NAVIGATING THE POST-PANDEMIC FRONTIER: EXPLORING FACTORS INFLUENCING TECHNOLOGY ADOPTION IN INDONESIAN MICROENTERPRISES

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Abstract: This study investigates the intricacies of technology adoption dynamics in the post-pandemic Indonesian microenterprise landscape. Using the Technology, Organization, Environment (TOE) framework and leveraging SmartPLS analysis on a sample of 300 microenterprises. This study reveals the impact of environmental, organizational, and technological factors and their profound influence on technology adoption decisions. The findings explain the compelling and affirmative impact of environmental factors, underscoring the critical role of regulatory support and economic conditions in driving technology adoption initiatives. Meanwhile, organizational factors show a positive albeit relatively weaker relationship, emphasizing the need for micro-enterprises to develop organizational capacity and foster a culture of innovation. Technological factors emerged as decisive, indicating that innovative solutions are an indispensable catalyst to drive technology adoption. These insights have profound implications for policymakers, microenterprise owners, and technology pioneers, offering strategic pathways to foster technology adoption, enhance resilience, and catalyze economic revival in the microenterprise sector.
Keywords: Technology Adoption, Microenterprise, Post-Pandemic, TOE Framework

Abstrak: Studi ini menyelidiki seluk-beluk dinamika adopsi teknologi dalam lanskap usaha mikro Indonesia pasca pandemi. Menggunakan kerangka Technology, Organization, Environment (TOE) dan memanfaatkan analisis SmartPLS pada sampel 300 usaha mikro. Studi ini mengungkapkan dampak faktor lingkungan, organisasi, dan teknologi serta pengaruhnya yang besar terhadap keputusan adopsi teknologi. Temuan ini menjelaskan dampak yang menarik dan afirmatif dari faktor lingkungan, menggarisbawahi peran penting dari dukungan peraturan dan kondisi ekonomi dalam mendorong inisiatif adopsi teknologi. Sementara itu, faktor organisasi menunjukkan hubungan yang positif meskipun relatif lemah, sehingga menekankan perlunya usaha mikro untuk mengembangkan kapasitas organisasi dan menumbuhkan budaya inovasi. Faktor teknologi menjadi faktor penentu, yang menunjukkan bahwa solusi inovatif merupakan katalis yang sangat diperlukan untuk mendorong adopsi teknologi. Wawasan ini mempunyai implikasi besar bagi para pembuat kebijakan, pemilik usaha mikro, dan pionir teknologi, yang menawarkan jalur strategis untuk mendorong adopsi

teknologi, meningkatkan ketahanan, dan mendorong kebangkitan ekonomi di sektor usaha mikro.
Kata Kunci: Adopsi Teknologi, Usaha Mikro, Pasca Pandemi, Kerangka TOE

INTRODUCTION

The COVID-19 pandemic has sent global shockwaves and has profoundly impacted the microenterprise sector (Sarkar & Clegg, 2021). Microenterprises, often the backbone of economies in many countries, including Indonesia, have faced significant challenges in maintaining operational continuity (Thaha et al., 2022). Physical restrictions and shifts in consumer behavior triggered by the pandemic have necessitated swift and substantial adjustments, including technology adoption, to sustain competitiveness and business viability (Sheth, 2020). In the post-pandemic era, technology has emerged as a key enabler in overcoming the myriad challenges microenterprises face (Joseph & Dhanabhakyam, 2022). The utilization of technology holds the potential to enhance operational efficiency and marketing strategies and create new opportunities for sustainable business models. However, it is imperative to comprehend the factors that influence technology adoption among microenterprises (Bvuma & Marnewick, 2020). In the context of this research, the Technology, Organization, Environment (TOE) framework presents a pertinent theoretical foundation. The TOE framework considers the impact of technology in conjunction with organizational and external environmental factors (Oliveira & Martins, 2011). This study aims to investigate how the dimensions within the TOE framework influence technology adoption among microenterprises in Indonesia in the post-pandemic scenario. Through a deeper understanding of these factors, it is anticipated that more effective strategies can be identified to enhance technology adoption within this sector, aiding microenterprises in their recovery efforts and bolstering their competitiveness amidst ongoing global transformations (Classen et al., 2021).

The current state of research in the field underscores the increasing recognition of technology adoption as a critical determinant of success for microenterprises, particularly in the aftermath of the COVID-19 pandemic (Raj & Jeyaraj, 2023). Scholars have explored various dimensions of technology adoption, including the role of digitalization, e-commerce, and mobile technologies in reshaping business models and market reach. Furthermore, the TOE framework has gained prominence in understanding the intricate relationships between technological innovation and organizational dynamics (Baker, 2011). However, while numerous studies have examined technology adoption within the broader business context, there remains a gap in the specific investigation of technology adoption patterns among microenterprises in Indonesia's unique context of post-pandemic recovery. This research seeks to bridge this gap by delving into the TOE framework within the microenterprise sector in Indonesia, shedding light on the nuanced interplay between technological, organizational, and environmental factors that shape technology adoption strategies in this crucial economic segment.

This research brings perspective by examining the post-pandemic technology adoption behaviors of microenterprises in Indonesia, a crucial yet understudied sector in the context of the TOE framework. It contributes to the existing body of knowledge by unraveling the intricate relationships between the dimensions of TOE and their influence on technology adoption within this context. Moreover, the study provides empirical evidence of the significant positive impact of the Environment, Organization, and Technology dimensions on technology adoption, offering valuable insights into the strategic decision-making process of microenterprises seeking to navigate the complexities of the post-pandemic business landscape. The primary objective of this study is to comprehensively investigate the determinants of technology adoption among microenterprises in Indonesia post-pandemic, within the TOE framework, to inform policymakers and practitioners on effective strategies for enhancing technology adoption and bolstering the resilience and competitiveness of this vital economic segment.

LITERATURE REVIEW

Technology adoption among microenterprises has received more consideration in recent years due to its profound impact on business resilience and competitiveness. This literature review provides a contextual framework for understanding the factors influencing technology adoption in microenterprises, particularly in the post-pandemic era. Technology adoption in microenterprises has garnered significant attention as these small businesses are crucial to the economy's growth (Bvuma & Marnewick, 2020; Mahliza, 2019). Understanding the factors influencing technology adoption in microenterprises is crucial for enhancing their competitiveness and resilience, particularly in the post-pandemic landscape.

TOE is a framework used in various business and organizational contexts (Chatzoglou & Chatzoudes, 2016). TOE integrates various factors that can influence technology adoption, including the technology factor itself (such as technology characteristics), organizational factors (such as innovation culture and management support), and environmental factors (such as government regulations and competitive pressure) (Al Hadwer et al., 2021).

Technology factors refer to the characteristics and attributes of the technology itself that might influence its adoption. It includes aspects like the relative advantage, compatibility, complexity, trialability, and observability of the technology. Organizational factors dimension encompasses internal aspects of the organization, such as size, scope, resources, managerial structure, and innovation culture. It looks at how the internal dynamics and resources of a microenterprise affect its propensity to adopt new technologies. Environmental factors include the external elements that can influence an organization's decision to adopt technology, like industry competitiveness, market dynamics, government regulations, and technological trends (Awa et al., 2015; Tornatzky et al., 1990).

Because of this, TOE serves as a comprehensive framework for comprehending the adoption of technology by businesses like microenterprises. Building on the foundation of these technology adoption theories, this study investigates the specific context of technology adoption in microenterprises in post-pandemic Indonesia. This study formulated three hypotheses to guide this research:

H_1: There is a significant positive relationship between technological factors and technology adoption in microenterprises in post-pandemic Indonesia. This hypothesis posits that more favorable technology attributes will lead to higher levels of technology adoption.

H_2: There is a significant positive relationship between organizational factors and technology adoption in microenterprises in post-pandemic Indonesia. This hypothesis suggests that supportive internal organizational characteristics are conducive to adopting new technologies.

H_3: There is a significant positive relationship between environmental factors and technology adoption in microenterprises in post-pandemic Indonesia. This hypothesis implies that external environmental pressures or incentives encourage technology adoption.

These hypotheses will be tested using statistical analysis techniques to understand the relationships between the factors within the Technology, Organization, Environment (TOE) framework and technology adoption in microenterprises.

METHOD

This study employs an explanatory quantitative research design with a survey approach. The survey method will collect data from respondents who are owners or key decision-makers in 300 microenterprises across various economic sectors in Indonesia. To collect data, a structured questionnaire will be utilized. The questionnaire will be designed using the Technology, Organization, Environment (TOE) framework. Questions in the questionnaire will pertain to technology usage, organizational structure, business environment, and other factors influencing technology adoption. The questionnaire will undergo a pilot test to ensure its validity and reliability.

Data will be gathered through online surveys using survey applications such as Google Forms. Using online platforms will facilitate respondents in completing the questionnaire at their preferred time and location. The questionnaire was distributed to various Micro, Small, and Medium Enterprises (MSME) associations in different cities and sent directly to business owners based on their company's revenue and the number of employees. Data will be collected from 300 randomly selected microenterprise respondents. The respondents used in this research only have income under IDR 300 million per year and 1-4 employees so they are categorized as microenterprises. The collected data will be analyzed using statistical software, particularly SmartPLS with Partial Least Squares Structural Equation Modeling (PLS-SEM). This method will be employed to test the hypotheses proposed within the TOE framework, including the significantly positive relationships between Environment, Organization, and Technology with technology adoption (Gui et al., 2020). Path regression analysis will measure the extent to which each TOE factor influences technology adoption.

The technological factor is assessed through seven items: perceived benefits, compatibility, complexity, perceived cost, observability, perceived risk, and trialability (Awa et al., 2015; Thaha et al., 2022; Tornatzky et al., 1990). The organizational factor is assessed using five items: IT knowledge, financial resources, innovation, management support, and standard operating procedures (Awa et al., 2015; Putra & Santoso, 2020; Tornatzky et al., 1990). The environmental factor is adapted from five items: competitive pressure, financial institutions support, government policies, digital infrastructure, and vendor support (Awa et al., 2015; Putra & Santoso, 2020; Tornatzky et al., 1990). Technology adoption in microenterprises is evaluated through eight items, including usage for communication needs, customer management, financial management, human resource management, marketing management, order and sales management, product production, and procurement and inventory (Bi et al., 2017; Putra & Santoso, 2020; Thaha et al., 2022). These factors can be seen in the following operational variables in Table 1.

Table 1
Operational Variables

Num.	Variable	Indicator	Notation
1	Technological Factor (T) (Awa et al., 2015; Thaha et al., 2022; Tornatzky et al., 1990)	Perceived benefits	T1
		Compatibility	T2
		Complexity	T3
		Perceived cost	T4
		Observability	T5
		Perceived risk	T6
		Trialability	T7
2	Organizational Factor (O) (Awa et al., 2015; Putra & Santoso, 2020; Tornatzky et al., 1990)	IT knowledge	O1
		Financial resources	O2
		Innovation	O3
		Management support	O4
		Standard operating procedures	O5
3	Environmental Factor (E) (Awa et al., 2015; Putra & Santoso, 2020; Tornatzky et al., 1990)	Competitive pressure	E1
		Financial institutions support	E2
		Government policies	E3
		Digital infrastructure	E4
		Vendor support	E5
4	Technology Adoption in Microenterprises (A) (Awa et al., 2015; Putra & Santoso, 2020; Tornatzky et al., 1990)	Usage technology for communication needs	A1
		Usage technology for customer management	A2
		Usage technology for financial management	A3
		Usage technology for human resource management	A4
		Usage technology for marketing management	A5
		Usage technology for order and sales management	A6
		Usage technology for product production	A7
		Usage technology for procurement and inventory	A8

Source: Researcher (2023)

The results of the data analysis will be comprehensively interpreted. Findings will be used to test research hypotheses and identify the most influential factors in technology adoption by microenterprises in post-pandemic Indonesia. Results will be presented to facilitate understanding and underscore the research's contribution within the context of TOE and microenterprises in post-pandemic Indonesia.

RESULTS AND DISCUSSION

Descriptive Analysis

The questionnaire survey conducted for this research obtained responses from 300 micro businesses throughout Indonesia, resulting in a diverse and comprehensive data set for analysis. These micro businesses represent a wide range of sectors, demonstrating the diversity in the country's small business landscape. Sectors such as fashion, food and beverage, and retail are the most prominent sectors, showing their significant presence in the micro-enterprise realm. The respondents, all of whom fall into the micro-enterprise category, have specific operational scale characteristics: each reported annual revenues of less than IDR 300 million and employed a workforce ranging from 1 to 4 employees. These criteria firmly place these businesses into the microenterprise classification, thereby offering focused insights into specific segments of the economy.

Geographically, respondents are spread across several main regions, this shows the extent of micro business operations in Indonesia. The majority, namely 46%, come from West Java, an area known for its dynamic economic activity and entrepreneurial spirit. This was followed by 20% of respondents from the island of Sumatra. The capital region, consisting of Jakarta and Banten, accounted for 13% of respondents. The remaining responses were spread across other regions, including East Java, Kalimantan, and Sulawesi. This geographic diversity not only enriches the data set but also ensures that this research is representative of the microenterprise sector in Indonesia.

Model Analysis

The results obtained from SmartPLS in Table 2 indicate strong internal consistency and reliability for the constructs measured in this research. The values for Cronbach's alpha for all constructs, including Environment Factor (0.89), Organization Factor (0.917), Technology Factor (0.929), and Technology Adoption (0.94), are well above the threshold of 0.7, indicating excellent internal consistency among the items within each construct. This result suggests that the survey questions used to measure these constructs are reliable and consistent in assessing the underlying concepts. Both composite reliability values, rho_a, and rho_c, exceed the recommended threshold of 0.7, indicating high reliability of the constructs. The composite reliability values are as follows: Environment Factor (rho_a: 0.903, rho_c: 0.919), Organization Factor (rho_a: 0.923, rho_c: 0.938), Technology Factor (rho_a: 0.936, rho_c: 0.945), and Technology Adoption (rho_a: 0.942, rho_c: 0.95). These high values suggest that the measurement model is robust and the constructs are dependable for further analysis. The AVE values, which measure the variance captured by the items relative to measurement error, are also satisfactory. While the recommended threshold for AVE is typically 0.5 or higher, the AVE values for Environment Factor (0.694), Organization Factor (0.752), Technology Factor (0.741), and Technology Adoption (0.705) are slightly below this threshold but still substantial. This result indicates that the constructs adequately explain the variance in their respective items and have convergent validity. Overall, the results from SmartPLS suggest that the measurement model used in this research is robust, and the constructs exhibit high reliability and internal consistency. Researchers can have confidence in the quality of the data and the ability to make meaningful inferences based on these constructs.

Table 2
Constructs and Items Measurement Results

Constructs and Items	Outer Loadings	Cronbach's Alpha	CR (rho_a)	CR (rho_c)	AVE
Technological Factor		0.929	0.936	0.945	0.741
T1	0.897				
T2	0.9				
T3	0.888				
T4	0.745				
T5	0.875				
T7	0.848				
Organizational Factor		0.917	0.923	0.938	0.752
O1	0.887				
O2	0.828				
O3	0.871				
O4	0.927				
O5	0.819				
Environmental Factor		0.89	0.903	0.919	0.694
E1	0.818				
E2	0.779				
E3	0.814				
E4	0.868				
E5	0.881				
Technology Adoption in Microenterprises		0.94	0.942	0.95	0.705
A1	0.874				
A2	0.881				
A3	0.785				
A4	0.803				
A5	0.903				
A6	0.88				
A7	0.806				
A8	0.776				

Source: Researcher (2023)

The outer loadings in SmartPLS in Table 2 indicate the strength and significance of the relationship between the latent constructs and their observed indicators (items). These loadings provide insights into the quality of measurement for each construct. The outer loadings for the items related to the Technology construct range from 0.745 to 0.900. While most of these loadings are high, there is one item (T_4) with a relatively lower loading and one item (T_6) not valid. Despite the slightly lower loading for one item, the overall high outer loadings for the Technology construct suggest that the items provide a solid representation of technological factors influencing technology adoption. The outer loadings for the items related to the Organization construct range from 0.819 to 0.927, all of which are notably high. This result indicates that these items are strong and reliable measures of the Organization's construct. The high outer loadings underscore the effectiveness of these items in capturing the organizational aspects influencing technology adoption among microenterprises. The outer loadings for the items related to the Environment construct range from 0.779 to 0.881, which are also quite high. This indicates that these items are effective in measuring the environmental construct. Like the other construct, these high outer loadings suggest that the items are robust indicators of the underlying environmental factors affecting microenterprises. The outer loadings for the items related to the Technology Adoption construct range from 0.774 to 0.903, which are generally high and well above the recommended threshold of 0.7. This suggests that the items effectively measure the Technology Adoption construct. The high outer loadings indicate that these items are strong indicators of the latent construct, implying that they capture the essence of technology adoption among microenterprises well.

The outer loadings in SmartPLS indicate that the items used to measure the latent constructs (Technology Adoption, Environment, Organization, and Technology) are generally strong and reliable indicators of their respective constructs. This confirms the quality of measurement and the validity of the constructs in this research, supporting the robustness of the model used to analyze the relationships between these constructs.

Measurement Model

The analysis of the SmartPLS in Table 3 results indicates significant findings regarding the relationship between the independent variables (Technology, Organization, and Environment) and the dependent variable (Technology Adoption) in the research context.

Table 3
Path Coefficient

Hypothesis	Coefficient	T statistics	P values
Technology -> Technology Adoption	0.423	6.932	0
Organization -> Technology Adoption	0.217	3.181	0.001
Environment -> Technology Adoption	0.242	3.927	0

Source: Researcher (2023)

The path coefficient from Technology-to-Technology Adoption is 0.423, which is statistically significant with a *t*-statistic of 6.932 and a *p*-value of 0. This result supports the hypothesis that a significant positive relationship exists between technological factors (such as technology characteristics) and technology adoption in microenterprises. In other words, as technological factors improve or become more favorable, microenterprises are more likely to adopt the technology. The path coefficient from Organization to Technology Adoption is 0.217, which is statistically significant with a *t*-statistic of 3.181 and a *p*-value of 0.001. This result supports the hypothesis that a significant positive relationship exists between organizational factors (such as innovation culture and management support) and technology adoption in microenterprises. This suggests that a supportive organizational environment enhances the likelihood of technology adoption by microenterprises. The path coefficient from Environment to Technology Adoption is 0.242, which is statistically significant with a *t*-statistic of 3.927 and a *p*-value of 0. This result supports the hypothesis that a significant positive relationship exists between environmental factors (such as competitive pressure and government policies) and technology adoption in microenterprises. It implies that external environmental factors play a significant role in influencing the technology adoption decisions of microenterprises. The three independent variables—Technology, Organization, and Environment—have a statistically significant and positive impact on Technology Adoption in microenterprises.

Analysis

The findings of this research carry significant implications for microenterprises in Indonesia, particularly in the context of post-pandemic recovery and technology adoption. First, the strong positive influence of Technological factors on technology adoption underscores the importance of assessing the perceived benefits, compatibility, complexity, cost, observability, risk, and trialability when considering technology adoption decisions. Microenterprises need to carefully evaluate these factors and invest in technologies that align with their perceived advantages and compatibility with their operations. Additionally, efforts to reduce perceived complexity and cost can further facilitate technology adoption. Secondly, the substantial impact of Organizational factors on technology adoption highlights the pivotal role of internal organizational factors in driving technology integration in microenterprises. To successfully adopt technology, microenterprises must ensure they have the necessary IT knowledge, financial resources, a culture of innovation, management support, and standardized operating procedures. This suggests that entrepreneurs need to focus not only on external

technological trends but also on building a supportive organizational infrastructure. Third, the significant influence of Environmental factors underscores the importance of considering the external business environment when making technology adoption decisions. Microenterprises must be attuned to competitive pressures, seek support from financial institutions, adapt to government policies, leverage digital infrastructure, and work collaboratively with supportive vendors. This external focus highlights the need for microenterprises to actively engage with their business environment and adapt their technology adoption strategies accordingly.

From a global perspective, this research aligns with the broader trends in technology adoption, emphasizing the significance of factors like perceived benefits, compatibility, and organizational support. Similar studies conducted in different countries have consistently identified the significance of these factors in influencing technology adoption decisions (Amornkitvikai et al., 2022; Hassan & Ogundipe, 2017; Li et al., 2022; Matias & Hernandez, 2021). However, when viewed through a local lens, particularly in the Indonesian context, this becomes even more important. Indonesia's unique business environment, characterized by diverse micro-enterprises and specific socio-economic factors, requires tailored insights. The uniqueness of this research lies in its focus on microenterprises in Indonesia, highlighting specific challenges and opportunities in the Indonesian business landscape. This study has different results from research in other countries, where organizational factors have a greater influence than environmental factors (Li et al., 2022). This research provides local evidence on the factors that influence technology adoption, assisting local businesses and policymakers in crafting targeted strategies for post-pandemic recovery.

While macro-level studies often focus on large corporations, this research's micro-level approach is distinctive. It delves into the technology adoption behavior of microenterprises, which are the backbone of many economies. This perspective is valuable because it recognizes that the challenges and opportunities for technology adoption differ significantly at the micro level. The findings can be contrasted with macro-level trends to understand how technology adoption in microenterprises contributes to overall economic growth and innovation. This study offers a distinct microenterprise-specific perspective compared to research on larger enterprises. Numerous studies have explored technology adoption in larger organizations, microenterprises have often been overlooked or grouped with small and medium-sized enterprises (SMEs). The research underscores that microenterprises face challenges and nuances in technology adoption, necessitating tailored strategies and support. This micro-level analysis contributes to a deeper understanding of how smaller businesses navigate the post-pandemic technology landscape.

From a literature standpoint, this research contributes to the body of knowledge in the field of technology adoption, validating the applicability of the TOE Framework in the context of microenterprises. However, its practical implications are equally noteworthy. By highlighting the critical factors influencing technology adoption, such as the need for technological training, financial resources, and supportive government policies, this study offers guidance for crafting effective intervention and support programs. Entrepreneurs and business owners can directly apply the findings to enhance their technology adoption strategies. Moreover, policymakers can utilize this research to design supportive policies that foster technological growth at the grassroots level, potentially driving economic development and job creation.

This research provides a foundation for microentrepreneurs and policymakers in post-pandemic Indonesia to understand the factors to consider when adopting technology. By comprehending the critical roles of technological, organizational, and environmental factors, microenterprises can develop more effective strategies in coping with evolving technology and business environment changes, ultimately enhancing their competitiveness and business sustainability.

CONCLUSION

This research, conducted with a rigorous quantitative approach and employing the Technology-Organization-Environment (TOE) Framework, contributes valuable insights into the landscape of technology adoption among microenterprises in post-pandemic Indonesia. The study systematically examined and validated the influential roles of technological, organizational, and environmental factors in shaping technology adoption decisions at the microenterprise level.

The findings firmly establish the pivotal role of technological factors, encompassing perceived benefits, compatibility, complexity, cost, observability, risk, and trialability, in influencing technology adoption. These factors collectively serve as critical determinants that guide microenterprises in evaluating and embracing new technologies. Organizational factors, comprising IT knowledge, financial resources, innovation culture, management support, and standardized procedures, also emerged as key enablers of technology adoption. This underscores the importance of fostering a supportive internal environment within microenterprises to facilitate technology integration effectively.

Furthermore, the study emphasizes the relevance of external environmental factors, including competitive pressures, financial institution support, government policies, digital infrastructure, and vendor collaboration, in shaping the technology adoption landscape. This external perspective underscores the need for microenterprises to adapt to the evolving business ecosystem and leverage external resources and partnerships to enhance their technological capabilities.

The practical implications of this research extend to microenterprise owners, policymakers, and technology providers, offering actionable guidance for advancing technology adoption in Indonesia's microenterprise sector. By addressing the nuanced challenges and opportunities within this unique context, the study enhances economic resilience and competitiveness among microenterprises in the dynamic post-pandemic era. Future research endeavors may explore the intricate relationships among these factors and conduct longitudinal studies to assess the long-term impacts of technology adoption on microenterprises' performance and sustainability.

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