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Strategy Factors to Strengthen Access to MSME Financing Through IoT Integration to Increase Competitiveness: TOE Frame Approach

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ABSTRACT

Objective: *Access to financing is a critical factor for Micro, Small, and Medium Enterprises (MSMEs) to enhance business capacity and competitiveness; however, it remains a major challenge in Indonesia. This study aims to analyze the roles of technological, organizational, and environmental factors in strengthening access to financing and their implications for MSME competitiveness using the Technology–Organization–Environment (TOE) framework, with Internet of Things (IoT) integration as the technological context.* ***Method:*** *A quantitative research design was employed using the Partial Least Squares–Structural Equation Modeling (PLS-SEM) approach. The sample consisted of 109 food and beverage MSMEs in Sidoarjo Regency, selected through proportionate stratified sampling.* ***Results:*** *The results indicate that technological and organizational factors have a significant effect on MSME financing, while environmental factors do not show a significant direct effect. Furthermore, technology and organization significantly influence MSME competitiveness, whereas environmental factors are not significant determinants of competitiveness. The findings also reveal that financing has a significant negative effect on MSME competitiveness, suggesting that increased access to financing does not automatically enhance competitiveness unless it is managed productively and efficiently. Overall, the study highlights that strengthening MSME competitiveness is more effectively achieved through the development of internal capabilities, particularly technological readiness and organizational capacity, with financing acting as a supporting factor that must be strategically managed.* ***Novelty:*** *This study contributes empirically to the TOE literature by positioning IoT integration as a mechanism for improving operational data quality to support financing, access and competitiveness.*

INTRODUCTION

Micro, Small, and Medium Enterprises (MSMEs) are the backbone of Indonesia's economy. In 2023, the number of MSMEs will reach 66 million business units, contributing around 61% to the Gross Domestic Product (GDP) and absorbing around 117 million workers or 97% of the total national workforce [1]. Despite their significant contributions, MSMEs face major challenges in accessing financing. Data from the Financial Services Authority (OJK) shows that only about 21% of MSMEs get access to financing from formal financial institutions, making Indonesia the country with the lowest access to MSME financing in Asia [2].

Table 1. Contribution of MSMEs to the Indonesian Economy

Indicator	Value
Number of MSMEs	±66 million units
Contribution to GDP	±61%
Labor absorption	±117 million people
Percentage of national labor force	±97%

Table 1 shows that MSMEs have a very dominant role in the national economy, both in terms of the number of business units, contribution to the Gross Domestic Product (GDP), and labor absorption. This dominance confirms that the sustainability of MSMEs has direct implications for national economic stability.

Table 2. Percentage of MSMEs Experiencing Obstacles in Access to Financing

Year	Percentage of MSMEs Constrained by Financing
2020	±60%
2021	±56%
2022	±53%
2023	±51.09%

Based on Table 2, it can be seen that the obstacles to access to MSME financing have shown a downward trend in recent years, but the percentage is still relatively high. In 2023, 51.09% of MSMEs will still have difficulties accessing capital. This condition shows that despite various financing and financial inclusion programs, the problem of access to financing for MSMEs has not been optimally resolved.

Based on data from the Central Statistics Agency (BPS) and the Ministry of Cooperatives and SMEs, obstacles to access to capital are still the main problems faced by MSMEs in recent years. The results of the national survey show that in the 2020–2023 period, more than half of MSMEs experienced difficulties in obtaining formal financing. Although the percentage of MSMEs constrained by capital shows a downward trend, in 2023 it is still recorded that **51.09%** of MSMEs face limited access to financing. This condition indicates that MSME financing problems are structural and sustainable, so a more comprehensive strategic approach is needed to strengthen access to financing in a sustainable manner.

The most common problems faced by MSMEs in Indonesia are capital problems which in the end are lack of financing, around 51.09% of MSMEs experience obstacles in access to capital and low use of information and communication technology in business operations[3]. This problem is a fundamental problem at this point because it will have an impact on everything else. On the other hand, MSMEs have strengths in the form of a

large number of business units, operational flexibility, and the ability to adapt to market changes. In addition, the development of digital technology and government policy support for financial inclusion and digitalization of MSMEs opens up significant opportunities to strengthen access to financing. The use of technology, including the integration of the Internet of Things (IoT), has the potential to be a strategic solution in improving the quality of business data, strengthening the trust of financing institutions, and encouraging sustainable improvement in the competitiveness of MSMEs.

The ability of MSMEs to create value and achieve long-term growth is greatly influenced by intellectual capital management and leadership structures, which are critical components in an organization's readiness to adopt technologies such as IoT[4]. In the digital era, the adoption of technology such as the Internet of Things (IoT) can improve operational efficiency and access to MSME financing. However, IoT adoption among Indonesian MSMEs is still low[5]. Integrating IoT technology in financing platforms can be a solution to overcome limited access to MSME financing. IoT can provide real-time data on business performance can improve operational efficiency and access to financing through real-time data[6]. In addition, it shows that the use of real-time data from IoT can improve the accuracy of MSME credit risk assessment through the Graph Neural Networks model, which is very important because it will ensure security for MSMEs[7]. In some respects of the integration of IoT integration, it was found that the adoption of technologies such as IoT by manufacturing MSMEs can increase the supply of credit from banks through real-time operational data[8]. However, the implementation of this solution requires an in-depth understanding of the factors that affect the adoption of technology by MSMEs. In this study, the Internet of Things (IoT) is not treated as a separate independent variable, but as a context of technology integration that strengthens the quality of MSME operational data, thereby supporting mechanisms to strengthen financing and increase competitiveness.

Various international studies show that the problem of low adoption of digital technology in MSMEs, which has an impact on weak business registration and limited access to financing, needs to be analyzed using a framework that is able to accommodate internal and external factors systematically. Framework *Technology–Organization–Environment (TOE)*) has been widely used in MSME research because it is able to explain how technological readiness, organizational characteristics, and environmental pressures and support affect digital technology adoption decisions[9]. Another study also confirms that the TOE approach is effective in analyzing the adoption of digital technology and e-commerce in MSMEs in developing countries, including Indonesia[10].

In the context of integration *Internet of Things (IoT),* research on the manufacturing and MSME sectors shows that TOE is relevant to explain the adoption of IoT and its impact on organizational performance and operational efficiency[11]. In addition, an international study in the field of MSME financing emphasizes that digitalization and financial technology are able to expand access to financing through improving the quality

of business information and reducing information asymmetry, so that the analysis of the adoption of TOE-based technology becomes increasingly relevant [12].

Therefore, this study uses the *Technology–Organization–Environment TOE* approach to explain how technology adoption in an organization is influenced by three main contexts, namely:

1. **Technological**
   Describe the technologies available to organizations both in use and under exploration. Factors such as relative benefits, complexity, and compatibility of technology come into this context [13].
2. **Organizational**
   It refers to the internal characteristics of the organization such as size, level of formality, human and technical resources, and management structure. These factors determine the organization's internal readiness to adopt new technologies [14].
3. **Environmental**
   Relating to external conditions that affect the organization, such as industry competition, support from the government, pressure from consumers, and linkages with business partners [15].

The TOE Framework is widely used in information systems and technology research because of its flexibility in explaining the multidimensional factors that influence technology adoption, including the Internet of Things (IoT), cloud computing, and e-commerce in the MSME (Micro, Small, and Medium Enterprises) sector [16]. The utilization of the TOE framework helps to understand the key factors influencing the adoption of digital technology by MSMEs in Indonesia, including technological readiness and environmental support, which is an important basis for the integration of IoT platforms to strengthen access to finance [17]. The TOE framework allows the formulation of a conceptual model that describes the readiness and potential for information technology adoption among MSMEs, as a strategic basis in encouraging the integration of digital platforms such as IoT to strengthen access to finance and competitiveness [18].

The adoption of technology by MSMEs is influenced by technological, organizational, and environmental factors, which in the perspective of TOE can be adapted to encourage the use of digital platforms such as IoT to improve access to financing and business performance[14]. Previous research has examined the adoption of digital technology by MSMEs and the challenges of accessing financing separately. Based on research by[19] stated that the adoption of artificial intelligence in Balikpapan MSMEs shows that the TOE approach is effective in identifying obstacles and drivers of technology implementation, which can also be applied in IoT integration to strengthen access to financing and competitiveness of MSMEs. This is in line with a study by[20] that technology has been proven to play a mediating role in improving the performance of MSMEs, which shows that the integration of digital technologies such as IoT by

considering technological, organizational, and environmental factors, can be an effective strategy to strengthen competitiveness and access to financing. Other researchers[21] that the adoption of technology by MSMEs in developing countries such as Indonesia is influenced by internal and external factors, including technology awareness, organizational support, and dimensional environmental pressures that are in line with the TOE framework in encouraging the use of digital technologies such as IoT to improve access to financing and business competitiveness.

However, the integration of IoT technology in MSME financing platforms with the TOE Framework approach is still rare, especially in the Indonesian context. The novelty of this research is that the concept that is based on **TOE Framework** which is a conceptual framework first introduced by **Tornatzky and Fleischer (1990)** in his book *The Processes of Technological Innovation*. The TOE framework allows MSMEs to identify key factors influencing the successful adoption of business technology, including technological, organizational, and environmental aspects, which are important guides in the implementation of IoT to strengthen access to finance and competitiveness[22]. Technological, organizational, and environmental factors significantly influence the adoption of e-commerce by MSMEs in Indonesia, which shows the importance of the TOE approach in developing technology integration strategies such as IoT to strengthen access to financing and competitiveness [23].

The weak understanding of financial knowledge, especially financing, makes the condition of MSMEs even more difficult in their management. The role of financial institutions needs to be improved again in order to contribute to MSMEs. The problems that are still an obstacle in the development of MSME businesses are the limited capital they have and the difficulty of MSMEs accessing capital sources. Prior to the enactment of the Law on Bank Indonesia No. 23 of 1999 as amended by Law No. 3 of 2004, Bank Indonesia's policy in assisting the development of small businesses and cooperatives, Bank Indonesia was able to provide financial assistance to MSMEs, known as Bank Indonesia Liquidity Loans (KLBI). However, after the law mentioned above.

This research has some significant novelties. First, conceptually, this study applies the *TOE Framework (Technology, Organization, Environment*) directly in the context of Internet *of Things (IoT) technology integration* to overcome the limited access to MSME financing, which has not been widely done in previous research, especially in Indonesia.

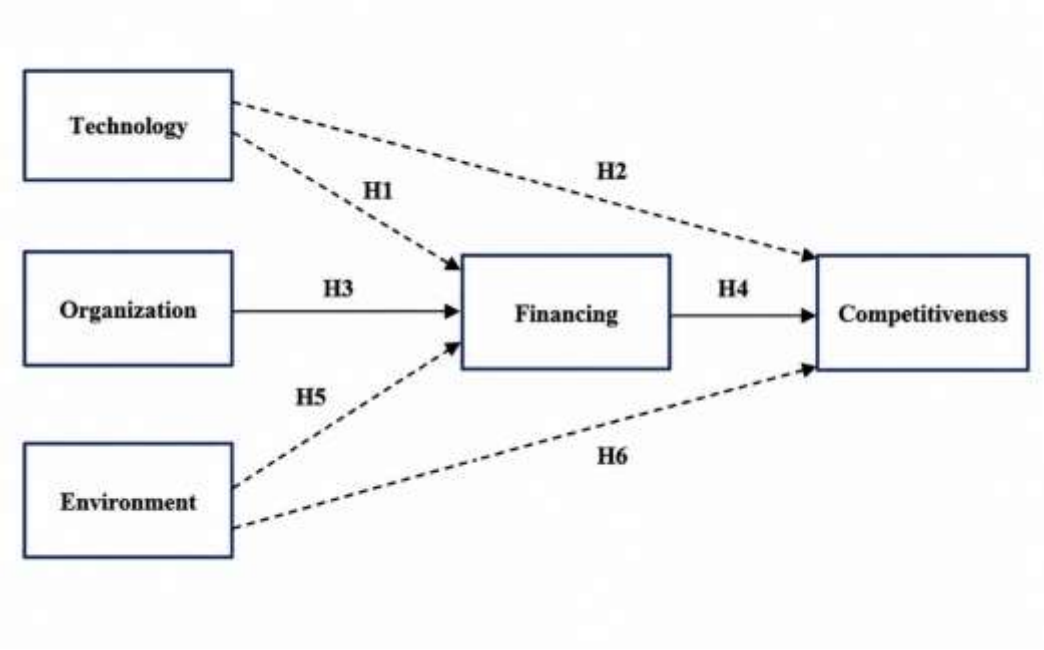

Figure 1. Conceptual Framework

RESEARCH METHOD

In research, the method used is quantitative, which is a form of research that uses the collection of numerical data and analytical techniques to test hypotheses, draw conclusions, and understand the relationships between the variables being studied [24].

According to [25] The research population refers to all units of analysis that have identical characteristics or have a meaningful relationship with the research issue. The population in this study includes all Micro, Small, and Medium Enterprises (MSMEs) in the food and beverage sector operating in the Sidoarjo Regency area. Based on data from the Central Statistics Agency (BPS) of Sidoarjo Regency contained in the publication *Sidoarjo Regency in 2025*, the number of MSMEs in Sidoarjo Regency is estimated to reach around 51,400 business units. This population is considered relevant as the food and beverage sector is one of the largest contributors to the MSME ecosystem, but still faces significant challenges in terms of technology adoption and access to formal financing.

However, for the purposes of this study, not all business units in the population can be included as potential respondents. Therefore, screening is carried out based on inclusion and exclusion criteria, including: (1) MSMEs are actively operating for at least the last three years, (2) have at least two employees, (3) are willing to participate in research and have access to digital technology, and (3) are not in a period of business delay or temporary closure. Based on the results of the initial survey and available data, the number of MSMEs that meet the selection criteria is as many as 150 business units.

Table 3. Stages of Screening the MSME Population Based on Inclusion and Exclusion Criteria

Selection Stage	Selection Criteria	Number of MSMEs (Business Units)	Remarks
1	Total MSMEs in the food and beverage sector in Sidoarjo Regency	51.400	Based on data from BPS and the Cooperatives & MSMEs Office
2	MSMEs that have been actively operating for at least the last 3 years	8.250	Elimination of new and inactive MSMEs
3	MSMEs with a minimum of 2 employees	3.480	Elimination of Household-Scale Businesses Without Employees
4	MSMEs have access to and use digital technology	620	Elimination of non-digital MSMEs
5	MSMEs are willing to become research respondents	185	Based on initial surveys
6	MSMEs are not in a period of business delay or temporary closure	150	Final sample of the study

Table 3 shows the stages of screening the MSME population based on the inclusion and exclusion criteria set out in this study. From the total population of around 51,400 MSMEs in the food and beverage sector in Sidoarjo Regency, screening was carried out in stages by considering aspects of business sustainability, workforce scale, digital readiness, and willingness to be a respondent. Based on the results of the initial survey and the availability of data, the number of MSMEs that meet all the selection criteria is 150 business units, which are then used as an effective population in determining the research sample.

This study uses a probability sampling method with a proportionate stratified sampling approach. This approach is used because the population has members (elements) that are not homogeneous and proportionally stratified[26]. Using the inclusion-exclusion criteria to determine the effective population, then the number of samples was determined with the Slovin formula and taken using the proportionate stratified sampling technique. According to[25] The Slovin formula is often used to determine a representative sample count so that the results of the study can be generalized properly. In this study, the researcher set an error tolerance limit

(e) by 0.05 or 5%. The Slovin formula used is as follows:

$$n = \frac{N}{1 + N\,e^2}$$

n = Number of Samples

N = Total Population

e = Fault Tolerance Limit

To determine the number of samples from the final population of 150 MSMEs that have met the inclusion and exclusion criteria, the Slovin formula with an error tolerance rate of 5% (e = 0.05) was used. The use of the Slovin formula aims to obtain efficient and representative sample sizes of a limited population, especially when population variance is not known with certainty. The calculation is as follows:

$$n = \frac{\mathrm{N}}{1+N.e^2} = \frac{150}{1+150(0.05^2)} = \frac{150}{1.375} = 109 \text{ UMKM}$$

Thus, the number of samples used in this study is 109 respondents.

Data were collected through a questionnaire with a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). Furthermore, the approach used is a survey by distributing questionnaires to respondents who meet the criteria for the research sample

Table 4. Research Variables

No	Variable	Definition	Indicator	Library
1	More Technology	Technologies available to organizations both already in use and under exploration	1. Adoption Cost 2. Perceived benefits 3. Compatibility 4. Complexity	[27]
	Organization	Organizational roles refer to the characteristics and internal resources of an organization that affect their ability and readiness to adopt and implement technological innovations.	1. Human Resources 2. Top management support 3. Digital Culture 4. International orientation	[27]
	Enviromental	The environment in question refers to external factors that influence an organization's decision to adopt and implement technological innovations.	1. Trading partner pressure 2. Competitive pressure 3. Government regulatory support 4. Government resource support	[27]
2.	Financing	Financing refers to the access and availability of funds that can be used by MSMEs to develop their businesses, including from financial institutions, investors, and alternative	1. Profitability 2. Liquidity 3. Company Size 4. Company Growth 5. Debt Levels	[28]

No	Variable	Definition	Indicator	Library
		sources		
3.	Competitiveness	The competitiveness of MSMEs reflects the ability of businesses to survive and develop in the market through product excellence, efficiency, innovation, and market response	1. Innovation Capabilities 2. Strategic Adaptability 3. Dynamic Capabilities 4. Organizational Structure and Company Culture 5. Business Connections and Relationships	[29]

According to [24] In the context of quantitative research, data analysis includes a series of steps designed to process, evaluate, and understand the data obtained. The selection of an analytical approach should be done with careful consideration, taking into account the nature of the data and the objectives of the research. Before the data is analyzed, all data is carried out several tests including:

1. Test Research Instruments

Testing research instruments is needed to ensure that the questionnaire or instrument used is able to measure research variables validly and reliably. Here are the stages and steps for instrument testing:

a) Validity Test
   Validity tests are performed to ensure that each item in the questionnaire actually measures the construct or variable in question.
b) Reliability Test
   Reliability tests are performed to ensure the internal consistency of the instrument, so that the results can be trusted.

2. Hypothesis Test

According to [30] Hypothesis testing is a method of testing statements or hypotheses about population characteristics based on data obtained from samples. Regression is a method of measuring the relationship between two or more variables and predicting the value of one variable based on the value of the other.

RESULTS AND DISCUSSION

Results

The results of this empirical analysis were carried out to test a research model developed based on the Technology–Organization–Environment (TOE) framework in the context of strengthening access to financing and increasing the competitiveness of

MSMEs through the integration of the Internet of Things (IoT). Data analysis was conducted using the Partial Least Squares–Structural Equation Modeling (PLS-SEM) approach, which was chosen for its ability to estimate predictive models with latent constructs and handle relatively limited sample sizes. Model testing is carried out in stages, starting from the evaluation of the measurement model to ensure the validity and reliability of the research construct, then continued with the evaluation of the structural model to test the causal relationship between variables. The results presented include testing the reliability of indicators, convergent and discriminant validity, and hypothesis testing through the analysis of path coefficients and their significance levels. The presentation of these results aims to provide a strong empirical basis in explaining the role of technological, organizational, and environmental factors in strengthening MSME financing and its implications for increasing business competitiveness.

To assess the validity of the indicators in the measurement model, the outer loading value was tested in each research construct. The outer loading value indicates the extent to which the indicator is able to represent the latent variable being measured. The results of these tests are presented in **Table 2**.

Table 3. Outer Loading

Indicator	Technology	Organization	Environment	Financing	Competitiveness
X1-1	0,832				
X1-2	0,818				
X1-3	0,822				
X1-4	0,826				
X2-1		0,853			
X2-2		0,824			
X2-3		0,835			
X2-4		0,796			
X3-1			0,802		
X3-2			0,900		
X3-3			0,895		
X3-4			0,812		
Y1				0,858	
Y2				0,817	
Y3				0,887	
Y4				0,795	
Y5				0,802	
Z1					0,811
Z2					0,818
Z3					0,791
Z4					0,832
Z5					0,810

Based on Table 3, all indicators in each construct show an outer loading value above the minimum limit of 0.70. This indicates that each indicator has a good ability to reflect the latent construct being measured, so that all indicators are declared valid and suitable for use in the analysis of the next structural model.

The next stage is the reliability and validity of the construct on the measurement model using Cronbach's Alpha, rho_A, Composite Reliability, and AVE. A summary of the test results is presented in Table 4

Table 4. Construct Reliability and Validity

	Cronbach'a Alpha	Rho_A	Composite Reliability	AVE
Technology	0,843	0,843	0,895	0,680
Organization	0,846	0,846	0,896	0,684
Environment	0,875	0,877	0,915	0,729
Financing	0,889	0,894	0,918	0,693
Competitiveness	0,871	0,872	0,907	0,660

Based on Table 4, the entire research construct shows a Composite Reliability value above 0.70 and Cronbach's Alpha value above 0.60. This indicates that each construct has a good level of internal consistency and can be declared reliable. In addition, the Average Variance Extracted (AVE) value of the entire construct was above the threshold of 0.50, which indicates that the construct is able to explain more than half of the variance of its indicators. Thus, it can be concluded that the measurement model in this study has met the criteria of reliability and convergent validity, making it feasible to use it for structural model analysis at a later stage.

After the measurement model is declared to meet the criteria of validity and reliability, the next stage is the evaluation of the structural model to test the causal relationship between the research variables. This test was carried out by analyzing path coefficients, t-statistics, and p-values to determine the direction, strength, and significance of the influence between constructs. The results of the structural relationship testing in this research model are presented in Table 5.

Table 5. Path Coefficients

Assumptions	Original Sample	Sample Mean	Standard Deviation	T Statistics	P Value
Technology → Financing (H1)	1,143	1,186	0,332	3,444	0,001
Technology → Competitiveness (H2)	0,827	0,828	0,031	26,854	0,000
Financing → Organizations (H3)	0,728	0,729	0,120	6,083	0,000

Assumptions	Original Sample	Sample Mean	Standard Deviation	T Statistics	P Value
Competitive → Organization (H4)	0,233	0,230	0,032	7,325	0,000
Environment → Financing (H5)	0,124	0,133	0,103	1,199	0,230
Environment → Competitiveness (H6)	-0,044	-0,042	0,031	1,425	0,154
Financing → Competitiveness (H7)	-1,017	-1,068	0,375	2,712	0,007

The results of hypothesis testing in Table 4 show that technology and organizational variables have a significant effect on MSME financing, while environmental variables do not show a significant influence. The significance criteria are determined based on a p-value of < 0.05. The technology variable has a path coefficient of 1.143 with a p-value of 0.001, which shows that the readiness and utilization of technology, including the use of digital systems and business support technology, plays an important role in increasing access to MSME financing. These findings indicate that the higher the level of technology adoption by MSMEs, the greater the chances for MSMEs to obtain financing from financial institutions.

Organizational variables also showed a significant influence on MSME financing, with a path coefficient of 0.728 and a p-value of 0.000. These results confirm that internal organizational factors, such as business management structure, managerial capabilities, and human resource support, have an important role in strengthening MSME financing access. Organizations that are managed more professionally tend to be able to increase the trust of financing institutions in the feasibility of MSME businesses.

On the other hand, environmental variables did not show a significant influence on MSME financing, with a path coefficient of 0.124 and a p-value of 0.230. These results indicate that external factors, such as competitive conditions, regulations, and business environment support, have not been directly considered by finance institutions in distributing funds to MSMEs. This condition shows that MSME financing access is more influenced by the internal readiness of the business than external environmental factors.

Furthermore, the test results also show that technology and organization have a significant effect on the competitiveness of MSMEs. The technology variable has a path coefficient of 0.827 with a p-value of 0.000, while the organizational variable has a path coefficient of 0.233 with a p-value of 0.000. These findings show that the use of technology and good organizational management can improve the ability of MSMEs to innovate, increase operational efficiency, and expand market reach, thus having a positive impact on competitiveness.

However, environmental variables did not show a significant influence on the competitiveness of MSMEs, with a path coefficient of -0.044 and a p-value of 0.154. These results indicate that external environmental conditions have not directly determined the level of competitiveness of MSMEs, which are more influenced by internal business factors, especially technology and organization.

Furthermore, the test results show that financing has a significant effect on the competitiveness of MSMEs, with a channel coefficient of -1.017 and a p-value of 0.007. These findings show that access to financing has an important role in increasing the competitiveness of MSMEs, even though the direction of the influence is negative. This indicates that increased financing needs to be managed optimally so that it can be used productively, such as for innovation investment, increasing operational efficiency, and strengthening business capacity, so as to be able to encourage the competitiveness of MSMEs in a sustainable manner. Thus, financing plays an important role as an important factor that connects the internal readiness of MSMEs, especially technology and organization, with increasing the competitiveness of MSMEs.

Based on the results of the direct influence test, indirect effect testing was then carried out to determine the role of financing as a mediating variable in the relationship between technological, organizational, and environmental factors on the competitiveness of MSMEs. This test aims to identify the extent to which financing is able to channel the influence of these variables on increasing the competitiveness of MSMEs. The results of the indirect effect test are presented in Table 5.

Table 6. Indirect Effect

Assumptions	Original Sample (O)	Sample Mean (M)	Standard Deviation	T Statistics	P Value
Technology → Financing	1,143	1,186	0,332	3,444	0,001
Financing → Organization	0,827	0,828	0,031	26,854	0,000
Environment → Financing	-1,017	-1,068	0,375	2,712	0,007

The results of the indirect effect test showed that there was an indirect influence of technological, organizational, and environmental variables on financing through mediator variables. The significance test was carried out using the bootstrapping method, with the T-statistics criteria > 1.96 and p-value < 0.05.

1. Indirect Influence of Technology on Financing

The results of the analysis showed that technology had a significant effect indirectly on financing, with a coefficient value of 1.143, a T-statistics value of 3.444, and a p-value of 0.001. These results show that the mediator variable is able to channel the influence of technology on financing significantly.

2. Indirect Influence of Organization on Financing

The organizational variables also showed a significant indirect influence on

financing, with a coefficient value of 0.827, a T-statistical value of 26.854, and a p-value of 0.000. These results confirm that organizational factors have a very strong role in influencing financing through mediator variables.

3. Indirect Influence of the Environment on Financing

The test results showed that the environment had a significant indirect effect on financing, with a coefficient value of -1.017, a T-statistics value of 2.712, and a p-value of 0.007. The negative value coefficient indicates that less conducive external environmental conditions can lower financing through the mediator variable mechanism.

Discussion

The Influence of Technology on Financing (H1)

Based on the results of the hypothesis test, it is proven that Technology has a positive effect on financing with a coefficient value of 1.143 and a significance value of 0.000 < 0.05. This shows that technology has an effect on financing. In MSME financing practices, the biggest obstacle is not only affordability, but information asymmetry: untidy business data, undocumented transactions, and difficult to verify performance. When MSMEs adopt digital technology. Business processes become more measurable, starting from recording transactions, inventory, production, to cash flow so that *Screening* and monitoring by financing institutions is easier. The TOE literature is also consistent: technology factors (adoption costs, suitability, benefits) play a direct role in the ability of MSMEs to adopt digital technology in real terms. If the adoption of technology is strong, MSMEs are better prepared to produce the operational evidence needed to strengthen financing feasibility[31]. In addition, systematic research on digital finance of MSME financing shows that digital technology improves the ability of finance institutions to collect and process information on MSMEs, thereby reducing information asymmetry and transaction costs.

In this study, the technology dimension in the framework *of Technology–Organization–Environment* (TOE) is not understood solely as the ownership of digital devices such as smartphones or internet access. The technology dimension is positioned as an *enabling capability* that allows MSMEs to further integrate digital technology, including the use of *the Internet of Things (IoT*) in recording and managing operational data. Thus, technological readiness reflects the ability of MSMEs to produce structured, measurable, and traceable data, which further plays an important role in strengthening financing parties' confidence in business feasibility.

Although various international studies show that the adoption of digital technology has a positive effect on increasing MSME access to financing through improving information quality and reducing information asymmetry, existing empirical findings still show mixed results. On the one hand, a systematic study by Sanga and Aziakpono (2023) confirms that digitalization and financial technology are able to increase access to MSME financing through mechanisms to increase business data transparency and credit risk assessment efficiency[12]. Similarly, Rehman et al.'s

(2023) research on manufacturing MSMEs shows that the use of digital technology contributes positively to increasing the supply of bank credit due to the availability of more accurate and real-time operational data[8]. However, on the other hand, a number of studies have also found that technology adoption does not always have a significant impact on financing when technology is only partially used and has not been integrated with the core operational systems of MSMEs. Study by[32] shows that the adoption of financial technology does not always have a significant impact directly on MSME financing access, as the benefits of technology tend to be indirect and highly dependent on the level of financial literacy and technology integration in core business processes. Another study also found that the development of digital financial services does not consistently reduce MSME financing constraints in all contexts, especially when the use of technology has not been supported by adequate operational readiness and business ecosystems[33]. This condition shows that there is a research gap related to how technology, especially the Internet of Things (IoT), is positioned not only as a tool for digitization, but as a credible mechanism for generating operational data. Therefore, this study fills this gap by emphasizing the role of technology readiness in the framework of TOE as a capability that enables IoT integration to strengthen the quality of business information, so that it is relevant in the context of MSME financing decision-making.

The results of the study show that technology factors have a significant effect on MSME financing. These findings strengthen the argument that technology readiness is not only limited to the use of basic digital devices, but also includes the ability of MSMEs to produce accurate, measurable, and sustainable business data. Internet of Things (IoT) integration plays a strategic role in this context as it is able to provide real-time operational data such as production volume, inventory levels, and cash flow based on actual activities. IoT-based data reduces information asymmetry between MSMEs and financing institutions, thereby increasing trust and feasibility of financing. The strategy that needs to be implemented by MSMEs is to encourage the adoption of simple IoT (e.g. stock sensors, automatic sales recording) to produce operational data that can be used as a basis for credit assessment by financial institutions.

The Influence of Technology on the Competitiveness of MSMEs (H2)

Based on the results of the hypothesis test, it is proven that technology has a positive effect on the competitiveness of MSMEs with a coefficient value of 0.827 and a significance value of 0.000 < 0.05. This shows that technology affects the competitiveness of MSMEs. This happens because technology plays a role as *a capability enabler* that strengthens process efficiency, data-based decision quality, and innovation and market response capabilities. In the logic of *resource-based view* and *dynamic capabilities*, the adoption of technology (including digitalization and IoT) helps MSMEs build resources/capabilities that are more difficult to replicate such as operational data integration, automation, and value chain coordination so that MSMEs can reduce costs faster, improve service quality/reliability, and expand market reach. This mechanism

makes technology not just a "tool", but a strategic capability that drives differentiation and productivity, which ultimately translates into increased competitiveness.

In line with the results of several previous studies, it also shows a pattern that when technology is actually used to transform core processes, the performance/competitive advantage of MSMEs is also encouraged: for example, digital transformation that encourages the performance of innovative MSMEs through strengthening business model innovation[34], digital adoption which is positively correlated with the performance and "market competitiveness" of UMSE/MSMEs in Indonesia[35], as well as evidence that a combination of data technologies *Complementary* with IoT driving revenue growth with competitiveness indicators[36]. However, there are also the results of previous studies that show results that are not always consistent, there are findings that the benefits of technology can not be seen directly when the adoption is partial or not translated into driving capabilities, for example, digital adoption is not directly significant to innovation performance because the effect is only strong through digital drive as a mediator[37]. Another study found that some technology components (e.g., digital payments) have no effect on the performance of MSMEs[38] and there is also an empirical argument that the positive impact of digital transformation on the performance of MSMEs requires a combination of resources (skills and strategies), so that technology alone does not automatically increase performance[39].

The significant influence of technology on competitiveness shows that technology functions as a capability enabler. IoT integration enables MSMEs to improve operational efficiency through real-time production process monitoring, quality control, and data-driven decision-making. With IoT, MSMEs are able to respond to market demand faster and reduce operational costs, which ultimately strengthens their competitive position. Strategies that need to be implemented by MSMEs can utilize IoT for internal process optimization, such as monitoring product quality and energy efficiency, so that competitiveness increases through differentiation and cost efficiency.

The Influence of Organizations on Financing (H3)

Based on the results of the hypothesis test, it is proven that the Organization has a positive effect on financing with a coefficient value of 0.728 and a significance value of 0.000 < 0.05. This shows that the Organization has an effect on financing. For MSMEs, the organizational context (human resource readiness, owner/management support, internal process readiness) theoretically strengthens financing because a more prepared organization will be better able to prepare the internal documents and controls requested by the funder. Organizations that are better prepared to be demonstrated through owner/management support, role sharing, and process discipline are able to provide business documents and internal controls needed by financing institutions in assessing creditworthiness. The quality of the organization reflects the capacity of MSMEs to manage risks and absorb financing accountably, thereby increasing the confidence of

funders in business sustainability. Within the framework of TOE, organizational capabilities strengthen the translation of resources (including technology and financing) into business performance, so that MSMEs with more mature organizations tend to have better access to financing[40].

In addition to the above findings, the latest literature also shows corroborating evidence that the quality of MSME organizations can be a "feasibility signal" for funders, especially when internal capabilities such as knowledge management and financial literacy increase as this relates to the ability to absorb credit (*Credit Absorption*) and manage funds more accountably[41]. Another support came from a study that confirmed that an organized organization, although simple, makes it easier for financing institutions to conduct post-credit monitoring and evaluation, so that MSMEs with better organizational capabilities are perceived to have lower financing risks[42]. In fact, in the context of more formal MSMEs, sustainability orientation, including governance and disclosure aspects, was found to be positively correlated with bank credit access because it strengthened the bank's reputation and trust in risk management and business compliance[43]. However, on the other hand, some studies show different results from these findings, where the quality of MSME organizations does not always have a significant effect on access to financing because many MSMEs operate informally and financing decisions are more based on guarantees and short-term cash flow[44]. Similar findings also show that new organizational capabilities have an impact on financing when mediated by other factors, such as digital technology adoption or financial literacy, so the organization's direct influence on financing is not always consistent[45]. In fact, in the context of Indonesian MSMEs, the adoption of certain fintech/digitalization is reported to have minimal direct impact on access to financing, indicating that organizational readiness may only be effective when technology and internal processes are fully integrated[32].

The results of the study show that organizational readiness has a significant effect on MSME financing. Organizations that have management support, clear division of tasks, and tech-savvy human resources are better able to integrate IoT into business operations. A ready organizational structure allows IoT data to be used consistently as a basis for reporting and financing applications, thereby increasing the credibility of MSMEs in the eyes of financing institutions. The strategy that needs to be carried out is to strengthen the capacity of human resources and management commitment is the key so that IoT data is not only collected, but also managed and presented systematically in the financing process.

The Influence of Organizations on the Competitiveness of MSMEs (H4)

Based on the results of the hypothesis test, it was shown that organizational variables had a positive and significant effect on the competitiveness of MSMEs with a coefficient value of 0.233 and a significance value of 0.000 < 0.05. This happens because a more prepared organization (owner/management support, quality of human resources, process discipline, and division of roles even if simple) is able to transform

resources into more consistent competitive performance. In theory (RBV and *Dynamic capabilities*), these organizational capabilities strengthen decision-making routines, coordination, quality control, market response speed, and innovation execution capabilities; As a result, MSMEs are more efficient, more adaptive, and better able to maintain differentiation which ultimately increases competitiveness.

This is in line with a study by[46] which shows that strengthening organizational aspects is related to competitive advantage and the innovation performance of HR practices encourages *Competitive Advantage* and performance., Joint organization development of strategic vision related to *Competitive Advantage* which then contributes to the performance of SMEs[47]. Based on a study by[48] stated that the Organization is important to build competitiveness. But the literature also shows results that are "not always immediate": in some contexts, an organization's influence on competitiveness emerges through mediators so that organizational variables such as digital culture or innovation do not appear to be directly significant[48]. Organizations can work through digital readiness as a channeling mechanism[49] and managerial capabilities can have an indirect impact through risk management and resource utilization[50]. This corroborates that in MSMEs, the organization is indeed significant to competitiveness, but the power of influence is greatly influenced by how far internal capabilities are really translated into operational practices and complementary capabilities.

The significant influence of an organization on competitiveness shows that technologies such as IoT are only effective when supported by the organization's internal readiness. MSMEs with digital culture and management support are able to utilize IoT data for product innovation, process improvement, and market strategy adaptation. Thus, organizations become a determining factor in turning technology into a competitive advantage. The strategy carried out is that MSMEs need to build a data-based organizational culture, where information from IoT is used as the basis for strategic decision-making and innovation development.

Environmental Influence on Financing (H5)

Based on the results of the hypothesis test, it shows that environmental variables do not have a significant effect on MSME financing with a coefficient value of 0.124 and a significance value of 0.230 > 0.05. This is because environmental factors such as regulation, competition, and external support have not been the main consideration of the financing institution compared to internal business indicators that are easier to verify, such as cash flow and financial records. The relatively uniform business environment conditions in the respondents cause this factor to not sufficiently differentiate the level of financing feasibility between MSMEs. Environmental influences tend to be indirect and only have an impact on financing when mediated by the internal readiness of MSMEs, such as technology and organization, so that the direct effect is[51]. From the perspective of TOE, the environmental dimension does not automatically increase access to financing if it is not followed by an increase in

technological and organizational capabilities that are able to translate external opportunities into business feasibility signals. This shows that in the context of MSMEs, the role of the environment in TOE is more contextual and supportive, while financing decisions are more responsive to internal readiness as reflected in the technological and organizational dimensions.

Research on MSME access to financing through fintech platforms shows that external factors in the form of challenges and barriers to adoption (reflecting environmental pressures/support) do not have a significant effect on access to financing, while the main determinants are more "internal" and operational.[52]. Other studies confirm that environmental pressures do not work as a stable direct driver, but rather that their impacts arise through intermediate mechanisms (internal capabilities), so the immediate effects of the environment are often not strong or inconsistent[53]. Another study found that the government's fiscal and financial policies for MSMEs did not significantly reduce financing constraints on small/micro enterprises and on private MSMEs, because there was still "scale and ownership" discrimination in the financing process, so the effects of environmental support were not automatically felt equally by small MSMEs.[54]. The results of another study suggest that contemporary evidence also shows that the environment can play a role as a contingency factor that weakens the influence of internal capabilities on performance, meaning that the environment does not automatically provide direct "added value", but depends on the internal readiness of MSMEs[55]. However, this study is not in line with several other researchers who have suggested that the environment influences and strengthens financial inclusion, including in the nature of financing[56]. Other research also confirms that environmental quality is related to the ease of MSMEs accessing financing through improved information and reporting practices[57] as well as strengthening digital financial inclusion and the role of local banks in reducing MSME financing constraints[58]. Several studies show that a conducive institutional environment including government policies, financial infrastructure, and business ecosystem support can have a significant effect on MSME financing access because it reduces regulatory barriers and increases financial institutions' trust in the MSME sector[59].

The insignificance of environmental influence on financing shows that external factors such as regulation and competition have not been direct determinants in MSME financing decisions. In the context of IoT, the environment only provides opportunities, but does not automatically increase access to finance without the readiness of technology and internal organizations capable of taking advantage of those opportunities. The strategy that needs to be implemented is that the strategy implemented by MSMEs should be directed at strengthening internal readiness and the use of IoT, while environmental support is used as a supporting factor, not the main mainstay.

The Influence of the Environment on the Competitiveness of MSMEs (H6)

Based on the results of the hypothesis test, it was shown that environmental variables did not have a significant effect on the competitiveness of MSMEs with a

coefficient value of –0.044 and a significance value of 0.154 > 0.05. Based on research that has been conducted, it is shown that the environmental context does not have a significant effect on the competitiveness of MSMEs. Theoretically, within the framework of *Technology–Organization–Environment* (TOE), environmental factors such as competition intensity, regulation, and market dynamics function more as external conditions that form pressure and business opportunities, rather than as an inherent source of competitive advantage. The same environment can result in different levels of competitiveness between MSMEs because the ability to respond to external pressures is highly dependent on the internal capabilities of the business. Therefore, the environment does not automatically increase competitiveness, but only has an impact when MSMEs have adequate technology, organization, and strategy readiness to take advantage of these opportunities.

A number of studies have found that environmental factors have a positive effect on the competitiveness of MSMEs. For example, research on MSMEs in Indonesia shows that the environmental sustainability dimension has a significant effect on *Competitiveness* because it drives business efficiency and reputation[60]. A meta-analysis of SMEs also found that *Environmental sustainability* has a positive effect on competitiveness, albeit with a moderate effect and is highly context-dependent. Other studies in the post-pandemic context show that the analysis and support of the business environment is able to drive green strategies and the performance of MSMEs, which are the basis for increasing competitiveness [61]. However, a number of other studies have shown that the influence of the environment on competitiveness is not always directly significant. Research on environmental turbulence has found that environmental factors have no direct effect on *Sustainable competitive advantage*, but rather work through mediation variables such as *Entrepreneurial Resilience* [62]. Other studies show that market and technological turbulence can actually weaken the relationship between internal capabilities and MSME performance, so that the environment plays a contingency factor, not a direct determinant of competitiveness [55]. In addition, research that positions the business environment as a moderator variable shows that the environment does not directly increase competitiveness, but only strengthens or weakens the influence of strategies on the performance of MSMEs [63].

The difference in findings shows that environmental factors are not universal determinants of the competitiveness of MSMEs. The insignificance of the direct influence of the environment on the competitiveness of MSMEs in this study strengthens the argument that competitiveness is more determined by the internal strength of the business, while the environment plays a role as the background for conditions whose impact is only felt through intermediary mechanisms such as innovation, resilience, and adaptive strategies. Thus, the results of this study contribute to the TOE literature by emphasizing that the influence of the environment on the competitiveness of MSMEs is contextual and does not always appear directly.

These results show that the external environment does not directly determine the competitiveness of MSMEs. IoT does not automatically increase competitiveness simply because of market pressure or policy support. Competitiveness is more determined by the ability of MSMEs to integrate IoT technology into business processes and internal strategies. The strategy that needs to be implemented is that MSMEs need to utilize IoT to respond to environmental dynamics adaptively, not just following external pressures without strengthening internal capabilities.

The Effect of Financing on Competitiveness (H7)

Based on the results of the hypothesis test, it is shown that financing has a significant effect on the competitiveness of MSMEs in a negative direction, shown by a coefficient value of -1.017 and a significance value of 0.007 < 0.05. The influence of financing on competitiveness is the most "practical" relationship in MSMEs, namely funds allow MSMEs to increase production capacity, maintain cash flow, improve quality, expand marketing, and innovate, all of these are core elements of competitiveness. What is often overlooked is that financing also allows investment in digital capabilities (devices, systems, data integration), so that efficiency and market response increase. Research on digital financial inclusion shows that strengthening digital financial services can encourage MSME innovation through mechanisms to reduce financing constraints. This is in line with the argument that financing is the fuel of competitiveness (innovation/capability) [64]. On the other hand, TOE's referral to Indonesian MSMEs also places the adoption of digital technology/capabilities as a factor that improves performance. If performance improves, competitiveness increases and financing can be positioned as an enabler that accelerates investment capabilities into these activities [65].

Various studies show that the availability of financing can have a positive impact on the competitiveness of MSMEs because it allows business actors to increase production capacity, expand marketing reach, and improve product quality and business processes. Empirical studies have found that MSMEs that have better access to financing tend to show improved business performance and higher competitiveness than MSMEs that experience limited funds [66]. Other research also shows that easy access to financing encourages MSMEs to carry out business development and innovation activities, which ultimately strengthens their competitive position in the market [67]. In addition, financing support through digital financial services has been proven to help MSMEs improve operational efficiency and business competitiveness [68]. However, on the other hand, a number of studies have found that increased financing is not always followed by increased competitiveness. Several studies have shown that the use of poorly managed debt-based financing can actually reduce business performance and do not have a significant impact on increasing competitiveness[69]. Other research also found that not all forms of financing have an effect on the performance of MSMEs, so additional funds are not always followed by improvements in competitiveness [70]. In addition, empirical evidence shows that in

some MSMEs, the ease of obtaining credit does not necessarily increase profits and productivity, so the impact of financing on competitiveness is highly dependent on how the funds are used [71].

The negative influence of financing on competitiveness indicates that increasing financing does not automatically increase the competitiveness of MSMEs. Without productive management, financing can actually become a burden. IoT integration is an important controlling mechanism because it allows MSMEs to monitor the use of funds in real-time, ensuring that financing is allocated to productive activities such as efficiency improvement and innovation, rather than short-term consumption. The strategy implemented is that financing must be directed to IoT-based investments, such as production automation and business performance monitoring, so that the funds obtained really contribute to increasing competitiveness.

CONCLUSION

Fundamental Finding: This research shows that strengthening MSME financing access through Internet of Things (IoT) integration can be understood more comprehensively through the Technology–Organization–Environment (TOE) framework. The results of the study show that technology has a significant effect on MSME financing, which indicates that the readiness and utilization of technology, including IoT integration, is able to strengthen MSMEs' access to financing sources. Furthermore, organizations have a significant influence on MSME financing, which emphasizes that internal readiness, managerial support, and more organized business management can increase the trust of financing institutions. **Implication:** In addition, technology also has a significant effect on the competitiveness of MSMEs, so the use of technology plays an important role in increasing efficiency, innovation, and business competitiveness. The results of the study also show that organizations have a significant effect on the competitiveness of MSMEs, which means that good organizational management can encourage improved business performance and adaptability. Finally, financing has a significant effect on the competitiveness of MSMEs in a negative direction, which indicates that increasing financing does not automatically increase competitiveness if it is not managed productively and efficiently. **Limitation:** On the other hand, the environment does not have a significant effect on MSME financing, and the environment also does not have a significant effect on the competitiveness of MSMEs, which shows that external environmental factors have not been a direct determinant in strengthening financing and competitiveness. **Future Research:** No sentence in the original text explicitly states a future research direction. Therefore, this section cannot be completed without adding or modifying the original sentences.

REFERENCES

[1] S. Sofyan, 'Peran UMKM (Usaha Mikro, Kecil, Dan Menengah) Dalam Perekonomian Indonesia', *J. Bilancia*, vol. 11, no. 1, pp. 33–59, 2017, [Online]. Available: file:///C:/Users/Asus/Downloads/298-Article Text-380-1-10-20180728-3.pdf

[2] piter leiwakabessy and fensca fenolisa lahallo, 'Pembiayaan USAha Mikro Kecil dan Menengah (UMKM) sebagai Solusi dalam Meningkatkan Produktivitas USAha pada UMKM Kabupaten Sorong', *J. Dedication to Papua Community*, vol. 1, no. 1, pp. 11–21, 2019, doi: 10.34124/266967.

[3] N. W. Pradana and S. Sumiyana, 'Analisis Kebutuhan UMKM Indonesia Dengan Menggunakan Pendekatan Penalaran Hierarki Maslow Secara Organisasional', *ABIS Account. Bus. Inf. Syst. J.*, vol. 11, no. 3, p. 260, Sep. 2023, doi: 10.22146/abis.v11i3.85988.

[4] M. Salehi and G. Zimon, 'The Effect of Intellectual Capital and Board Characteristics on Value Creation and Growth', *Sustainability*, vol. 13, no. 13, p. 7436, Jul. 2021, doi: 10.3390/su13137436.

[5] T. Fizzanty, 'Digitalization of Indonesian MSMEs: Innovation Challenges and Opportunities', 2024, pp. 13–28. doi: 10.1007/978-981-97-0029-5_2.

[6] S. Verma, S. Shome, and M. K. Hassan, 'FinTech in small and medium enterprises (SMEs): A review and future research agenda', *Eur. Manag. J.*, vol. 41, no. 6, pp. 950–971, Dec. 2023, doi: 10.1016/j.emj.2023.07.003.

[7] B. Liu, I. Li, J. Yao, Y. Chen, G. Huang, and J. Wang, 'Unveiling the Potential of Graph Neural Networks in SME Credit Risk Assessment', in *2024 5th International Conference on Intelligent Computing and Human-Computer Interaction (ICHCI)*, IEEE, Sep. 2024, pp. 562–566. doi: 10.1109/ICHCI63580.2024.10808129.

[8] S. U. Rehman *et al.*, 'FinTech Adoption in SMEs and Bank Credit Supplies: A Study on Manufacturing SMEs', *Economies*, vol. 11, no. 8, p. 213, Aug. 2023, doi: 10.3390/economies11080213.

[9] F. Faiz, V. Le, and E. K. Masli, 'Determinants of digital technology adoption in innovative SMEs', *J. Innov. Knowl.*, vol. 9, no. 4, p. 100610, Oct. 2024, doi: 10.1016/j.jik.2024.100610.

[10] R. Rahayu and J. Day, 'Determinant Factors of E-commerce Adoption by SMEs in Developing Country: Evidence from Indonesia', *Procedia - Soc. Behav. Sci.*, vol. 195, pp. 142–150, Jul. 2015, doi: 10.1016/j.sbspro.2015.06.423.

[11] A. Vafaei-Zadeh, D. Nikbin, T. Danaraj, and H. Hanifah, 'Internet of Things adoption and manufacturing firms' performance: the role of innovation capabilities', *J. Manuf. Technol. Manag.*, vol. 36, no. 6, pp. 1215–1241, Nov. 2025, doi: 10.1108/JMTM-11-2024-0610.

[12] B. Sanga and M. Aziakpono, 'FinTech and SMEs financing: A systematic literature review and bibliometric analysis', *Digit. Bus.*, vol. 3, no. 2, p. 100067, Dec. 2023, doi: 10.1016/j.digbus.2023.100067.

[13] D. K. Pramudito, S. Achmady, D. M. Ratna Tungga Dewa, T. Pitri, and D. M. Candrasari Hermanto, 'The Application of Technology-Organization-Environment Framework to Analyze SME Readiness in Using Digital Payment Applications', *J. Inf. dan Teknol.*, vol. 5, no. 3, pp. 95–90, Nov. 2023, doi: 10.60083/jidt.v5i3.406.

[14] L. F. Lina and E. Suwarni, 'Social Commerce Adoption to Enhance SMEs Performance: Technology, Organization and Environment (TOE) Perspectives', *J. Apl. Bisnis dan Manaj.*, Sep. 2022, doi: 10.17358/jabm.8.3.689.

[15] N. Qatawneh, 'Empirical insights into business intelligence adoption and decision-making performance during the digital transformation era: Extending the TOE model in the Jordanian banking sector', *J. Open Innov. Technol. Mark. Complex.*, vol. 10, no. 4, p. 100401, Dec. 2024, doi: 10.1016/j.joitmc.2024.100401.

[16] A. A. Anindita, Y. M. Siagian, and W. Santosa, 'Utilization of T-O-E Framework in IoT for Food Quality Management: The Role of Perceived Risk in the Industry', *J. Ilm. Manaj. Kesatuan*, vol. 13, no. 1, pp. 91–100, Jan. 2025, doi: 10.37641/jimkes.v13i1.3038.

[17] A. Gui, Y. Fernando, M. S. Shaharudin, M. Mokhtar, I. G. M. Karmawan, and - Suryanto, 'Cloud Computing Adoption Using TOE Framework for Indonesiaâ€™s Micro Small Medium Enterprises', *JOIV Int. J. Informatics Vis.*, vol. 4, no. 4, pp. 237–242, Dec. 2020, doi: 10.30630/joiv.4.4.458.

[18] A. S. Hendri and E. Sudarmilah, 'Enhancing Information Technology Adoption Potential in MSMEs: a Conceptual Model Based on TOE Framework', *JUITA J. Inform.*, vol. 12, no. 1, p. 91, May 2024, doi: 10.30595/juita.v12i1.21051.

[19] R. Jun Prasetyo and R. Andrilla, 'BALIKPAPAN MICRO, SMALL, AND MEDIUM ENTERPRISES (MSMES) AND ARTIFICIAL INTELLIGENCE ADOPTION: TOE FRAMEWORK', *J. GeoEkonomi*, vol. 16, no. 1, pp. 11–20, Mar. 2025, doi: 10.36277/geoekonomi.v16i1.540.

[20] S. Ali Qalati, W. Li, N. Ahmed, M. Ali Mirani, and A. Khan, 'Examining the Factors Affecting SME Performance: The Mediating Role of Social Media Adoption', *Sustainability*, vol. 13, no. 1, p. 75, Dec. 2020, doi: 10.3390/su13010075.

[21] R. Rahayu and J. Day, 'E-commerce adoption by SMEs in developing countries: evidence from Indonesia', *Eurasian Bus. Rev.*, vol. 7, no. 1, pp. 25–41, Apr. 2017, doi: 10.1007/s40821-016-0044-6.

[22] U. Paraguayo Alemana, 'Adoption of business intelligence for SMEs Rubén Coronel', no. June, 2020, [Online]. Available: https://www.researchgate.net/publication/342447288

[23] C. C. HOANG, 'Negative Emotions and Coping Behaviors of Passenger in the Airline Industry, Vietnam', *J. Asian Financ. Econ. Bus.*, vol. 7, no. 10, pp. 865–874, Oct. 2020, doi: 10.13106/jafeb.2020.vol7.no10.865.

[24] H. Susanto, E. N. Sari, and M. Sari, 'Factors affecting the quality of financial reports in the government of Langkat Regency', *Budapest Int. Res. Critics Institute-Journal*, vol. 4, no. 4, pp. 12264–12278, 2021.

[25] A. Husen, 'STRATEGI PEMASARAN MELALUI DIGITAL MARKETING CAMPAIGN DI TOKO MEBEL SAKINAH KARAWANG', *J. Econ.*, vol. 2, no. 6, pp. 1356–1362, Jun. 2023, doi: 10.55681/economina.v2i6.608.

[26] F. Faiz, 'Factors Influencing Digital Technologies Adoption among Indonesian SMEs: A Conceptual Framework', 2023, pp. 227–241. doi: 10.2991/978-94-6463-350-4_22.

[27] F. Naatu, F. S. Selormey, and S. Naatu, 'Determinants of digital technology adoption in sub-Sahara Africa: Ghana', *Int. J. Emerg. Mark.*, vol. 9, no. 4, p. 100610, 2024, doi: 10.1108/IJOEM-09-2023-1503.

[28] A. Mueller and L. Sensini, 'Determinants of Financing Decisions of SMEs: Evidence from Hotel Industry', *Int. J. Bus. Manag.*, vol. 16, no. 3, p. 117, Feb. 2021, doi: 10.5539/ijbm.v16n3p117.

[29] J. Gu, Y. Bai, and X. Chu, 'Do more friends make your way smooth? Supply chain relationships, moral disengagement, and innovation performance', *Ind. Mark. Manag.*, vol. 120, no. May, pp. 49–61, 2024, doi: 10.1016/j.indmarman.2024.05.005.

[30] A. Y. Suvorov *et al.*, 'Statistical hypothesis testing: general approach in medical research', *Sechenov Med. J.*, vol. 13, no. 1, pp. 4–13, Aug. 2022, doi: 10.47093/2218-7332.2022.426.08.

[31] F. Faiz, V. Le, and E. K. Masli, 'Determinants of digital technology adoption in innovative SMEs', *J. Innov. Knowl.*, vol. 9, no. 4, p. 100610, Oct. 2024, doi: 10.1016/j.jik.2024.100610.

[32] F. Kurniasari, N. Abd Hamid, and E. D. Lestari, 'Unraveling the impact of financial literacy, financial technology adoption, and access to finance on small medium enterprises business performance and sustainability: a serial mediation model', *Cogent Bus. Manag.*, vol. 12, no. 1, Dec. 2025, doi: 10.1080/23311975.2025.2487837.

[33] J. Li, R. Wei, and Y. Guo, 'How Can the Financing Constraints of SMEs Be Eased in China?-Effect Analysis, Heterogeneity Test and Mechanism Identification Based on Digital Inclusive Finance', *Front. Environ. Sci.*, vol. 10, Jul. 2022, doi: 10.3389/fenvs.2022.949164.

[34] J. Merín-Rodrigáñez, À. Dasí, and J. Alegre, 'Digital transformation and firm performance in innovative SMEs: The mediating role of business model innovation', *Technovation*, vol. 134, p. 103027, Jun. 2024, doi: 10.1016/j.technovation.2024.103027.

[35] Y. Affandi, M. M. Ridhwan, I. Trinugroho, and D. Hermawan Adiwibowo, 'Digital adoption, business performance, and financial literacy in ultra-micro, micro, and small enterprises in Indonesia', *Res. Int. Bus. Financ.*, vol. 70, p. 102376, Jun. 2024, doi: 10.1016/j.ribaf.2024.102376.

[36] L. Ardito, R. Filieri, E. Raguseo, and C. Vitari, 'Artificial intelligence adoption and revenue growth in European SMEs: synergies with IoT and big data analytics', *Internet Res.*, vol. 35, no. 4, pp. 1508–1534, Nov. 2025, doi: 10.1108/INTR-02-2024-0195.

[37] S. Wang and H. Zhang, 'Digital Transformation and Innovation Performance in Small- and Medium-Sized Enterprises: A Systems Perspective on the Interplay of Digital Adoption, Digital Drive, and Digital Culture', *Systems*, vol. 13, no. 1, p. 43, Jan. 2025, doi: 10.3390/systems13010043.

[38] P. Nugraheni, E. S. Darma, and R. Muhammad, 'Adoption of Digital Technology and Financial Knowledge: Strategies for Achieving Sustainable Performance of MSMEs', *J. Risk Financ. Manag.*, vol. 18, no. 11, p. 646, Nov. 2025, doi: 10.3390/jrfm18110646.

[39] X. Teng, Z. Wu, and F. Yang, 'Research on the Relationship between Digital Transformation and Performance of SMEs', *Sustainability*, vol. 14, no. 10, p. 6012, May 2022, doi: 10.3390/su14106012.

[40] U. M. H. Tamyiz, M. Munir, C. Furqon, and P. D. Dirgantari, 'Investigate The Relationship Between ICT Adoption and SME Performance with Digital Literacy Serving as A Mediator Variable Using TOE Framework', *Khazanah Sos.*, vol. 7, no. 3, pp. 616–638, Sep. 2025, doi: 10.15575/ks.v7i3.49432.

[41] I. Bawono, E. Maulina, M. Rizal, and M. Purnomo, 'The Role of Knowledge Management Capability, Financial Literacy, and Problem-Solving Skills on Organizational Performance for SMEs', *Front. Psychol.*, vol. 13, Oct. 2022, doi: 10.3389/fpsyg.2022.930742.

[42] T. B. Ciza, J. R. K. Kamdjoug, M. Biga-Diambeidou, I. D. Tchokote, and G. B. Kibekenge, 'Quality of accounting information and SMEs' financial performance: The mediating role of bank and informal financing', *Res. Int. Bus. Financ.*, vol. 75, p. 102763, Mar. 2025, doi: 10.1016/j.ribaf.2025.102763.

[43] E. D'Apolito, S. Galletta, A. P. Iannuzzi, and S. S. Labini, 'Sustainability and bank credit access: New evidence from Italian SMEs', *Res. Int. Bus. Financ.*, vol. 69, p. 102242, Apr. 2024, doi: 10.1016/j.ribaf.2024.102242.

[44] S. A. Basha, H. Bennasr, and M. Goaied, 'Financial literacy, financial development, and leverage of small firms', *Int. Rev. Financ. Anal.*, vol. 86, p. 102510, Mar. 2023, doi: 10.1016/j.irfa.2023.102510.

[45] R. Graña-Alvarez, J. Gomez-Conde, E. Lopez-Valeiras, and M. González-Loureiro, 'Management control systems, business financial literacy and financial leverage in business-incubated start-ups', *Br. Account. Rev.*, vol. 56, no. 6, p. 101427, Nov. 2024, doi: 10.1016/j.bar.2024.101427.

[46] J. Wongsansukcharoen and J. Thaweepaiboonwong, 'Effect of innovations in human resource practices, innovation capabilities, and competitive advantage on small and medium enterprises' performance in Thailand', *Eur. Res. Manag. Bus. Econ.*, vol. 29, no. 1, p. 100210, Jan. 2023, doi: 10.1016/j.iedeen.2022.100210.

[47] H. T. Truong, H. T. Dang, and C. Van Nguyen, 'The influence of organizational culture, strategic vision development and competitive advantage on organizational performance in small and medium enterprises', *Cogent Bus. Manag.*, vol. 12, no. 1, Dec. 2025, doi: 10.1080/23311975.2024.2437146.

[48] V. Velyako and S. Musa, 'The Relationship Between Digital Organizational Culture, Digital Capability, Digital Innovation, Organizational Resilience, and Competitive Advantage', *J. Knowl. Econ.*, vol. 15, no. 3, pp. 11956–11975, Oct. 2023, doi: 10.1007/s13132-023-01575-4.

[49] F. Azzahra, A. Salendu, and A. N. Sengkananingrum, 'Does Digital Readiness Matter? The Mediating Role of Digital Readiness Between Organizational Culture and Innovative Work Behavior Among SMEs in Indonesia', *Indones. J. Bus. Entrep.*, vol. 11, no. 2, p. 368, May 2025, doi: 10.17358/ijbe.11.2.368.

[50] T. Shen and A. Badulescu, 'Managerial Capabilities and the Internationalization Process of Small and Medium Enterprises: The Sustainable Role of Risk and Resource Management', *Sustainability*, vol. 17, no. 15, p. 6943, Jul. 2025, doi: 10.3390/su17156943.

[51] R. Wirdiyanti *et al.*, 'How does e-commerce adoption impact micro, small, and medium enterprises' performance and financial inclusion? Evidence from Indonesia', *Electron. Commer. Res.*, vol. 23, no. 4, pp. 2485–2515, Dec. 2023, doi: 10.1007/s10660-022-09547-7.

[52] A. A. Bani Atta, 'Financial technology platforms and enhancing SME financing in Jordan', *Discov. Sustain.*, vol. 6, no. 1, p. 568, Jul. 2025, doi: 10.1007/s43621-025-01345-z.

[53] M. H. Al Dhaheri, S. Z. Ahmad, and A. Papastathopoulos, 'Do environmental turbulence, dynamic capabilities, and artificial intelligence force SMEs to be innovative?', *J. Innov. Knowl.*, vol. 9, no. 3, p. 100528, Jul. 2024, doi: 10.1016/j.jik.2024.100528.

[54] W. Zhang and Z. Wang, 'Can SMEs benefit equally from supportive policies in China?', *PLoS One*, vol. 18, no. 3, p. e0280253, Mar. 2023, doi: 10.1371/journal.pone.0280253.

[55] A. S. İbrahimcioğlu and H. Kitapçı, 'How Environmental Turbulence Shapes the Path from Resilience to Sustainability: Useful Insights Gathered from Small and Medium Enterprises (SMEs)', *Sustainability*, vol. 17, no. 15, p. 6938, Jul. 2025, doi: 10.3390/su17156938.

[56] N. Abu, F. P. da Silva, and P. R. Vieira, 'Government support for SMEs in the Fintech Era: Enhancing access to finance, survival, and performance', *Digit. Bus.*, vol. 5, no. 1, p. 100099, Jun. 2025, doi: 10.1016/j.digbus.2024.100099.

[57] X. Huang, X. Wang, L. Han, and B. Laker, 'Does sound lending infrastructure foster better financial reporting quality of SMEs?', *Eur. J. Financ.*, vol. 29, no. 5, pp. 542–566, Mar. 2023, doi: 10.1080/1351847X.2022.2075281.

[58] Z. Lu, J. Wu, H. Li, and D. K. Nguyen, 'Local Bank, Digital Financial Inclusion and SME Financing Constraints: Empirical Evidence from China', *Emerg. Mark. Financ. Trade*, vol. 58, no. 6, pp. 1712–1725, May 2022, doi: 10.1080/1540496X.2021.1923477.

[59] H. Hussain Khan and A. M. Kutan, 'Banking sector competition and firms' financial constraints: Firm-Level evidence from developing economies', *J. Int. Financ. Mark. Institutions Money*, vol. 88, p. 101848, Oct. 2023, doi: 10.1016/j.intfin.2023.101848.

[60] J. M. Munandar, E. R. Cahyadi, and M. S. Andrianto, 'The Impacts of Business Sustainability Factors on Competitiveness and Marketing Performance: An Exploratory Approach to the Case of Indonesian Micro-, Small, and Medium Enterprises', *Sustainability*, vol. 17, no. 10, p. 4593, May 2025, doi: 10.3390/su17104593.

[61] Sabihaini, A. Kurniawan, J. Eko Prasetio, and Rusdiyanto, 'Environmental analysis and impact on green business strategy and performance in SMEs post the Covid-19 pandemic', *Cogent Econ. Financ.*, vol. 12, no. 1, Dec. 2024, doi: 10.1080/23322039.2024.2330428.

[62] N. Hidayatinnisa', R. A. Setiawati, and S. Nurfauziah, 'The Mediating Role of Entrepreneurial Resilience in Transforming Environmental Factor Turbulence into Sustainable Competitive Advantage', *J. Manaj. dan Inov.*, vol. 8, no. 1, pp. 33–45, Jan. 2025, doi: 10.15642/manova.v8i1.2008.

[63] A. Sagita, M. S. Shamsudin, A. Ramli, R. Budiharjo, and A. F. I. Himawan, 'Business Strategy and Small and Medium Enterprises (SMEs) Performance: The Moderating Role of the Business Environment', *PaperASIA*, vol. 40, no. 2b, pp. 33–41, Mar. 2024, doi: 10.59953/paperasia.v40i2b.97.

[64] L. Zhang, J. Chen, Z. Liu, and Z. Hao, 'Digital Inclusive Finance, Financing Constraints, and Technological Innovation of SMEs—Differences in the Effects of Financial Regulation and Government Subsidies', *Sustainability*, vol. 15, no. 9, p. 7144, Apr. 2023, doi: 10.3390/su15097144.

[65] A. D. Putro, E. R. Cahyadi, and E. Anggraini, 'The Influence of Digital Transformation On The Performance of Culinary SMEs in Bogor District Using The Technology Organization Environment (TOE) Model', *Indones. J. Bus. Entrep.*, vol. 11, no. 2, p. 344, May 2025, doi: 10.17358/ijbe.11.2.344.

[66] E. O. D. Amadasun and A. T. Mutezo, 'Factors of market-driven strategies and access to finance effect on SMEs competitive performance in Lesotho', *South. African J. Entrep. Small Bus. Manag.*, vol. 15, no. 1, Jun. 2023, doi: 10.4102/sajesbm.v15i1.663.

[67] S. E. Frimpong, G. Agyapong, and D. Agyapong, 'Financial literacy, access to digital finance and performance of SMEs: Evidence From Central region of Ghana', *Cogent Econ. Financ.*, vol. 10, no. 1, Dec. 2022, doi: 10.1080/23322039.2022.2121356.

[68] J. Feng, J. Tang, Z. Qi, and J. Liu, 'Supply Chain Finance and Innovation Investment: Based on financing constraints', *Financ. Res. Lett.*, vol. 63, p. 105349, May 2024, doi: 10.1016/j.frl.2024.105349.

[69] Z. Serrasqueiro, B. Pinto, and F. Sardo, 'SMEs growth and profitability, productivity and debt relationships', *J. Econ. Financ. Adm. Sci.*, vol. 28, no. 56, pp. 404–419, Dec. 2023, doi: 10.1108/JEFAS-01-2022-0018.

[70] P. Jha and S. Kumar Mittal, 'The nexus between financing pattern, firm-specific factors, and financial performance: Panel evidence of listed SMEs in India', *IIMB Manag. Rev.*, vol. 36, no. 1, pp. 71–82, Mar. 2024, doi: 10.1016/j.iimb.2024.02.001.

[71] T. A. Aminkeng, S. Huaming, N. B. Mukete, and G. E. Mwalupaso, 'Impact of Credit Constraints on Financial Performance of Small and Medium Size Enterprises', *Eur. J. Dev. Res.*, vol. 36, no. 4, pp. 868–896, Aug. 2024, doi: 10.1057/s41287-023-00615-8.

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