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Digital Transformation in Operational Management: Adaptation Strategies for MSMEs Facing the Industry 4.0 Era

Transformasi Digital dalam Manajemen Operasional: Strategi Adaptasi UMKM Menghadapi Era Industri 4.0

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ABSTRACT

The Industry 4.0 era has encouraged Micro, Small, and Medium Enterprises (MSMEs) to undertake digital transformation in their operational management systems. This study aims to analyze the adaptation strategies employed by MSMEs in facing the challenges of digitalization and identify supporting and inhibiting factors in this process. The research method used was a descriptive qualitative approach through in-depth interviews with MSMEs in the trade and services sectors. The results indicate that most MSMEs have begun utilizing digital technologies such as financial recording applications, social media for marketing, and e-commerce platforms. However, limited digital literacy, access to technological infrastructure, and a lack of mentoring are key obstacles. This study recommends the need for collaboration between the government, academia, and the private sector to accelerate MSME digitalization through training, incentives, and the provision of easily accessible platforms.

Keywords: Digital Transformation, Operational Management, MSMEs, Industry 4.0

ABSTRAK

Era Industri 4.0 telah mendorong pelaku Usaha Mikro, Kecil, dan Menengah (UMKM) untuk melakukan transformasi digital dalam sistem manajemen operasional mereka. Penelitian ini bertujuan untuk menganalisis strategi adaptasi yang dilakukan oleh UMKM dalam menghadapi tantangan digitalisasi, serta mengidentifikasi faktor pendukung dan penghambat dalam proses tersebut. Metode penelitian yang digunakan adalah pendekatan kualitatif deskriptif melalui wawancara mendalam dengan pelaku UMKM di sektor perdagangan dan jasa. Hasil penelitian

menunjukkan bahwa sebagian besar UMKM telah mulai memanfaatkan teknologi digital seperti aplikasi pencatatan keuangan, media sosial untuk pemasaran, dan platform e-commerce. Namun, keterbatasan literasi digital, akses terhadap infrastruktur teknologi, serta kurangnya pendampingan menjadi kendala utama. Studi ini merekomendasikan perlunya kolaborasi antara pemerintah, akademisi, dan sektor swasta dalam mendorong percepatan digitalisasi UMKM melalui pelatihan, insentif, dan penyediaan platform yang mudah diakses.



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Kata Kunci: Transformasi Digital, Manajemen Operasional, UMKM, Industri 4.0

A. INTRODUCTION

The Industrial Revolution 4.0 has fundamentally changed the business landscape, particularly in terms of integrating digital technology into various operational aspects. This concept presents both challenges and opportunities for Micro, Small, and Medium Enterprises (MSMEs), which have long been the backbone of the national economy. Digital transformation is no longer merely an option but a necessity for survival amidst increasingly competitive conditions. MSMEs are required to improve operational efficiency, expand their markets, and adapt to changing consumer behavior, which is increasingly digital. On the other hand, limited resources are a major obstacle in this adaptation process.

In Indonesia, MSMEs contribute approximately 60% to Gross Domestic Product (GDP) and employ over 97% of the workforce (Ministry of Cooperatives and SMEs of the Republic of Indonesia, 2023). This demonstrates the strategic role of MSMEs in national economic development. However, the challenges faced by MSMEs in implementing digitalization are quite complex. Many MSMEs still rely on conventional methods for operational management, such as manual record-keeping, word-of-mouth marketing, and cash transactions. Lack of preparedness in terms of infrastructure and digital literacy is a major obstacle that needs to be addressed immediately. Digital transformation refers to the use of digital technology to change the way an organization operates and delivers value to customers (Vial, 2019). In the context of MSMEs, this transformation includes the digitization of business processes, the use of application-based financial management systems, and the adoption of digital platforms for marketing and product distribution. By adopting these technologies, MSMEs can increase efficiency, accelerate

processes, and reach a wider market. Therefore, understanding the dynamics of digital transformation is crucial for developing appropriate adaptation strategies.

Operational management, as a key pillar of business continuity, needs to be redesigned to adapt to the digital era. Effective and efficient operations can provide a competitive advantage for MSMEs. Operational digitization includes the use of accounting software, inventory applications, and integrated online ordering systems. A study by Setiawan & Nugroho (2022) showed that operational digitization can increase MSME productivity by up to 30% within one year. This indicates the enormous potential that can be exploited if digitalization is implemented appropriately and sustainably.

Despite the promising benefits of digital transformation, its implementation among MSMEs still faces structural and cultural barriers. According to a report by Google and Temasek (2022), only around 25% of MSMEs in Southeast Asia are truly able to utilize digital technology optimally. The biggest obstacles are a lack of technological knowledge, initial investment costs, and a fear of change. In Indonesia itself, many MSMEs lack stable internet access and adequate technological devices to implement digitalization. Recent research by Fitriani and Nurhayati (2023) emphasizes the importance of ongoing digital literacy training so that MSMEs are not only able to use technology but also understand its strategic use in a business context. With appropriate training, business owners can manage customer data, optimize supply chains, and make data-driven decisions. This demonstrates that the success of digital transformation depends not only on the technology itself but also on the readiness of its human resources.

In addition to digital literacy, access to digital infrastructure is a critical issue in supporting the transformation process. In rural or peri-urban areas, many MSMEs face constraints on internet signal strength and the availability of digital devices. According to Prasetyo et al. (2021), the digital divide between urban and rural areas contributes to productivity disparities between regions. Therefore, government intervention through the provision of digital infrastructure and incentives is essential to encourage comprehensive digital inclusion of MSMEs. The COVID-19 pandemic has become a catalyst for accelerating MSME digitalization. Restrictions on mobility and physical interaction have encouraged businesses to quickly shift to digital channels. Platforms such as WhatsApp Business, Tokopedia, and Shopee have become primary marketing and

transaction tools. According to research by Hootsuite (2023), approximately 67% of MSMEs in Indonesia have begun using social media as their primary marketing strategy since the pandemic. This demonstrates that external pressures can trigger innovation and accelerate digital adoption, even without adequate initial preparation.

However, digital transformation is not an instant process. It requires a planned, gradual, and adaptive strategy tailored to business capacity. This strategy includes analyzing digital needs, selecting appropriate platforms, and integrating business processes. A study by Suryana and Wicaksono (2022) states that a successful digital strategy is based on real needs and the organization's ability to manage them. Therefore, mapping digital readiness is a crucial first step. Effective digital adaptation also requires ecosystem support. Partnerships between MSMEs and technology startups, training institutions, and universities can accelerate the transformation process. The involvement of academics in assisting MSMEs through community service programs is a promising collaborative model. According to Ningsih and Kurniawan (2023), the triple helix model (government–business–academia) has proven effective in improving the digital capabilities of MSMEs in several regions in Indonesia.

Furthermore, strengthening public policy also plays a crucial role. The government, through the Ministry of Cooperatives and SMEs, has launched various MSME digitalization programs, including online training, production equipment assistance, and a digital catalog platform. However, the implementation of these policies remains uneven and often does not address the specific needs of business actors at the regional level. Therefore, a more participatory and data-driven approach is needed in designing policy interventions.

Evaluating the success of digital transformation also requires attention. Performance indicators are measured not only by increased revenue, but also by process efficiency, customer satisfaction, and long-term adaptability. Therefore, digital transformation can be considered successful if it can create systemic changes in the way MSMEs manage their businesses. According to Widyastuti et al. (2023), MSME digitalization must be oriented towards sustainability, not just short-term trends. In the context of operational management, digital transformation enables the automation of various processes such as ordering, inventory, payments, and delivery. This can reduce administrative burdens, improve data accuracy, and expedite

customer service. Research by Aulia & Mahendra (2024) shows that the use of digital cashier applications can reduce recording errors by up to 80% in MSMEs in the culinary sector. This demonstrates that a small investment in operational digitalization can have a significant impact on business efficiency.

Given these challenges and opportunities, it is important to delve deeper into the adaptation strategies implemented by MSMEs in digital transformation. This study aims to identify best practices, barriers, and solutions implemented by MSMEs across various sectors. A qualitative approach was chosen to gain a deeper understanding of the dynamics of digital adaptation in daily operational management. It is hoped that the results of this study can contribute to the development of applicable and sustainable digital adaptation models. Furthermore, this study also aims to provide input for policymakers, MSME support institutions, and academics in developing more targeted intervention strategies. Digital transformation is not only about adopting technology, but also about building new capabilities that can sustainably increase MSME competitiveness in the Industry 4.0 era.

B.RESEARCH METHOD

This research uses a descriptive qualitative approach with the aim of in-depth understanding of the adaptation strategies employed by Micro, Small, and Medium Enterprises (MSMEs) in facing digital transformation in the Industry 4.0 era. This approach was chosen because it allows researchers to explore the experiences, perceptions, and challenges faced by these businesses in a contextual and comprehensive manner. The research location was purposively selected in Barru Regency, South Sulawesi, which is known for its dynamic MSME growth and has begun to adopt several forms of digitalization in its operational management. The focus of the research subjects was MSMEs from various sectors, such as culinary, trade, and services, who have implemented or are in the process of implementing digital technology in their business processes.

Data collection techniques were conducted through:

1. In-depth interviews with 10 MSMEs to explore their direct experiences related to digital adaptation strategies.

2. Direct observation of the operational activities of the MSMEs selected for the study to determine the actual implementation of digitalization.
3. Documentation studies, including business profiles, operational reports, and the use of digital applications such as cashier systems, e-commerce, and social media.

The data analysis technique used the interactive model from Miles and Huberman (1994), which includes three main stages:

- a. Data reduction: simplifying, selecting, and focusing data based on the research objectives.
- b. Data presentation: organizing data in narrative form, tables, and quotations for easy understanding.
- c. Conclusion drawing and verification: formulating key findings and verifying data validity through source triangulation.

To maintain data validity, triangulation was conducted by comparing interview results, observations, and documentation. Furthermore, member checking was conducted by asking respondents to verify the researcher's interpretations to ensure that the information presented was accurate and did not deviate from its original meaning.

This method is expected to provide a comprehensive picture of the dynamics, obstacles, and digital adaptation strategies of MSMEs in a real and contextual manner, which can provide input for stakeholders in formulating targeted policies and mentoring programs.

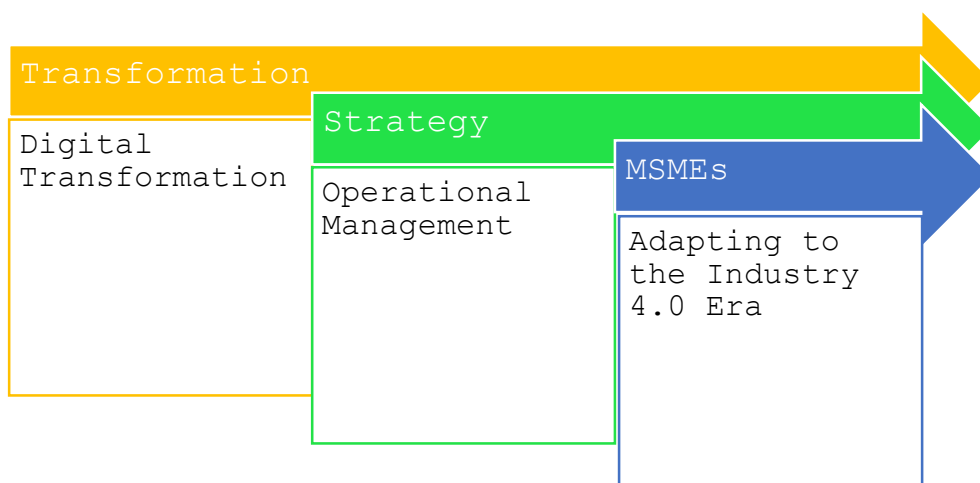


Figure 1 Thinking Framework Diagram

C. RESEARCH FINDINGS AND DISCUSSION

➤ Research Findings

The research findings indicate that the majority of MSMEs in Barru Regency have recognized the importance of digital transformation as part of their strategy to survive and thrive in the Industry 4.0 era. This awareness stems from changes in consumer behavior, which increasingly relies on digital platforms to purchase products and services. While not all MSMEs have fully transformed, most have begun integrating digital elements into their operational management. This transformation did not occur simultaneously, but rather gradually, tailored to the capabilities of each business. In terms of financial record-keeping, some MSMEs have begun abandoning manual methods and switching to simple digital applications such as BukuWarung and Akuntansi UKM. These applications were chosen because they are easy to use, free, and accessible via mobile phone. Business owners reported that using digital applications helps them control cash flow more efficiently and transparently. However, some still find it difficult to use certain features, especially those unfamiliar with technology. This highlights the need for ongoing training.

Digital transformation in marketing is also a significant part of the adaptation strategy. Nearly all informants acknowledged that social media platforms like WhatsApp, Facebook, and Instagram are their primary means of product promotion. They utilize status, story, and post features to showcase their products and interact with customers. Some MSMEs have even collaborated with local content creators or created their own content to increase their product appeal. As a result, they have expanded their market reach and seen an increase in orders from outside the region. For their distribution and ordering systems, some MSMEs have utilized e-commerce platforms like Shopee, Tokopedia, and GrabFood. This allows them to receive orders from outside the city and deliver them through integrated couriers. However, not all business owners are able to manage these systems effectively due to time and energy constraints. There are also concerns about commission systems and dependence on third parties. Therefore, some MSMEs choose to continue using direct ordering methods via WhatsApp or phone.

The adoption of digital payment systems has also increased. MSMEs are starting to accept payments through QRIS, bank transfers, and digital wallets like OVO and Dana. According to

informants, these systems speed up the transaction process and reduce the risk of losing cash. However, some customers, especially older ones, are still reluctant to use digital methods. As a result, MSMEs continue to offer cash payment options to ensure the convenience of all customers. This demonstrates that the digitalization process needs to be adapted to local consumer characteristics. A major obstacle to digital transformation is limited technological literacy. Many MSMEs lack an adequate understanding of how digital applications operate, even basic tasks like downloading an app, registering an account, or updating it. They also experience difficulty reading analytical data or digital financial reports. Most entrepreneurs report being self-taught, and only a small proportion have received digital training from government or private institutions.

Besides digital literacy, another frequently cited obstacle is limited supporting infrastructure, such as unstable internet connections or inadequate devices. Some entrepreneurs only have one mobile phone, which they use alternately for personal and business purposes. This makes it difficult to manage promotions, bookkeeping, and customer communications simultaneously. This problem is particularly prevalent among MSMEs in remote areas lacking high-speed internet access. Despite this, MSMEs are highly adaptable. Many continue to seek alternative solutions, such as using public Wi-Fi, borrowing family devices, or following online tutorials. They also demonstrated creativity in managing promotional content, despite limited tools and experience. This enthusiasm serves as crucial social capital in accelerating digital transformation gradually and independently.

Interviews also revealed that most MSMEs lack a structured digital plan. They tend to adapt spontaneously and reactively, depending on market conditions or social media trends. Few conduct digital needs analysis, technology audits, or develop long-term strategies. This results in suboptimal and sometimes temporary technology utilization. The importance of mentoring was also a key finding. The same was true in this study. Business owners felt greatly helped by having someone who could provide direct guidance, such as KKN students, extension workers from relevant agencies, or digital communities. Having a mentor makes them more confident in trying new things and less afraid of making mistakes. Some MSMEs even stated that their success began with small interventions such as training or digital promotional assistance from external partners.

In daily operational management, digital transformation also includes the use of stock recording applications, order reminders, and time management. Most MSMEs have not yet used automated systems, but have begun to organize their operations more efficiently with the help of Google Sheets or similar applications. They record inventory, customer lists, and delivery schedules digitally. This indicates progress, although not yet fully systematic. In terms of customer satisfaction, MSMEs recognize that the use of technology provides added value for consumers. Customers find it easier to order, make payments, and obtain product information. MSMEs that respond quickly to messages and provide order tracking systems tend to receive positive reviews. This impacts customer loyalty and increases long-term sales. Technology has proven to be a means of improving service quality.

Technology adoption also impacts time and energy efficiency. MSMEs that use digital systems for daily recaps or monthly reports find they save time compared to manual methods. Some business owners even report being able to focus more on product innovation because they are less burdened with administrative matters. Digitalization also reduces work fatigue, especially for family businesses that previously managed everything manually. Despite significant benefits, digital transformation also presents new challenges. Some MSMEs feel stressed by having to continuously learn new and ever-changing technologies. They are also concerned about data security risks and online fraud. There are concerns about business accounts being hacked or customer data being leaked. These concerns create a psychological barrier that hinders trust in digitalization, especially among more senior MSME owners.

Regarding collaboration between MSME owners, there is a tendency to share information and digital experiences informally. Some business owners form WhatsApp groups to exchange promotional tips, training information, or discuss specific applications. This practice accelerates the transfer of knowledge between businesses, especially those in the same market or village. This collaboration has been proven to accelerate digital adaptation, even though it has not been officially facilitated by local governments. MSMEs that have succeeded in digital transformation generally have young, technology-adaptive business owners. They quickly grasp new applications, actively seek information through social media, and diligently participate in online training. These business owner characteristics are key determinants of successful digital adoption in business operations. Meanwhile, MSMEs with more senior business owners and limited access to

information tend to be slower to adapt to digital change. Therefore, an adaptive approach and training segmentation are crucial.

Family support is also a significant factor in supporting the digitalization process. Many MSMEs receive assistance from their children in managing social media accounts, creating promotional designs, or managing online orders. The involvement of young family members in the business makes the transformation process easier and more collaborative. In some cases, the children of business owners have even become the driving force behind digitalization. This demonstrates that family-based MSMEs have an advantage in internal digital regeneration. The impact of the COVID-19 pandemic was also cited as a key moment driving the acceleration of digital adoption. When physical interactions were limited, MSMEs began seeking ways to continue reaching customers through online channels. Most acknowledged that the pandemic was the starting point for their introduction to online ordering systems, digital payments, and delivery services. Even though the crisis has passed, many of these innovations remain in use today due to their proven efficiency.

Another interesting finding is the increasing interest among MSMEs in participating in independent digital training, especially those provided by platforms like Google, Meta, and Tokopedia. They are beginning to realize the importance of personal branding, copywriting, and customer data management. Stakeholders should capitalize on this enthusiasm by providing training modules tailored to local conditions and needs. Practice-based training with local MSME case studies is preferred over general theory.

Some MSMEs are also starting to become. Digitalization serves as a business identity and advantage. They include the information "can order via WhatsApp" or "available on Shopee" on product packaging. Some businesses even print QR codes on product labels to facilitate access to online catalogs. This demonstrates that digital transformation is not only about internal efficiency, but also serves as a marketing strategy and product differentiation amidst increasingly fierce market competition. In the context of sustainability, MSMEs that have successfully undergone digital transformation tend to be more prepared for growth. They are starting to think about market expansion, diversifying products based on digital consumer trends, and even considering collaborations with logistics players or IT service providers. This process demonstrates that

digitalization is not only a response to change but also opens up opportunities for more professional, long-term business growth and innovation.

The role of local governments in supporting the digital transformation process of MSMEs is still suboptimal. Several business owners admitted to never receiving training or direct assistance from relevant agencies. Information about digitalization programs is also unevenly distributed, resulting in only certain MSMEs gaining access. This is an important note for policymakers to design more structured interventions and target MSMEs that truly need direct technical guidance. MSMEs also expressed their hope that the government would provide local platforms or regional marketplaces that could serve as promotional and educational platforms. They desire a digital system that is MSME-friendly, simple, and oriented towards developing local potential. Village- or sub-district-based marketplaces are considered more appropriate because they can stimulate the local economy without overly competing with large brands on national platforms. Such initiatives require synergy across sectors, including universities and communities.

Overall, the results of this study indicate that the digital transformation process among MSMEs is gradual, non-linear, and heavily influenced by internal (literacy, age, family) and external (pandemic, training, government support) factors. MSMEs generally have a strong motivation to change, but require an adequate supporting ecosystem to ensure this transformation is sustainable and not stalled midway. It can be concluded that MSMEs' digital adaptation strategies are heavily influenced by the local context and the characteristics of the business actors. Technological support needs to be tailored to actual needs on the ground, not simply encouraging application usage. The government, academics, and communities need to play an active role in bridging the technology gap and developing intervention programs based on local potential. This way, digital transformation will become more than just talk, but a real force in the operational management of MSMEs in the Industry 4.0 era.

➤ Discussion

Digital transformation in MSME operational management is a response to modern demands that prioritize efficiency, speed, and adaptability. Research results indicate that MSMEs have begun adopting technology in various operational aspects, such as financial recording, marketing, distribution systems, and customer service. This finding aligns with the opinion of

Setyawan and Surachman (2022), who stated that digitalization provides opportunities for MSMEs to increase productivity and expand market reach. However, this process is not instantaneous and requires stages and human resource readiness. In the context of marketing, the majority of MSMEs utilize social media as their primary promotional tool. This indicates that digital technology can reduce marketing costs, which were previously quite high for small businesses. Social media has become an interactive channel that connects businesses with their consumers. This phenomenon is also evidenced by a study by Putri and Santosa (2023), which stated that the use of digital marketing directly impacts increased sales and customer loyalty among MSMEs.

However, limited digital literacy remains a major obstacle hindering the optimization of digital transformation. Many MSMEs do not fully understand how digital systems operate. They tend to use only a small portion of the features of available applications or platforms. This issue aligns with the research findings of Prasetyo et al. (2021), which states that low technological literacy hinders optimal digital adoption, especially among micro-enterprises in non-urban areas. Infrastructure limitations, such as a lack of technological devices and limited internet access, are also significant obstacles. MSMEs in remote areas struggle to access information or manage their businesses digitally consistently. As explained by Ramadhan and Lestari (2022), the digital divide between regions causes some businesses to lag behind the ongoing global digital transformation. Therefore, government intervention approaches must consider geographic factors.

Interestingly, the research results show a high level of adaptability among MSMEs. Some even learn independently through YouTube or seek help from family members to understand technology. This demonstrates the existence of social capital and a culture of mutual cooperation that support the informal digital transformation process. This is supported by findings from Sari & Widodo (2023), which emphasize the importance of social support in accelerating the adoption of digital technology by MSMEs. The COVID-19 pandemic also proved to be a turning point in accelerating the digital transformation of MSMEs. Limited mobility during the pandemic prompted businesses to seek alternative online marketing and distribution methods. These new habits persisted post-pandemic, becoming part of new operational patterns. A study by Yusuf et al. (2023) stated that post-pandemic digitalization will remain a necessity, not just an option, in building MSME competitiveness.

Unfortunately, most MSMEs lack a structured digitalization strategy. Transformations are undertaken quickly and without a needs analysis or long-term projections. Without thorough planning, the digitalization process risks becoming a fleeting activity. These findings align with the analysis by Nugroho & Hartini (2022), which states that irregularities in the digitalization process result in unmet expectations for efficiency and even burden business operations.

From a policy perspective, the role of local governments is perceived as still minimal. MSMEs expect regular training and comprehensive mentoring, from application usage to social media management. The absence of ongoing training programs leaves business owners confused about how to navigate digital systems. A study by the Ministry of Cooperatives and SMEs (2023) stated that local government intervention is still limited to providing physical facilities, failing to address the technical aspects and digital mindset of business owners. Overall, the success of MSME digital transformation is heavily influenced by individual openness to change and the availability of a supportive ecosystem. MSMEs with access to information, training, and digital networks adapt more quickly than those without. Therefore, strategies to increase MSME digital competitiveness must be implemented collaboratively by various parties: government, academia, the private sector, and communities. This synergy will bridge the digital adoption gap at the grassroots level.

This discussion demonstrates that digital transformation is a complex process involving n technical, social, and psychological aspects. Technology adoption is inseparable from business actor readiness, supporting infrastructure, and long-term policy interventions. Therefore, any strategy to increase MSME digital capacity must consider the local context and avoid a one-size-fits-all approach. Only in this way will digital transformation truly provide optimal benefits for the sustainability and growth of MSMEs in the Industry 4.0 era.

D. CONCLUSIONS AND SUGGESTIONS

➤ Conclusion

This study reveals that digital transformation has become a critical requirement for MSMEs to survive and thrive in the Industry 4.0 era. MSMEs in Barru Regency have demonstrated considerable enthusiasm for adopting technology, ranging from simple financial applications and

social media for promotions, digital payment systems, to e-commerce platforms. However, the digitalization process still faces various obstacles, such as limited digital literacy, uneven technological infrastructure, and a lack of training and mentoring support from the government.

The adaptation strategies employed by MSMEs tend to be reactive and unstructured, but are influenced by a strong enthusiasm for learning, family support, and the impact of the pandemic, which has accelerated changes in business behavior. Age, business leadership characteristics, and access to information are also important variables in the success of digital transformation. This study confirms that digital transformation is not only related to technology use but also encompasses changes in the mindset and work culture of MSMEs.

➤ **Recommendations**

1. For MSMEs: Independent and sustainable digital capacity building is necessary, whether through online training, digital communities, or collaboration between business actors. The use of technology should not be limited to promotion, but also directed at operational management and data-driven decision-making.
2. For local governments: It is necessary to strengthen digital transformation mentoring programs that are inclusive and based on local needs. Providing technical training, providing access to digital infrastructure, and creating local platforms based on village potential can encourage MSMEs to be more prepared to compete digitally.
3. For academics and universities: They are expected to play a role as partners in assisting MSMEs through community service programs, digital literacy training, and collaborative research focused on strengthening the digital competitiveness of micro and small businesses.
4. For national policymakers: It is necessary to formulate specific regulations and incentives to encourage MSMEs to enter the digital ecosystem, including data security protection, internet access subsidies, and collaboration with the private sector and startups providing MSME-friendly technology solutions.

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