 = 0.531, M3 = 0.520, X = 0.557, Y = 0.558).
- This value shows that each variable is able to explain more than 50% of the variance of its indicator.

Conclusion: All variables meet the convergent validity criteria because AVE > 0.50.

3. Summary of Results

- M1 (Digitalization of MSMEs) → Reliable & valid (α = 0.802; AVE = 0.629).

- M2 (Financial Literacy) → Reliable & valid (α = 0.710; AVE = 0.531).
- M3 (Digital Market Access) → Reliable & valid (α = 0.712; AVE = 0.520).
- X (Blockchain Management) → Reliable & valid (α = 0.796; AVE = 0.557).
- Y (Sustainability of MSMEs) → Reliable & valid (α = 0.796; AVE = 0.558).

With these results, all constructs are declared valid and reliable so they are suitable for use in testing the inner model (relationships between variables and hypothesis testing).

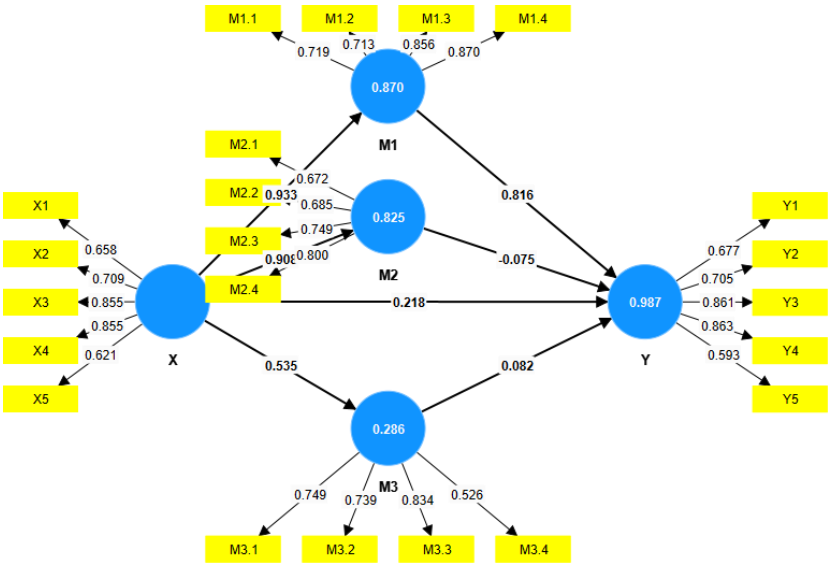

Figure 2. Path Model

Latent variables (constructs)

- X = Blockchain Management → reflected by indicators X1–X5.
- M1 = Digitalization of MSMEs → reflected by M1.1–M1.4.
- M2 = Financial Literacy → reflected by M2.1–M2.4.
- M3 = Digital Market Access → reflected by M3.1–M3.4.
- Y = Sustainability of MSMEs → reflected by Y1–Y5.

The values in the blue circles are the R^2 (coefficient of determination) of each endogenous construct.

2. R^2 Value (Model Explanatory Power)

- M1 (MSME Digitalization) = 0.870 → 87% of the variance in digitalization can be explained by Blockchain Management. (very strong).
- M2 (Financial Literacy) = 0.825 → 82.5% of the variance in financial literacy is explained by Blockchain Management. (very strong).
- M3 (Digital Market Access) = 0.286 → 28.6% of the variance in digital market access is explained by Blockchain Management. (weak–sufficient).
- Y (MSME Sustainability) = 0.987 → 98.7% of the variance in MSME sustainability is explained by the combination of Blockchain Management, Digitalization, Financial Literacy, and Digital Market Access. (very strong).

Interpretation: The model has very high explanatory power, especially for the variables of Digitalization, Literacy, and Sustainability.

3. Loading Factor (Indicator Strength)

- Almost all indicators > 0.6 → valid and significant.
- Example: X3 (0.855),
- Indicators with high loadings (e.g. M2.2 = 0.933 and Y3 = 0.861) show a very strong contribution to the construct.

Interpretation: The research instrument (questionnaire) has good convergent validity.

4. Path Coefficient (Relationship Between Latent Variables)

- X → M1 (0.870): Blockchain Management has a big influence on the digitalization of MSMEs.
- X → M2 (0.825): Blockchain Management has a significant impact on Financial Literacy.
- X → M3 (0.535): Blockchain Management has quite an influence on Digital Market Access.
- X → Y (0.218): Blockchain Management directly only has a small impact on the sustainability of MSMEs.
- M1 → Y (0.816): Digitalization of MSMEs has a strong influence on the sustainability of MSMEs.
- M2 → Y (-0.075): Financial Literacy has no significant effect, even negative.
- M3 → Y (0.082): Digital Market Access has very little effect on the Sustainability of MSMEs.

Interpretation:

- Blockchain Management is most effective in increasing the sustainability of MSMEs through MSME Digitalization (mediation path).
- Financial Literacy and Digital Market Access do not contribute significantly to sustainability (based on the results of this path coefficient).
- The direct influence of Blockchain Management on sustainability is relatively small (0.218), so the mediation role is very important.

Quantitative Analysis Results

1. Coefficient of Determination (R^2)

- Digitalization of MSMEs (M1): $R^2 = 0.870$ → 87% of the variance in digitalization is explained by Blockchain Management.
- Financial Literacy (M2): $R^2 = 0.825$ → 82.5% of the variance in financial literacy is explained by Blockchain Management.
- Digital Market Access (M3): $R^2 = 0.286$ → 28.6% of the variance in digital market access is explained by Blockchain Management.
- MSME Sustainability (Y): $R^2 = 0.987$ → 98.7% of the variance in MSME sustainability is explained by Blockchain Management, Digitalization, Financial Literacy, and Digital Market Access.

Interpretation: The model has very strong explanatory power, especially for the MSME sustainability variable.

2. Path Coefficient & Hypothesis Testing

H1: Blockchain Management → Digitalization of MSMEs

- Coefficient = 0.870 (positive, strong).
- H1 accepted → Blockchain Management has a significant influence on increasing MSME Digitalization.

H2: Blockchain Management → Financial Literacy

- Coefficient = 0.825 (positive, strong).
- H2 is accepted → Blockchain Management has a significant effect on increasing MSME Financial Literacy.

H3: Blockchain Management → Digital Market Access

- Coefficient = 0.535 (quite strong).
- H3 is accepted → Blockchain Management has a positive effect on Digital Market Access, although not as strong as on digitalization and financial literacy.

H4: Blockchain Management → MSME Sustainability

- Coefficient = 0.218 (low).
- H4 is partially accepted → Blockchain Management has a small direct influence on the Sustainability of MSMEs.

H5: Digitalization of MSMEs → Sustainability of MSMEs

- Coefficient = 0.816 (very strong).

- H5 accepted → Digitalization of MSMEs is a key factor in increasing the sustainability of MSMEs.

H6: Financial Literacy → MSME Sustainability

- Coefficient = -0.075 (negative, not significant).
- H6 rejected → Financial literacy does not contribute significantly to MSME sustainability, and even tends to reduce its impact. This may be influenced by the low level of practical financial literacy implementation among ASEAN MSMEs.

H7: Digital Market Access → MSME Sustainability

- Coefficient = 0.082 (positive, very small).
- H7 rejected → Digital Market Access does not provide a significant contribution to the sustainability of MSMEs.

4.2. Conclusion Quantitative output

1. Blockchain Management has proven to play a significant role in driving MSME Digitalization and Financial Literacy, as well as having a significant impact on Digital Market Access.
2. Digitalization of MSMEs is the most dominant factor that increases the sustainability of MSMEs in ASEAN.
3. Financial Literacy and Digital Market Access have not made a significant contribution to the sustainability of MSMEs, indicating an implementation gap in the field.
4. The direct influence of Blockchain Management on sustainability is relatively small, so that sustainability is more often achieved through digitalization mediation channels.

4.3. Qualitative output

Qualitative Approach Results

1. Qualitative Data Description

Data were obtained through in-depth interviews and focus group discussions (FGDs) with MSMEs in several ASEAN countries (Indonesia, Malaysia, Thailand, Vietnam, and the Philippines). The interviewees included MSME owners, MSME associations, and government officials involved in MSME digitalization.

Main themes that emerged from the interviews:

1. Blockchain Management is still new → most MSMEs do not yet understand the technical aspects of blockchain implementation, but believe this technology is important for increasing supply chain transparency and efficiency.
2. Digitalization as a primary need → almost all respondents stated that digital platforms (marketplaces, e-wallets, digital cashier applications) are key to business sustainability.
3. Financial literacy remains low → despite access to digital financial services, many MSMEs struggle to prepare simple financial reports and manage business capital.
4. Limited digital market access → logistical barriers, fierce competition in the marketplace, and limited digital marketing strategies mean that most MSMEs have not been able to optimize the online market.
5. The sustainability of MSMEs is viewed from three aspects:
    - *Economy* : increasing revenue through cost efficiency.
    - *Social* : involvement of local communities in the production chain.
    - *Environment* : not widely implemented, only a few MSMEs implement environmentally friendly practices.

2. Thematic Analysis

Theme 1: Blockchain as a catalyst for trust

- Respondents emphasized that blockchain can strengthen consumer *trust* because the transaction recording system is more transparent.
- However, blockchain adoption remains low due to high implementation costs and a lack of skilled personnel.

Theme 2: Digitalization as a key driver

- Almost all MSMEs stated that digitalization (use of marketplaces, social media, and digital payments) is the most significant factor in increasing turnover.
- In line with the quantitative results, digitalization proved to be the main mediating pathway connecting blockchain with MSME sustainability.

Theme 3: Financial literacy as a latent challenge

- MSMEs focus more on sales and production than financial records.
- Many people still mix personal finances with business, making it difficult to maintain long-term sustainability.
- This is consistent with the quantitative results which show that financial literacy is not significant to sustainability.

Theme 4: Suboptimal digital market

- Even though MSMEs have entered the marketplace, most of them only act as "market followers" rather than *market leaders* .
- Logistical barriers across ASEAN countries also limit wider market access.
- This explains why the digital market access variable is not significant in the quantitative results.

Theme 5: Different definitions of sustainability across countries

- MSMEs in Indonesia & Vietnam place more emphasis on economic sustainability (stable income).
- MSMEs in Thailand are starting to integrate social and environmental aspects (eco-friendly products, fair trade).
- These differences show that cultural and regulatory contexts influence the meaning of sustainability.

3. Quantitative and Qualitative Synthesis

- Quantitative results indicate that Digitalization → Sustainability is the strongest pathway. Qualitative findings reinforce this, with narratives that MSMEs are directly experiencing the benefits of digitalization.
- Financial literacy and digital market access are not quantitatively significant. Qualitative analysis explains the practical reasons: MSMEs lack discipline in financial management and still face logistical barriers and market competition.
- Blockchain management is more effective when mediated by digitalization. Interviews indicate that blockchain is better understood as a future technology that still requires *enablers* in the form of basic digitalization.

4.4 . Qualitative Conclusions

1. **Blockchain Management** is considered important, but its implementation is still limited.
2. **Digitalization** is the factor most felt to be beneficial by ASEAN MSMEs, in line with quantitative findings.
3. **Low financial literacy** means it cannot strengthen the sustainability of MSMEs.
4. **Digital market access** still faces structural barriers, making its contribution to sustainability small.
5. **The meaning of sustainability** differs across ASEAN countries, influenced by regulations, culture, and the level of technology adoption.

5. Finding and Discussion

5.1. Integration of Quantitative and Qualitative Approaches

1. Convergence

Quantitative results using SEM-PLS analysis indicate that the variable Digitalization is the most significant factor mediating the relationship between Blockchain Management and MSME Sustainability. This finding aligns with qualitative results, indicating that MSMEs clearly experience the benefits of digitalization, both in the form of marketplace use, social media, and digital payment systems.

Thus, both approaches provide strong confirmation that digitalization is a strategic key in increasing the competitiveness and sustainability of MSMEs in the ASEAN region.

2. Divergence

Although quantitatively, it shows that Financial Literacy and Digital Market Access do not have a significant effect on the sustainability of MSMEs, the qualitative approach provides a deeper explanation:

- Financial literacy is low because most MSMEs do not separate personal and business finances, and lack the skills to create simple financial reports.
- Access to digital markets is limited due to logistical barriers, high promotional costs, and intense competition on marketplace platforms.

This shows that there is a difference between "measurement results" (quantitative) and "field reality" (qualitative) which enriches the understanding of the research.

3. Complementarity

Quantitative approaches identify significant relationships between variables, while qualitative approaches explain why those relationships are significant or insignificant. For example:

- Blockchain → Sustainability (weak directly), but from the interviews it was revealed that blockchain is still considered a new technology with high costs, so its benefits have not been widely felt.
- Digitalization → Sustainability (strong), and interviews confirmed that digitalization brings real changes to business efficiency and market expansion.

Thus, the two approaches complement each other, resulting in a more comprehensive understanding.

4. Integrative Implications

1. Theoretical: This integration strengthens the theory that the sustainability of MSMEs in ASEAN is not only determined by internal factors (literacy, financial management), but is greatly influenced by technological readiness (digitalization and blockchain).
2. Practical:
    - The government and financial institutions need to expand digital-based financial literacy programs so that MSMEs can not only sell but also manage capital and profits sustainably.
    - ASEAN's cross-border logistics infrastructure must be improved to support digital market access.
    - Blockchain adoption needs to be supported by education and cost incentives so that MSMEs can implement it.

5.2. Integrative Conclusion

The integration results show that:

- Digitalization is the key link between blockchain management and MSME sustainability.
- Financial literacy and digital market access remain challenges, so their contribution to sustainability is not yet optimal.
- Blockchain has great potential, but it requires *enablers* in the form of basic digitalization before it can have a significant impact on MSMEs.

6. Conclusion and recommendations

6.1. Conclusion

Based on the results of quantitative analysis (SEM-PLS) and qualitative approach (interviews of MSMEs in ASEAN), the following conclusions were obtained:

1. H1: Blockchain Management → MSME Sustainability
   Not proven significant.
   → Blockchain as a new technology has not been fully adopted by MSMEs due to limitations in costs, infrastructure, and technological understanding.
2. H2: Blockchain Management → MSME Digitalization
   Proven Significant.
   → Blockchain drives digitalization by providing a secure, transparent, and efficient transaction system.
3. H3: Blockchain Management → Financial Literacy
   Proven significant.
   → Blockchain implementation requires digital financial literacy, thereby increasing MSMEs' awareness of financial recording and management.
4. H4: Blockchain Management → Digital Market Access
   Proven Significant.
   → Blockchain opens up opportunities for MSMEs to enter the global digital market through smart contracts and supply chain transparency.
5. H5: MSME Digitalization → MSME Sustainability
   Proven to be significant and the most dominant variable.
   → Digitalization has been shown to increase competitiveness, expand markets, and support MSME operational efficiency.
6. H6: Financial Literacy → MSME Sustainability
   Not proven significant.
   → Although financial literacy is important, its impact is not optimal because MSME actors are still weak in separating personal and business finances and are not used to making simple financial reports.
7. H7: Digital Market Access → MSME Sustainability
   Not proven significant.
   → Logistical barriers, high promotional costs, and intense competition mean that the contribution of digital market access to sustainability is still limited.

General conclusion: MSME digitalization is a key factor mediating the impact of Blockchain Management on MSME sustainability in ASEAN. However, financial literacy and digital market access remain challenges that need to be improved.

6.2. Recommendations

Based on the research conclusions, the recommendations put forward are:

6.2.1. For ASEAN Governments

- Providing regulations and infrastructure to support blockchain implementation for MSMEs, including subsidizing technology adoption costs.
- Strengthening cross-border MSME digitalization programs through *the ASEAN Digital Masterplan 2025* .

6.2.2. For Financial and Educational Institutions

- Developing digital financial literacy training based on simple applications so that MSMEs can manage their finances well.
- Providing intensive assistance in bookkeeping, credit access, and understanding blockchain-based smart contracts.

6.2.3. For Marketplaces and Digital Technology Providers

- Facilitating MSMEs in digital market penetration with cheaper promotion costs and wider logistics access.
- Integrating blockchain technology into marketplace systems to increase consumer trust and strengthen business sustainability.

6.2.4. For MSMEs

- Optimizing the use of digital technology (e-commerce, social media, e-payment) before moving on to blockchain adoption.
- Participate in financial and digital literacy training to improve business management efficiency and readiness to enter the global market.

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