Adoption of Information Technology and its Implications for The Operational Efficiency of Micro, Small, and Medium Enterprises

Tanty Yuanita
Universitas Borobudur
Email: tantyyuanita1@gmail.com

Bambang Bernanthos
Universitas Borobudur
Email: bambangbernanthos@borobudur.ac.id
*Korespondensi penulis: *tantyyuanita1@gmail.com*

Abstract: The digitalization era has transformed the global business landscape, including the Micro, Small, and Medium Enterprises (MSMEs) sector in Indonesia. This study analyzes the impact of information technology adoption on operational efficiency of MSMEs using quantitative approach through surveys of 250 MSMEs in Central Java. Data were analyzed using Structural Equation Modeling (SEM) to examine relationships between information technology adoption variables and operational efficiency. Results indicate that information technology adoption has significant positive effect on MSME operational efficiency with determination coefficient of 0.742. Implementation of point-of-sale systems, e-commerce, and digital inventory management proved to increase operational productivity by 35.6% and reduce operational costs up to 28.4%. Factors influencing adoption include business owner digital literacy, infrastructure support, and financial capacity. These findings provide strategic implications for MSME digitalization policy development and digital transformation strategies for small and medium enterprise sector in Indonesia.
Keywords: MSMEs, information technology, operational efficiency, digitalization, digital transformation

INTRODUCTIONS

The industrial revolution 4.0 has brought fundamental changes in the way of doing business around the world. Indonesia, as a country with 64.2 million MSMEs or 99.9% of the total national business actors according to data from the Ministry of Cooperatives and SMEs in 2021, faces an urgent need to undergo digital transformation. The contribution of MSMEs to Indonesia's Gross Domestic Product (GDP) reaches 61.07% with employment absorption of 97% of the total workers in the private sector, making this sector the backbone of the national economy. The adoption of information technology in MSME operations is no longer an option but a necessity to survive in global competition. Data from the Indonesian Internet Service Providers Association (APJII) shows internet penetration in Indonesia reached 210.03 million users or 77.02% of the total population in 2022. This phenomenon creates great opportunities for MSMEs to optimize operations through the utilization of digital technology.

Operational efficiency becomes the key to the success of MSMEs in facing increasingly complex market dynamics. Research by McKinsey Global Institute (2020) shows that MSMEs adopting digital technology experience a productivity increase of up to 40% compared to those still using conventional methods. However, the rate of information technology adoption among Indonesian MSMEs is still relatively low, with only 16% of MSMEs using digital platforms for their business operations based on a 2021 survey by Bank Indonesia. The digital divide between regions in Indonesia also affects the adoption of information technology by MSMEs. Information and communication technology infrastructure in urban areas is much better than in rural areas, creating disparities in access and utilization of

technology. Data from the Central Statistics Agency (2022) shows that 87.3% of MSMEs in urban areas have internet access, while in rural areas only 52.1%.

The digital literacy of MSME owners is also a crucial factor in the adoption of information technology. A survey by Katadata Insight Center (2021) revealed that 68% of MSME owners still have limited digital capabilities, especially in using business applications and e-commerce platforms. This condition is worsened by limited financial resources for technology investment, with 73% of MSMEs experiencing capital constraints for digitalizing operations. The COVID-19 pandemic has accelerated the digitalization of MSMEs in Indonesia. Data from Google-Temasek-Bain shows that the value of Indonesia's e-commerce transactions grew by 54% in 2020, with MSMEs contributing a significant increase. This phenomenon proves that MSMEs capable of adapting to digital technology have better resilience in facing crises.

Various digital platforms have been developed to support MSME operations, ranging from point-of-sale systems, inventory management, to digital marketing platforms. However, the effectiveness of information technology implementation in improving MSME operational efficiency still requires further analysis. This research aims to analyze the extent to which information technology adoption affects MSME operational efficiency, identify the factors influencing technology adoption, and provide strategic recommendations for accelerating MSME digitalization in Indonesia.

LITERATUR REVIEW
Concept of Information Technology Adoption

The adoption of information technology in MSMEs is the process of using technology systems to support operational business activities. Davis (1989), through the Technology Acceptance Model (TAM), explained that technology adoption is influenced by perceived usefulness and perceived ease of use. This model has been widely used to analyze technology adoption behavior across various business sectors, including MSMEs. Venkatesh et al. (2003) developed the Unified Theory of Acceptance and Use of Technology (UTAUT), which integrates various technology adoption theories. The UTAUT model identifies four main constructs that influence technology adoption: performance expectancy, effort expectancy, social influence, and facilitating conditions.

Research by Oliveira and Martins (2011) applied the UTAUT model to the adoption of e-business by MSMEs and found that facilitating conditions were the most significant factor. Rogers (2003), in the Diffusion of Innovation Theory, explained that technology adoption goes through five stages: knowledge, persuasion, decision, implementation, and confirmation. The characteristics of innovation that affect the level of adoption include relative advantage, compatibility, complexity, trialability, and observability. Tornatzky and Fleischer (1990) developed the Technology-Organization-Environment (TOE) framework, which categorizes technology adoption factors into three main dimensions: technology, organization, and environment.

Operational Efficiency of MSMEs

Operational efficiency refers to an organization's ability to optimize the use of resources to achieve maximum output. Farrell (1957) defined efficiency as the ratio between actual output and the maximum potential output that can be achieved with a given input. In the context of MSMEs, operational efficiency includes the optimization of production processes, inventory management, customer service, and business administration. Coelli et al. (2005)

distinguished efficiency into technical efficiency and allocative efficiency. Technical efficiency measures the ability to produce maximum output from a given input, while allocative efficiency measures the ability to use inputs in optimal proportions considering relative prices and production technology. The combination of both results in economic efficiency, which becomes an indicator of operational performance.

Research by Brynjolfsson and Hitt (2000) found that investment in information technology positively contributes to productivity and operational efficiency of companies. However, the benefits of information technology do not occur automatically but require complementarity with organizational and business process changes. Melville et al. (2004) developed the value creation from IT model, which explains how information technology creates business value through improved process efficiency and organizational capabilities.

Information Technology for MSMEs

The development of information technology has presented various solutions that suit the characteristics and needs of MSMEs. Cloud computing has become one of the most relevant technologies because it offers access to advanced information systems without large infrastructure investments. Armbrust et al. (2010) explained that cloud computing provides elasticity, scalability, and cost efficiency that are very beneficial for MSMEs. Simplified Enterprise Resource Planning (ERP) systems for MSMEs have been developed to integrate various business functions. Moon (2007) found that ERP implementation in small businesses improves operational efficiency through process automation and data integration.

E-commerce platforms and digital marketplaces also provide broader market access for MSMEs at relatively affordable costs. Mobile technology and smartphone-based business applications allow MSMEs to manage operations from anywhere. Research by Donner and Escobari (2010) showed that mobile phone use in small businesses in developing countries improves communication and coordination efficiency. Social media platforms have also become effective tools for marketing and customer relationship management for MSMEs.

Factors Influencing the Adoption of Information Technology

Various studies have identified factors that influence the adoption of information technology by MSMEs. Ramayah et al. (2016) found that CEO characteristics, organizational factors, and environmental factors significantly affect IT adoption. Influential CEO characteristics include age, education, technology experience, and attitude toward innovation. Thong (1999) identified that business size, employees' IT knowledge, and decision makers' innovativeness are key factors in IT adoption by small businesses. Meanwhile, Iacovou et al. (1995) stated that perceived benefits, organizational readiness, and external pressure influence the adoption of Electronic Data Interchange (EDI) in small firms. Grandon and Pearson (2004) found that compatibility, relative advantage, and complexity are the main factors for e-commerce adoption by small businesses. External factors such as competitive pressure and vendor support also have significant influence. Al-Qirim (2007) added that government support and industry characteristics affect IT adoption by MSMEs in developing countries.

Impact of Information Technology on MSME Performance

Empirical studies show the positive impact of information technology on MSME performance. Levy and Powell (2005) found that the use of information technology enhances operational efficiency, customer service, and competitive advantage in small firms. Raymond (2001) showed that strategic alignment between IT and business strategy improves overall organizational performance. Apulu and Latham (2011), in a study in Nigeria, found that the adoption of information technology improves MSME business performance through increased productivity, reduced operational costs, and broader market access. Esselaar et al. (2007)

showed that the use of ICT by small businesses in Africa results in significant revenue growth and job creation. Nguyen (2009) found that IT adoption by MSMEs in Vietnam increased operational efficiency by 23% and customer satisfaction by 31%. Meanwhile, Soto-Acosta et al. (2016) showed that the use of internet and web technologies improves innovation performance and business performance of MSMEs in Spain.

RESEARCH METHODS

This research uses a quantitative approach with an explanatory research design to analyze the causal relationship between information technology adoption and the operational efficiency of MSMEs. This approach was chosen because it can objectively measure the effect of the independent variable on the dependent variable using numerical data and statistical analysis. The research population includes all MSMEs registered with the Cooperatives and SMEs Agency of Central Java Province, totaling 4,267,859 units based on 2022 data. Central Java was selected as the research location considering that it has the second-largest number of MSMEs in Indonesia after East Java and is representative of national MSME characteristics.

The sample size was determined using the Slovin formula with a 95% confidence level and a 5% margin of error, resulting in a minimum sample of 400 MSMEs. However, to improve the accuracy of the SEM analysis, this study used 600 MSMEs as a sample with a proportionate stratified random sampling technique based on business categories (micro, small, medium) and business sectors. Primary data was collected through surveys using structured questionnaires developed based on previously validated and reliable research instruments. The questionnaire consists of three main parts: respondent and MSME characteristics, information technology adoption variables, and operational efficiency variables. The measurement scale uses a 5-point Likert scale ranging from strongly disagree to strongly agree.

Data collection was carried out from June to August 2023 through a combination of online and offline surveys. The online survey used the Google Forms platform distributed via the database of the Cooperatives and SMEs Agency, while the offline survey was conducted by directly visiting MSME locations. The response rate reached 83.3%, with 500 questionnaires usable for analysis. The independent variable in this study is Information Technology Adoption, measured through five dimensions: Infrastructure Technology, Business Applications, Communication Technology, E-commerce Technology, and Data Management Technology. Each dimension is measured using 4–5 indicators adapted from studies by Ramdani et al. (2013) and Ghobakhloo et al. (2011). The dependent variable is Operational Efficiency, measured through four dimensions: Process Efficiency, Resource Efficiency, Time Efficiency, and Cost Efficiency. The measurement instrument was adapted from research by Zhu and Kraemer (2005) and Melville et al. (2004), with adjustments made to fit the characteristics of MSMEs in Indonesia.

Data analysis uses Structural Equation Modeling (SEM) with AMOS 24.0 software to test the structural model and hypotheses. The stages of analysis include descriptive analysis to describe respondent and research variable characteristics, instrument validity and reliability testing, confirmatory factor analysis (CFA) to test the measurement model, and full structural equation modeling to test the research hypotheses. Model evaluation is conducted using several goodness of fit indices: Chi-square/df ratio, Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), Comparative Fit Index (CFI), Tucker Lewis Index (TLI), and Root Mean Square Error of Approximation (RMSEA). The model is considered fit if it meets the criteria established in the SEM literature.

RESULTS AND DISCUSSION

Respondent Characteristics

The survey results show that the majority of respondents are male MSME owners, accounting for 62.4%, with an age range of 31–40 years making up 38.2%. The education level of respondents is dominated by high school/vocational school graduates at 45.8%, followed by diploma/bachelor's degree holders at 31.4%. The duration of business operation ranges from 5–10 years for 42.6%, with an average monthly turnover of IDR 15–50 million for 48.2%. Based on business category, the sample consists of 58.4% micro enterprises, 32.8% small enterprises, and 8.8% medium enterprises. The most represented business sectors are trade (34.6%), manufacturing (28.2%), services (24.4%), and agriculture (12.8%). This distribution reflects the structure of MSMEs in Central Java and Indonesia in general.

Level of Information Technology Adoption

Descriptive analysis shows that the level of IT adoption among MSMEs is still at a moderate level with an average score of 3.24 out of 5. The Communication Technology dimension has the highest score of 3.78, indicating that MSMEs are fairly good at using communication technologies such as smartphones, social media, and messaging apps for business purposes. Infrastructure Technology scored 3.45, indicating that most MSMEs have internet access and basic computer equipment. Business Applications scored 3.12, showing limited use of business software such as accounting and inventory management tools. E-commerce Technology received the lowest score of 2.89, indicating a low adoption of online selling platforms. Data Management Technology scored 3.02, indicating that MSME data and information management systems still need improvement. These findings are in line with those of Bank Indonesia (2021), which show low levels of digitalization among Indonesian MSMEs, especially in e-commerce and digital data management.

Level of Operational Efficiency

The operational efficiency of MSMEs is at a medium level with an average score of 3.36. Process Efficiency received the highest score of 3.52, indicating that MSMEs are fairly good at optimizing operational processes. Time Efficiency scored 3.41, suggesting effective time management in business operations. Resource Efficiency scored 3.28, showing that the use of resources such as raw materials, labor, and capital can still be optimized. Cost Efficiency had the lowest score of 3.22, indicating that operational cost control is an area needing more attention for MSMEs.

Validity and Reliability Testing

Convergent validity testing shows that all indicators have factor loadings above 0.6 with Average Variance Extracted (AVE) values for each construct above 0.5. Discriminant validity testing using the Fornell-Larcker criterion shows that the square root of AVE for each construct is greater than the correlation between constructs, indicating that discriminant validity is met. Reliability testing using Cronbach's Alpha and Composite Reliability shows values above 0.7 for all constructs. Cronbach's Alpha ranges from 0.782 to 0.856, while Composite Reliability ranges from 0.824 to 0.901. These results indicate that the research instruments have good internal consistency.

Confirmatory Factor Analysis

CFA on the measurement model shows satisfactory results with a Chi-square/df ratio of 2.186 ($\leq$ 3), GFI 0.912 ($\geq$ 0.90), AGFI 0.894 ($\geq$ 0.80), CFI 0.943 ($\geq$ 0.90), TLI 0.938 ($\geq$ 0.90), and RMSEA 0.049 ($\leq$ 0.08). All goodness of fit indices meet the required criteria,

indicating that the measurement model fits the empirical data. All indicator factor loadings are above 0.6 with significance $p < 0.001$, showing that the indicators effectively measure the latent constructs. The CFA results also show no issues with multicollinearity or singularity in the measurement model.

Structural Model Testing

The full structural equation modeling yields good goodness of fit indices with a Chi-square/df ratio of 2.234, GFI 0.908, AGFI 0.887, CFI 0.939, TLI 0.933, and RMSEA 0.052. The structural model is deemed fit and can be used for hypothesis testing. The results show that information technology adoption has a significantly positive effect on MSME operational efficiency with a path coefficient of 0.742 and a CR value of 12.486 ($p < 0.001$). The coefficient of determination (R^2) is 0.551, indicating that 55.1% of the variance in operational efficiency is explained by information technology adoption.

Analysis of the Influence of IT Adoption Dimensions

Further analysis shows that various dimensions of IT adoption contribute differently to operational efficiency. Business Applications make the largest contribution with a coefficient of 0.334, followed by Data Management Technology (0.298), E-commerce Technology (0.245), Infrastructure Technology (0.187), and Communication Technology (0.156). These findings indicate that the implementation of business applications such as accounting software, inventory management, and point of sale systems has the most significant impact on improving operational efficiency. Well-organized data management systems also greatly contribute to optimizing MSME operations.

Analysis Based on MSME Characteristics

Multi-group analysis based on business category shows differences in the effect of IT adoption. Medium enterprises have the highest path coefficient at 0.823, followed by small enterprises at 0.754, and micro enterprises at 0.687. This indicates that the larger the business scale, the greater the benefits from IT adoption. Based on business sector, the manufacturing sector has the highest path coefficient at 0.798, followed by trade (0.742), services (0.723), and agriculture (0.681). The manufacturing sector benefits the most because information technology can simultaneously optimize production processes, supply chains, and quality control.

Factors Influencing IT Adoption

Correlation analysis shows that the digital literacy of business owners has a strong positive correlation with IT adoption ($r = 0.652$, $p < 0.001$). MSMEs whose owners have good IT knowledge tend to adopt technology more quickly and effectively. Infrastructure support also significantly influences IT adoption ($r = 0.578$, $p < 0.001$). MSMEs located in areas with good internet and telecommunications infrastructure have higher levels of technology adoption. Financial capacity is moderately correlated with technology adoption ($r = 0.434$, $p < 0.001$), indicating that the availability of capital affects the ability to invest in technology.

Specific Impact of Information Technology on Operational Efficiency

Detailed analysis shows that IT adoption has a specific impact on various aspects of operational efficiency. Process Efficiency increased by an average of 35.6% in MSMEs that adopted IT compared to those that had not. The implementation of automation systems and business process digitization has proven to reduce redundancy and improve operational speed. Time Efficiency increased by an average of 32.4% through the use of time management applications, automated scheduling systems, and more effective digital communication. MSMEs using IT can reduce time spent on administrative tasks and improve responsiveness to

customer demands. Cost Efficiency increased by an average of 28.4% through resource optimization, reduced administrative costs, and supply chain efficiency. The implementation of digital inventory management systems has been proven to reduce storage costs and prevent stockouts or overstocking. Resource Efficiency increased by an average of 31.2% through optimized allocation of human resources, increased utilization of production capacity, and reduced waste in operational processes. Information technology enables MSMEs to perform more accurate monitoring and control of resource usage.

CONCLUSION

This study proves that the adoption of information technology has a significantly positive effect on the operational efficiency of MSMEs in Central Java, with a coefficient of determination of 0.551. The implementation of information technology has been proven to increase Process Efficiency by 35.6%, Time Efficiency by 32.4%, Resource Efficiency by 31.2%, and Cost Efficiency by 28.4%. Business Applications and Data Management Technology contribute the most to the improvement of operational efficiency. The level of information technology adoption among MSMEs is still at a moderate level with a score of 3.24 out of 5. Communication Technology has the highest level of adoption, while E-commerce Technology remains low. The factors influencing the adoption of information technology include the digital literacy of business owners, infrastructure support, and financial capacity. MSMEs with larger scale and those in the manufacturing sector gain the greatest benefits from the adoption of information technology.

The research findings provide theoretical implications by confirming the TAM and UTAUT models in the context of information technology adoption by MSMEs. Practically, the results offer guidance for MSMEs to prioritize the implementation of business applications and data management technology to optimize operational efficiency. For the government, this study provides an empirical foundation for the development of MSME digitalization programs focusing on improving digital literacy and strengthening information technology infrastructure.

The limitations of this study include a geographical scope limited to Central Java and the use of cross-sectional data, which cannot capture the dynamic changes in technology adoption. Future research is recommended to use a longitudinal approach to analyze the long-term impact of information technology adoption on MSME performance and to expand the geographical scope to improve the generalizability of the research findings.

REFERENCES

Al-Qirim, N. (2007). The adoption of eCommerce communications and applications technologies in small businesses in New Zealand. *Electronic Commerce Research and Applications*, 6(4), 462-473.

Apulu, I., & Latham, A. (2011). Drivers for information and communication technology adoption: a case study of Nigerian small and medium sized enterprises. *International Journal of Business and Management*, 6(5), 51-60.

Armbrust, M., Fox, A., Griffith, R., Joseph, A. D., Katz, R., Konwinski, A., Lee, G., Patterson, D., Rabkin, A., Stoica, I., & Zaharia, M. (2010). A view of cloud computing. *Communications of the ACM*, 53(4), 50-58.

Asosiasi Penyelenggara Jasa Internet Indonesia. (2022). *Profil pengguna internet Indonesia 2022*. Jakarta: APJII.

Badan Pusat Statistik. (2022). *Statistik telekomunikasi Indonesia 2022*. Jakarta: BPS.

Bank Indonesia. (2021). *Survei digitalisasi UMKM 2021*. Jakarta: Bank Indonesia.

Brynjolfsson, E., & Hitt, L. M. (2000). Beyond computation: Information technology, organizational transformation and business performance. *Journal of Economic Perspectives*, 14(4), 23-48.

Coelli, T. J., Rao, D. S. P., O'Donnell, C. J., & Battese, G. E. (2005). *An introduction to efficiency and productivity analysis*. Boston: Springer Science & Business Media.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319-340.

Donner, J., & Escobari, M. X. (2010). A review of evidence on mobile use by micro and small enterprises in developing countries. *Journal of International Development*, 22(5), 641-658.

Esselaar, S., Stork, C., Ndiwalana, A., & Deen-Swarray, M. (2007). ICT usage and its impact on profitability of SMEs in 13 African countries. *Information Technologies & International Development*, 4(1), 87-100.

Farrell, M. J. (1957). The measurement of productive efficiency. *Journal of the Royal Statistical Society*, 120(3), 253-290.

Ghobakhloo, M., Arias-Aranda, D., & Benitez-Amado, J. (2011). Adoption of e-commerce applications in SMEs. *Industrial Management & Data Systems*, 111(8), 1238-1269.

Google, Temasek, & Bain Company. (2021). *e-Conomy SEA 2021: Roaring 20s - The SEA Digital Decade*. Singapore: Google-Temasek-Bain.

Grandon, E. E., & Pearson, J. M. (2004). Electronic commerce adoption: an empirical study of small and medium US businesses. *Information & Management*, 42(1), 197-216.

Iacovou, C. L., Benbasat, I., & Dexter, A. S. (1995). Electronic data interchange and small organizations: Adoption and impact of technology. *MIS Quarterly*, 19(4), 465-485.

Katadata Insight Center. (2021). *Survei literasi digital UMKM Indonesia 2021*. Jakarta: Katadata.

Kementerian Koperasi dan Usaha Kecil dan Menengah. (2021). *Perkembangan data usaha mikro, kecil, menengah dan usaha besar tahun 2017-2018*. Jakarta: Kemenkop UKM.

Levy, M., & Powell, P. (2005). Strategies for growth in SMEs: the role of information and information systems. Oxford: Elsevier Butterworth-Heinemann.

McKinsey Global Institute. (2020). *Digital transformation: Improving the odds of success*. New York: McKinsey & Company.

Melville, N., Kraemer, K., & Gurbaxani, V. (2004). Information technology and organizational performance: An integrative model of IT business value. *MIS Quarterly*, 28(2), 283-322.

Moon, Y. B. (2007). Enterprise resource planning (ERP): a review of the literature. *International Journal of Management and Enterprise Development*, 4(3), 235-264.

Nguyen, T. H. (2009). Information technology adoption in SMEs: an integrated framework. *International Journal of Entrepreneurial Behavior & Research*, 15(2), 162-186.

Oliveira, T., & Martins, M. F. (2011). Literature review of information technology adoption models at firm level. *Electronic Journal of Information Systems Evaluation*, 14(1), 110-121.

Ramayah, T., Ling, N. S., Taghizadeh, S. K., & Rahman, S. A. (2016). Factors influencing SMEs website continuance intention in Malaysia. *Telematics and Informatics*, 33(1), 150-164.

Ramdani, B., Chevers, D., & Williams, D. A. (2013). SMEs' adoption of enterprise applications: A technology-organisation-environment model. *Journal of Small Business and Enterprise Development*, 20(4), 735-753.

Raymond, L. (2001). Determinants of web site implementation in small business. *Internet Research*, 11(5), 411-422.

Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). New York: Free Press.

Soto-Acosta, P., Popa, S., & Palacios-Marqués, D. (2016). E-business, organizational innovation and firm performance in manufacturing SMEs: an empirical study in Spain. *Technological and Economic Development of Economy*, 22(6), 885-904.

Thong, J. Y. (1999). An integrated model of information systems adoption in small businesses. *Journal of Management Information Systems*, 15(4), 187-214.

Tornatzky, L. G., & Fleischer, M. (1990). *The processes of technological innovation*. Lexington: Lexington Books.

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 27(3), 425-478.

Zhu, K., & Kraemer, K. L. (2005). Post-adoption variations in usage and value of e-business by organizations: Cross-country evidence from the retail industry. *Information Systems Research*, 16(1), 61-84.