

THE CLUSTERING OF MICRO AND SMALL ENTERPRISES (MSEs) BASED ON THE LEVEL OF DIGITALIZATION IN WEST JAVA

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ABSTRACT

Background: Digital infrastructure and penetration in Indonesia continue to develop, and digital marketing trends continue to emerge, bringing new opportunities. In addition, development has also targeted business operations; thus, digital tools have emerged in the form of web-based applications and portable devices to encourage the creation of an integrated business ecosystem and facilitate access to control in the business.

Purpose: This study aims to identify parameters that have been digitized, measure the digitalization index of micro and small enterprises (MSEs), and identify problems in using digital technology.

Design/methodology/approach: This research uses descriptive analysis, index calculation, and the interval formula to divide MSEs into five levels according to the index value.

Finding/result: The results showed that 15 out of 17 parameters were digitized. Most MSEs are at level 4, namely experienced, meaning that they already understand digitalization well and the main processes in their business operations have tactically implemented digitalization. The results also show that MSEs still need help adopting digitalization in business operations.

Conclusion: MSE actors face challenges in digitalization, such as mastering digital tools, cost constraints, and signal interference. Government support is crucial, including socialization programs and workshops, providing free software, and improving internet infrastructure.

Originality/value (state of the art): The increasing digitization of business operations requires an in-depth examination of its impact, particularly within the micro and small business sectors. Consequently, this study seeks to ascertain the prevalence of website and application utilization among MSEs.

Keywords: business process digitalization, digital adoption, digitalization index, MSE clustering, MSE

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INTRODUCTION

The advancement of digital technology has fundamentally transformed the business landscape. Traditional offline business processes have shifted toward digital, online operations. The fourth industrial revolution leverages the internet to connect individuals and enterprises (Tirdasari et al. 2021). Increased internet accessibility, as a component of digital technology development, enhances the effectiveness and efficiency of business operations, reduces costs, and facilitates consumer interaction (Yustiani & Yunanto, 2017). Digitalization involves utilizing digital technology to convert traditional activities, processes, and business models into integrated, efficient, and information technology-driven systems (Brennen & Kreiss, 2016). In organizational contexts, digitalization encompasses not only the adoption of digital devices but also the transformation of operational processes, communication, marketing, transactions, and data management, thereby improving business performance and competitiveness (Verhoef et al. 2021).

The increasing digitalization of micro, small, and medium enterprises (MSMEs) in Indonesia is strongly associated with the country's high internet penetration rate. According to the Indonesian Internet Service Providers Association (APJII), internet penetration reached 79.5% in 2024, with most users belonging to the productive age group and actively participating in digital economic activities (APJII, 2024). Furthermore, the expansion of Indonesia's digital ecosystem is evidenced by the growing adoption of digital payment systems such as QRIS, which is projected to be utilized by over 38 million merchants by 2025, predominantly from the SME and microenterprise sectors (Bank Indonesia, 2025).

Despite ongoing advancements, significant digitalization disparities persist among micro, small, and medium enterprises (MSMEs) in Indonesia. While some business owners have fully adopted digital technologies, others remain at a basic stage of technology use or have not embraced digitalization (Ministry of Cooperatives and SMEs 2024). These disparities are shaped by factors such as infrastructure and the capacity of businesses. According to Cahyadi et al. (2023), technology, business environment, management, digital knowledge, human resources, and infrastructure are primary determinants of SME digital readiness. Business owners with reliable internet access, sufficient technological capabilities,

and strong organizational support are generally better prepared for digitalization than traditional micro-enterprises that continue to operate conventionally. This uneven digital transformation among SMEs underscores the need to map digitalization levels to better understand the characteristics and requirements of each business group.

West Java Province hosts one of the largest populations of micro, small, and medium enterprises (MSMEs) in Indonesia and contributes significantly to the national economy. Data from the Central Statistics Agency (2024) indicate that micro and small businesses in West Java predominantly operate in the trade, food and beverage, creative, and service sectors. Additionally, West Java ranks among the provinces with the highest internet penetration and digital economic activity in Indonesia (BPS, 2024). These factors suggest a substantial potential for advancing MSME digitalization in the region. Nevertheless, the extent of digital technology adoption among business actors remains uneven, highlighting the need for further assessment of the digitalization levels within MSME operations.

The existing literature indicates that research on the digitalization of SMEs in Indonesia predominantly focuses on the impact of digitalization on business performance, digital marketing strategies, and overall digital transformation. Ramadhan et al. (2025) conducted a bibliometric analysis of SME digitalization research in Indonesia and identified that the primary research themes remain focused on digital marketing adoption, e-commerce, and digital transformation. Similarly, Panduwinata et al. (2024) reported, through a systematic literature review, that digitalization positively influences operational efficiency, market expansion, and SME sustainability.

Studies that specifically cluster SME actors according to their level of operational digitalization remain limited, especially at the provincial level, such as in West Java, Indonesia. Additionally, most existing research relies primarily on digital marketing indicators, whereas comprehensive analyses of operational business digitalization, including business inputs, processes, and outputs, are scarce. Consequently, research that clusters SME actors by digitalization level is essential for identifying the distinct characteristics of digital SMEs and informing the development of targeted digital transformation policies.

METHODS

This study used a sequential explanatory design, collecting quantitative data first, followed by qualitative interviews to explain the quantitative findings, particularly those related to the barriers to digitization. The team collected and processed data both online and offline in the West Java region. For online data collection, we identified micro and small enterprise (MSE) operators through social media platforms such as *Instagram* and *TikTok*, who completed a questionnaire distributed via *Google Forms*. Offline data collection consisted of direct visits to MSE business locations where operators completed printed questionnaires.

This study used a non-probability sampling technique, namely purposive sampling. The sample criteria were as follows: MSEs in West Java with owners aged 19–54 who use the internet. According to data from the Ministry of Cooperatives and Small and Medium Enterprises (2022), West Java has 1,494,723 business entities. This study used a sample of 100 based on these criteria. The minimum sample size was calculated using the Slovin formula. Next, to identify issues in the implementation of digitalization, 30 potential samples were selected for this study. A sample size of 30 is considered sufficient for small-scale studies (Cohen et al. 2007). The 30 samples were selected purposefully, considering that these businesses had already implemented digitalization in 50% of the measured parameters. In other words, the selected MSEs fall into the “top performer,” “expert,” and “experienced” categories, respectively.

This study used primary and secondary data. Researchers collected primary data through online and offline questionnaires. Secondary data were sourced from official government websites, research institutions, books, theses, journals, and various other sources relevant to the research topic. This study employed a mixed-methods approach, combining quantitative and qualitative methods. The quantitative approach used a questionnaire with closed-ended questions administered to 100 MSE operators to gather data on their identities and characteristics, as well as their digitalization scores, enabling categorization into six tiers based on their level of digitalization. Additionally, this study identified how digitalization is implemented in MSE business operations.

The research results were analyzed in Microsoft Excel and presented as tables and diagrams. The study also used a qualitative approach through in-depth interviews with 30 potential MSEs part of the 100 respondents to identify challenges in implementing digitalization. These parameters were adapted from the research findings of Tirdasari et al. (2021), which include raw material certification, workforce recruitment, product traceability, production process control, business licenses, communication with internal teams, product pricing, legal entity management, communication with suppliers, coordination with the pentahelix, inventory control, bookkeeping, communication with investors, raw material ordering, quality control, product certification, and margin and revenue percentage calculations. A validity test of 24 questions corresponding to these parameters revealed that five indicators were invalid. Additionally, the reliability test results showed that all indicators were reliable, with a Cronbach’s alpha above 0.6.

To determine the level of digitization among MSE operators, a digitization score analysis was conducted, in which the score was obtained by summing the MSE operators’ ratings of 17 parameters. At this stage, the data were coded as follows: MSEs that did not implement digitalization for any of these parameters were assigned a code of zero (0). In contrast, those that did implement digitalization for these parameters were assigned a code of one (1). Based on these calculations, the scores range from 0 to 17, where zero indicates that an MSE has not implemented digitalization at all, and 17 indicates that an MSE has implemented digitalization across all parameters. Next, MSEs were grouped into six levels based on their level of digitalization, following Lichtblau et al. (2015): Thematic analysis was conducted to analyze the qualitative data by identifying themes, patterns, or meanings from the interview results to explain quantitative findings. The details of SME categorization are presented in Table 1 and the research stages in Figure 1.

Table 1. Clustering of MSEs

Level	Digitalization score
0 (Outsider)	0 – <3
1 (Beginner)	3 – <6
2 (Intermediate)	6 – <9
3 (Experienced)	9 – <12
4 (Expert)	12 – <15
5 (Top Performer)	15 – 17

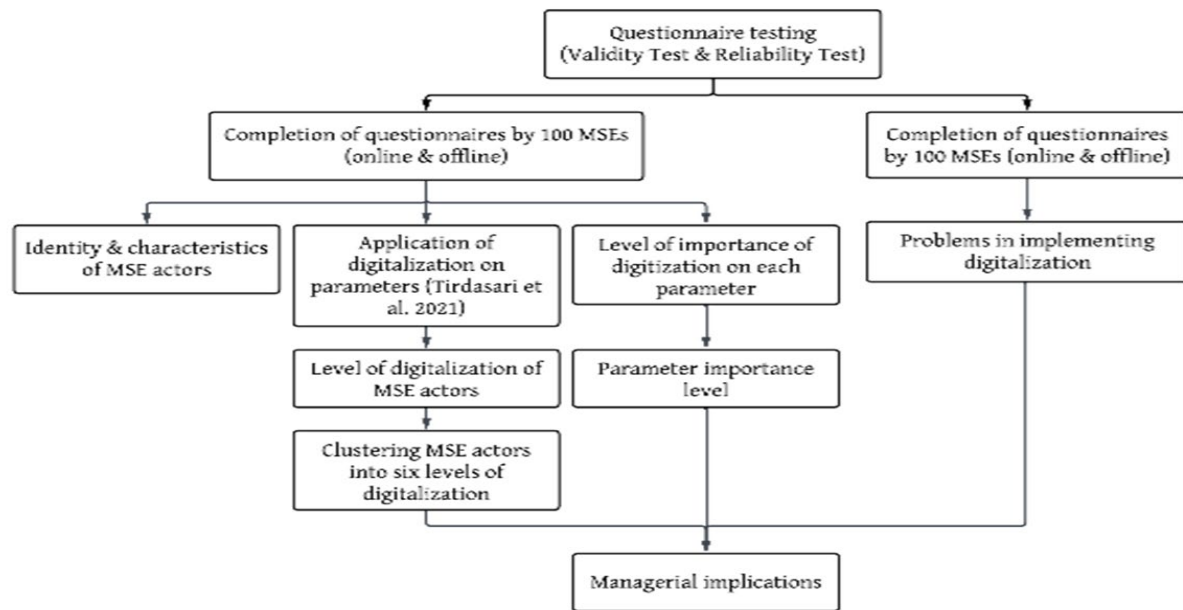


Figure 1. Research stages

RESULTS

Identity and Characteristics of MSE Actors

This study was conducted on 100 MSEs selected using a purposive sampling technique with the criteria that MSE actors are 19–54 years old, domiciled in the West Java region, and use the internet. Based on the research results, most MSE actors in this study are aged 19–34 years, with 85 MSE actors. Most MSE actors are domiciled in Bogor City (40 MSE actors), followed by Bogor Regency (30 MSE actors). The majority of MSE operators have an income of less than IDR 5.5 million per day (94 MSE operators), and 6 MSE operators have an income of IDR 5.5 million–41 million per day, according to PP No. 7 of 2021; this amount is the criteria for sales results for micro and small businesses. A total of 60 MSE actors have a workforce of less than ten people, and 3 MSE actors have a workforce of between 10 and 30 people. According to BI in LPPI and BI (2015), this number is the criteria for the number of employees for micro and small businesses. As many as 37 MSEs do not have a workforce. According to Kuncoro (2000), small industries are managed directly by the owner and usually utilize labor from close relatives, therefore they do not recruit labor from outside.

The MSE actors in our study, predominantly business actors in the culinary sector (51 MSE actors) and also in the service sector (cosmetology, photography, and beauty salons) (16 MSE actors), embody a remarkable

entrepreneurial spirit. For instance, the beauty business is experiencing rapid growth in tandem with evolving human routines, a trend that these business actors have astutely tapped into (Damayanti et al. 2018). Additionally, we observed a significant presence of craft businesses (3 MSE actors), a testament to the diverse entrepreneurial landscape in Indonesia. Research from the UKM Center FEB UI (2018) further confirms that crafts are among the top three creative economy sub-sectors that dominate MSMEs in Indonesia.

Only a few MSE actors whose businesses have been running for a long time (6 MSE actors) are dominated by new players whose businesses have been running for less than five years (69 MSE actors). As mentioned above, MSE actors are dominated by business actors in the culinary field, where culinary is limited in its expansion to the outside because the product is not durable, so the majority of MSE actors only market their products around the place of business, which is called local marketing coverage (84 MSE actors). Exceptional knowledge and skills are needed to process culinary products so they can be marketed outside the region.

Most MSEs use smartphones for 5–10 hours daily to support their businesses (52 MSEs). Thirty-one MSE actors use it for more than 10 hours, 13 use it for 3–5 hours, and 4 use it for 1–3 hours daily for business activities. Apart from supporting businesses, smartphones are also used for other activities. Smartphones also access information (49 MSEs) and

transact through mobile banking or e-money (OVO, Dana, Flip, GoPay). Transactions using digital services help MSEs increase sales transactions and volume and expand market reach (Hastuti & Ghoniyah, 2023). MSE actors also use smartphones to shop through the marketplace (74 MSE actors). In the marketplace, there are many suppliers who sell their goods online (Maulana et al. 2019) so that MSE actors can make price comparisons and determine the right supplier.

A total of 55 MSEs use smartphones to communicate through calls and messages. Looking for entertainment, such as playing games, accessing YouTube, watching Netflix, and listening to favorite music on Spotify, is also done by 50 MSE actors. A total of 43 MSE actors also use smartphones to increase their knowledge through RuangGuru and YouTube. Seventeen MSE actors, such as Microsoft Office Mobile, Quick Office, and Polaris Office, also use smartphones to do document-related work. Meanwhile, 23 MSEs use smartphones for other activities, such as building self-branding, documenting, and finding references or ideas through Pinterest, CookPad, and Yummy Apps.

In addition to the use of smartphones by MSE actors, researchers also analyzed the digital marketing knowledge of MSE actors. Seventy MSE actors are familiar with creative content that often appears on social media Instagram, Facebook, and most recently TikTok. Almost the same number, namely 65 MSE actors, understand that selling products through marketplaces (Shopee, Lazada, Tokopedia, and Bukalapak) is included in digital marketing. They are using business accounts such as WhatsApp for Business (35 MSE actors), a website (39 MSE actors), and online advertising services such as Google Ads, Facebook Ads, and Instagram Ads (44 MSE actors). In addition, as many as 30 MSE actors already know the method of selling through live broadcasts on Instagram, Facebook, and TikTok, followed by 30 MSE actors who are familiar with marketing using influencer services or appointing a brand ambassador. Only 19 MSEs are aware of the Linktr.ee platform, which makes it easy for consumers to connect to sellers and Milkshake as many as 15 MSEs. Regarding the use of digital marketing on sales, 95 MSE players admit that digital marketing helps increase sales in their business.

Identification of Digitalization Implementation in MSE Business Operations

Raw material certification

As many as 45 percent of MSEs admitted to not paying attention to raw material certification. Raw material certification is essential to ensure the quality and halalness of the final product produced using these raw materials (Warto & Samsuri, 2020). MSE actors have begun to utilize digital technology to check raw material certification, namely through scanning the QR code available on the packaging (21%), accessing the official websites of suppliers (5%), and certification bodies (4%), and using electronic certification systems (5%). In addition, there are also MSE actors who check the certification of raw materials by looking at the certification label on the packaging of raw materials, for example, the Halal label (1%), asking shop employees/sales promotion girls (4%), and asking directly to suppliers (15%).

Labor recruitment

As many as 34% of MSEs do not have any workers. Most MSE that employ workers use digital methods to find them, namely through social media (36%) and business websites (1%). Many job seekers look for vacancies through social media, especially Instagram and Facebook, because they consider them more flexible and negotiable regarding working time (Bachmid et al. 2022). A business's success is determined by good business management and the ability of its workers (Alaina et al. 2023). In addition to digital methods, 29% of MSEs use manual methods, namely, through acquaintances.

Product traceability

Traceability is the ability to provide information about the history and movement of a product through each stage of the production and distribution processes. A traceability system requires supply chain actors to know who the supplier is and to whom the product is delivered so that each party involved in production can access product journey information, both upstream and downstream (Ginantaka et al. 2017). Over half of the MSEs did not know product traceability (61%). A total of 10% of MSEs admitted that they only saw reports from their team, while 29% of MSEs did not conduct product traceability. These results support the research

of Ginantaka et al. (2017), who stated that MSME product traceability is still low because it has yet to utilize technology.

Production process control

As many as 58% of MSEs admitted to intervening directly in the production process to control the production process in their business. MSE actors control production using production management software (1%), surveillance cameras or CCTV (7%), requesting employees for production data records (8%), and visiting the production site (5%). Production management software is a website-based digital application specifically designed for factories or industries in production management activities (Anita et al. 2018). Meanwhile, 21% of MSE actors who are retail traders do not control the production process because these MSE actors only play the role of distributors, not producers.

Business license processing

Business legality is a standard that must be met by business actors to compete in the free market era (Anggraeni, 2021). MSE actors still need to utilize digital technology to manage business licenses. MSE actors tend to use conventional methods, namely, going directly to the office where they take care of business licenses (42%). MSE actors who use digital technology in managing business licenses include using the Online Single Submission / OSS application (6%), accessing the official website of the licensing agency (14%), and using other applications (1%). As many as 37% of MSEs still need to manage business licenses. MSEs are still reluctant to manage business licenses because of the tax burden and the complexity of paying taxes (Badina et al. 2022).

Communication with internal team

Messaging applications such as WhatsApp, Telegram, and Line are the most widely used by MSEs (51%). WhatsApp is one of the most widely accessed applications by Indonesians, with a proportion reaching 83%; its features, apart from communicating, can also be used for business (Andamisari, 2021). In addition, MSE actors also communicate via email (1%), online meeting applications such as Zoom and Google Meet (4%), and telephone connections (13%). Apart from communicating online, communication between MSE

actors and their teams occurs offline, namely when meeting directly at a business place (31%). In their conclusion, Henryanto et al. (2025) state that digital platform capabilities are essential for improving SME competitiveness, especially when coupled with strategic agility.

Product pricing

The use of digital technology for product pricing by MSEs includes accessing marketplaces to see the prices of similar products (22%), analyzing data from digital markets (8%), using product valuation applications or websites (4%), and using accounting software such as QuickBooks, Wave, etc. (2%). The use of accounting software by MSEs is shallow, even though the government has provided free accounting software that can be accessed by MSEs, including Lamikro, Financial Information Recording Application (APIK), MYOB, Zahir, and Accurate. However, only 2% of MSEs use accounting software. Other methods used by MSEs to determine product prices include calculating their costs (7%), the cost of goods sold (3%), following the prices offered by competitors (2%), the market price of the product (8%), and raw materials (10%), and calculating operational costs along with estimated profits (25%). In addition, 9% of MSEs admitted that they only estimated the selling price without careful calculation and consideration.

Management of legal entities

Business entity legality is an identity that legalizes or confirms a business entity so that it receives protection in the form of legal and official documents in the eyes of the state (Akhmaddhian et al. 2021). The study's results stated that only 1% of MSE actors took care of the legality or legal entity for their business, namely, in the form of a *commanditaire vennootschap*/CV. These MSE actors use legal representatives to manage legality or legal entities. As many as 17% of MSE actors do not know what legal entities are, 12% of other MSE actors know what legal entities are but do not understand how to create them, and 54% of other MSE actors admit that they do not care about legal entities because they feel unnecessary.

Communication with suppliers

Messaging applications, such as WhatsApp, Telegram, and Line, are the most commonly used means of

communication (47%). Other ways used by MSEs to communicate with suppliers include the supplier's website (4%), email (1%), and telephone (11%). MSE players also meet suppliers directly at their offices (6%) or attend events held by suppliers (3%). However, some MSEs require more intensive communication with suppliers (28%).

Coordination with Pentahelix

The role of the pentahelix party can help MSEs in business development. Pentahelix comprises academics, communities, government, industry players, and the media. The majority of MSEs are unaware of pentahelix (68%). The term Pentahelix is still unfamiliar to the general public, so many people need to learn the term. As many as 14% of MSEs admitted that they could connect with pentahelix through online seminars held by pentahelix using online meeting applications. In addition, 4% of MSEs have joined online communities created to connect with pentahelix on social media, 1% of MSEs through websites managed by pentahelix, and 1% of MSEs through e-learning to connect with educational institutions. In addition to online methods, MSEs also use offline methods, namely attending seminars made by pentahelix so that they can discuss directly (7%) and attending exhibitions or MSME bazaars from Pentahelix (5%).

Inventory control

Inventory is an essential factor in a business's production process. The existence of control over inventory can minimize costs in procuring supplies according to business needs. The utilization of digital technology has been carried out by several MSE actors, namely by using inventory management software (2%), scanning codes (3%), and installing surveillance cameras in the storage room (7%). Proper inventory management needs to be carried out by business actors so that the control of goods can be carried out correctly (Prihasti & Nugraha, 2021).

Despite the prevalence of digital methods, many MSEs (60%) still rely on manual inventory management, involving employee reports (16%) and direct storage room checks. Although suitable for simple MSE operations, this traditional approach poses risks. Notably, 10% of MSEs admitted to not conducting inventory control, highlighting the need for digital tools for inventory management.

Bookkeeping

MSEs in this study have started utilizing digital technology to make reports or bookkeeping for their businesses. MSE actors use accounting software (6%), bookkeeping applications (9%), Ms Excel (16%), and Google Sheets (10%). The use of bookkeeping applications in recording transactions can maximize operational activities, especially the finances of business actors (Praja & Syaiful, 2021). Apart from using digital methods, many MSEs also use manual methods, namely recording reports in ledgers (43%). MSE actors also do not make reports or bookkeeping for their businesses (16%).

Communication with investors

Only four percent of MSEs have investors as funders. MSEs that have investors can connect with them through LinkedIn social media (2%), attend online seminars (1%), and meet in person (1%). LinkedIn is a social network that can connect users with investors, and it can be utilized by MSEs (Chandra, 2017). Meanwhile, most MSEs are not connected with investors (96%). Improvement in this aspect is warranted, as collaborative governance has been shown to enhance the competitiveness and sustainability of MSMEs in the digital age (Harsono & Rinanda, 2025).

Raw material ordering

Many MSE actors have used digital technology to order raw materials from suppliers. MSEs order raw materials through WhatsApp (26%) and the marketplace (16%). MSEs also order raw materials via telephone (11%), supplier's website (7%), supplier's mobile application (2%), and social commerce such as TikTok Shop (1%). In addition to digital methods, MSEs also use methods such as buying directly at the store (34%), using entrustment services (2%), and sending letters ordering raw materials to suppliers (1%).

Quality control

Many MSEs use manual methods for quality control. MSE actors directly conduct visual checks of products (12%), check documents related to product quality (10%), and try products directly (51%). MSE actors also use digital methods, but the proportion is still small, namely by making video calls with employees (3%) and using mobile applications (1%). Product

quality control has not been effective due to a lack of knowledge about the latest production technology (Haptari & Nugroho, 2019).

Product certification

Most MSEs admitted that they did not apply for product certification (50%). Providing certified products is a prospective business because it invites customer loyalty from both Muslim and non-Muslim customers (Warto & Samsuri, 2020). Five percent of MSEs admitted that they did not know how to apply for certification. Meanwhile, 17% of MSEs admitted that they did not need certification because they sell products that are not their production (distributors/retailers). MSE actors who have applied for product certification use a digital method through an online system provided by the certification body (16%). The manual method MSEs use is sending a letter of application for certification to the certification body (7%) and visiting the certification body office (1%). In addition, four percent of MSE actors who are dressers attended workshops held by professional dressers and received certificates from professionals.

Calculation of margin and percentage of turnover

Many MSEs use digital methods to calculate margins and turnover. MSEs calculate it with spreadsheets (28%), accounting software (6%), and paid platforms (1%). The government has provided free accounting software for MSEs, but utilization by MSEs is still small. Accounting software has features to help MSEs set margins (Suharyono, 2021). In addition to the digital method, many MSEs calculate manually (43%). As many as 22% admitted that they did not calculate the margin and percentage of turnover. The calculation of margins and turnover is essential because the correct calculation will illustrate the extent to which a business can generate profits (Sumarni, 2020).

Digitalization Clustering of MSE Actors

After identifying the application of digitalization in MSE business operations, the level of digitalization of MSE actors was determined. According to Saputro (2020), digitalization involves using websites and application-based tools. In data processing in this study, MSEs that use the web, applications, or both in the parameters are coded one (1), and MSEs that do not use them are coded zero (0). Based on the analysis, a

digitization score of between 0 and 17 was obtained. Clustering was performed to group MSE actors based on similar characteristics (Asrianda et al. 2021). The characteristics referred to in this study are digitization scores that indicate the level of digitalization of MSE actors.

Based on Table 2, 28 MSE actors were at Level 0 (outsiders). Outsider is the lowest level of digitization in this cluster, with a digitization score of $0 - <3$. The most digitized parameter by MSE actors at the outsider level is the method of ordering raw materials (61%), with the WhatsApp application being the most widely used to order raw materials. One of the challenges in digitizing a business is the mindset of actors who still need to be updated to respond to the times (Media Indonesia, 2023). Business actors need a digital mindset that helps MSEs remain open to change (Annisa et al. 2023). In addition, many business actors feel comfortable running their businesses conventionally rather than adopting digital methods. Apart from a lack of knowledge and expertise, business actors also feel anxious about using technology in the industry.

Table 2. Distribution of MSEs based on digitalization level

Level	Digitalization score	Total
0 (Outsider)	$0 - <3$	28
1 (Beginner)	$3 - <6$	38
2 (Intermediate)	$6 - <9$	24
3 (Experienced)	$9 - <12$	6
4 (Expert)	$12 - <15$	4
5 (Top Performer)	$15 - 17$	0

A total of 38 business owners were at level 1 (beginner), the highest number among all levels. The digitalization score of MSEs at this level was $3 - <6$. The level of digitalization of MSE actors at the outsider and beginner levels was low, with digitalization application only at 29% of the total parameters measured. The parameter with the most digitization applications was the same as that at the outsider level, but the proportion was higher (74%). Other parameters that were heavily digitized were communication with suppliers (61%) and communication with internal teams (58%). MSE players at this level used WhatsApp as the first and basic step in digitalization. Digital transformation of business actors is not easy and immediate and requires community empowerment. The community's role in facilitating business actors' digitalization is crucial (Fuadi et al. 2021), through empowerment activities

that aim to motivate and provide direct assistance (Muzdalifah et al. 2020).

A total of 24 MSE actors are at level 2 (intermediate), with a digitization score of 6 – <9. MSE actors at the intermediate level demonstrate a good understanding of digitization, with the number of digitized parameters reaching almost 50% of the total parameters measured. The most digitized parameters are the method of ordering raw materials and communication with suppliers (92%), communication with internal teams (87.5%), product pricing (75%), bookkeeping (71%), calculation of margins and percentage of turnover (58%), and certification of raw materials and recruitment of labor (54%).

Only 6 MSE actors are at level 3 (experienced) with a digitization score of 9 – <12. The level of digitalization of MSEs at the intermediate and experienced levels is classified as moderate because the application of digitalization is 35–65% of the number of parameters measured. All MSEs at this level apply digitalization to recruiting workers, communication with internal teams, bookkeeping, and methods of ordering raw materials. As many as 83% are in the process of obtaining business licenses, determining product / P5 prices, communicating with suppliers, and calculating margins and percentages of turnover. In addition, 67% applied digitalization to the inventory control process. MSEs have started implementing digitalization in the production section, namely inventory control. MSEs at the experienced level must continue to improve capabilities and sustainable implementation, especially in the production section, so that digitization can reach a high level.

Only four MSE actors were at level 4 (Expert) with a 12 – <15 digitization score. Expert-level MSE actors have a good understanding of digitalization, as evidenced by the application of digitalization, which is as much as 71-82% of the number of parameters measured. 100% of MSE actors at the expert level apply digitalization to workforce recruitment, production process control, communication with internal teams and suppliers, coordination with Pentahelix, bookkeeping, raw material ordering methods, and calculation of margins and turnover percentage. As many as 75% apply to raw material certification, business license processing, product pricing, inventory control, and quality control. Digitalization has been applied to accounting, production, and coordination with outside parties.

Therefore, MSEs at this level are advised to maximize the use of digitalization so that the business adds memorable value to customers.

Issues in Implementing Digitalization

This study also identifies the problems experienced by MSEs, especially those related to the implementation of digitalization in MSE business operations. Problem identification was conducted through in-depth interviews with 30 potential MSE actors. The selection of 30 MSE actors was carried out deliberately, considering that the MSE digitalization score was more significant than or equal to 9, indicating that the actors were at the expert and experienced level. The identification results show that MSE actors still experience problems related to implementing digitalization in their business. The problems or obstacles experienced by MSEs are that the QR Code scanning process takes a long time, so it is considered less efficient, the QR Code data that has been scanned cannot be accessed, many applicants ignore the predetermined qualifications, the quality of surveillance cameras is not good, the recording period of surveillance cameras does not last long so that controlling the production process through surveillance cameras is considered less effective, difficulty in uploading files when managing business licenses through an online system.

In addition, problems such as signal interference when making video calls or online meetings, so that the information received by the team becomes incomplete, the time limit set by the online meeting application is limited to 40 minutes but if you use premium services it will increase operational costs, there are often differences in understanding if conveying information via messages, data from the internet is not updated regularly so that MSEs have difficulty determining product prices, signal interference when attending online seminars from Pentahelix, difficulty getting information about seminars held by Pentahelix, experiencing system errors, objected to accessing Microsoft Excel through smartphones because it requires a large amount of storage space, felt anxious because data was in danger of being lost and MSEs felt unable to recover the data, did not understand the features on LinkedIn to connect with investors, lacked information about seminars that investors could attend, signal interference when making video calls with the team to check product quality, difficulty in understanding the provisions or criteria required by the

certification body on the website, the cost of applying for product certification was quite expensive, and wanted to use accounting software but the cost was expensive.

Managerial Implications

As many as 61% of MSEs consider the product pricing parameter necessary to apply digitalization. Meanwhile, regarding implementation, only 36% of MSEs use digitalization in these parameters, and only 2% use accounting software. Many MSE actors consider it essential, but the application is low. Based on the results of problem identification, MSE actors admit that they want to use accounting software, but the cost is high. In addition, 50% of MSEs have not yet applied for product certification because the application fee is expensive. Capital is the main obstacle for MSMEs (Purnomo, 2019). The government has provided free accounting software, including Lamikro, MYOB, Financial Information Recording Application/APIK, Zahir, and Accurate (Suharyono, 2021). However, many MSE players need to be made aware of the software. This indicates that the digital literacy of MSE actors still needs to improve. For this reason, the government needs to improve the digital literacy of MSE actors through socialization programs and workshops. The socialization program aims to introduce software to MSE actors and workshops to train MSE actors in operating software, such as installing software, creating accounts, recognizing features, and resolving system errors. The government must also provide help center services for MSE actors who experience problems operating the software.

CONCLUSSIONS AND RECOMMENDATIONS

Conclussions

This study identifies the application of digitalization in 17 parts of MSE business operations, called parameters. The results show that most of the parameters have been digitized by MSEs, although some parameters have a small proportion of digitization. The parameters mainly applied to digitization are related to maintaining communication with parties that play an essential role in the business, such as internal teams and suppliers. Two parameters have yet to be digitized by MSEs: product traceability and taking care of legal entities. Traceability is usually carried out by large businesses

with complex and systematic production processes involving many parties and export-ready products, so MSEs have yet to achieve digitization in product traceability. MSE actors are still reluctant to take care of legal entities because they feel it is unnecessary.

The MSE actors in this study were clustered into six levels of digitalization based on the level of digitalization. The digitization level was 0–17. 28 MSE actors were outsiders, 38 MSE actors were beginners, 24 MSE actors were intermediate, 6 MSE actors were experienced, and only 4 MSE actors were experts. There are no MSE actors who are top performers. Most MSE actors were beginners with a 3–<6 digitization score.

The challenges faced by MSE actors in implementing digitalization, such as lack of tool mastery, cost constraints, and signal interference, underscore the need for government support. It is crucial for the government to organize socialization programs and workshops on software use in business operations, provide free software, and enhance internet infrastructure quality. This support is not only beneficial but also necessary for the successful digitalization of MSEs.

Recommendations

In this era of digitalization, it is necessary to conduct broader, more complex, and comprehensive research related to the implementation of digitalization in MSEs. Future research should take samples that better describe the population. In addition, the government needs to work with internet provider companies to identify internet needs in each region. Once identified, regional mapping can be done based on internet needs and current internet quality in the region, and then the return on investment (ROI) can be calculated.

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