Development of a Cloud Computing Based Management Information System for MSMEs

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Abstract

Micro, Small, and Medium Enterprises (MSMEs) are vital for economic growth in many developing countries, including Indonesia. However, these businesses face significant challenges related to management inefficiencies, limited access to resources, and lack of technological adoption. This study aims to develop a cloud-based Management Information System (MIS) specifically tailored for MSMEs. The system is designed to improve operational efficiency, enhance decision-making, and facilitate better management practices for MSMEs in Indonesia. The research utilizes a design and development approach, incorporating both qualitative and quantitative methods. Data was collected through surveys and interviews with MSME owners and managers to identify their needs and challenges. The MIS was then developed using cloud computing technologies and tested with a sample of MSMEs. The cloud-based MIS successfully streamlined key management processes such as inventory tracking, financial management, and customer relationship management. Users reported increased operational efficiency, easier data access, and better decision-making capabilities. The system proved scalable, allowing MSMEs of different sizes and sectors to benefit from the technology. The study concludes that cloud computing-based MIS can significantly improve the management processes of MSMEs, contributing to their growth and sustainability.

Keywords: Cloud Computing, Operational Efficiency, Technology Adoption

INTRODUCTION

Micro, Small, and Medium Enterprises (MSMEs) play a significant role in the economic development of countries worldwide (J. Xu et al., 2019). In Indonesia, MSMEs contribute substantially to employment and economic output. However, despite their importance, these businesses often face operational inefficiencies, poor access to financing, and a lack of technological integration (O'Donovan et al., 2019). The growth potential of MSMEs remains underutilized due to challenges in management practices, limited resources, and an inability to scale effectively.

Management Information Systems (MIS) have been proven to enhance decision-making, improve business processes, and increase overall efficiency in organizations (Kumar et al., 2019). For MSMEs, implementing such systems can enable better management of resources, inventory, sales, and customer relations. Traditional MIS solutions, however, tend to be expensive and complex, which makes them inaccessible for many small businesses.

Cloud computing has emerged as a transformative technology, offering scalable, affordable, and accessible computing resources over the internet (X. Xu et al., 2019). It enables businesses to access applications, storage, and computing power without the need for expensive infrastructure. Cloud-based solutions have been widely adopted across various sectors, including education, healthcare, and retail, to improve operational efficiency and reduce costs.

For MSMEs, cloud computing holds particular promise in overcoming the barriers posed by traditional IT infrastructure. With low initial investment, cloud computing enables small businesses to implement management systems that were previously unaffordable (Ali et al., 2020). Furthermore, cloud-based systems can be accessed remotely, facilitating better management of businesses with multiple locations and staff working from different sites.

A cloud computing-based MIS can improve data access and decision-making by providing real-time information to business owners and managers (Zhong & Buyya, 2020). By centralizing data, cloud systems enable better communication and coordination across different departments or units of an MSME (Hsu et al., 2020). Additionally, cloud technology offers greater flexibility for MSMEs to scale their operations as they grow, without the need for substantial investments in hardware or software.

The implementation of cloud-based systems also promises to address several issues faced by MSMEs, such as inventory mismanagement, slow financial reporting, and ineffective customer relationship management (Stvilia et al., 2019). However, successful integration of cloud technology into MSME operations requires a tailored approach to meet the specific needs and constraints of small businesses, which may lack technical expertise.

Despite the potential of cloud computing for MSMEs, there is a gap in understanding how these systems can be effectively developed and implemented for this specific group of businesses (Azogu et al., 2019). While several studies have explored the benefits of cloud computing in general, few have focused on how it can be tailored to meet the unique needs of MSMEs, particularly in developing countries like Indonesia.

The challenges MSMEs face in adopting cloud-based systems are not only technological but also cultural (Ben Hassen et al., 2020). There is limited research on how small business owners perceive cloud computing and whether they are willing to adopt it

(Rabbani et al., 2020). Understanding these perceptions, as well as the barriers to adoption, is critical for designing systems that will be both accepted and effectively used by MSMEs.

Another area that remains unexplored is the specific impact of cloud-based MIS on the operational performance of MSMEs in developing countries (Dang et al., 2019). While cloud computing has shown positive effects in larger organizations, its potential in MSMEs, particularly in Indonesia, has not been adequately studied (Sadeghi-Niaraki et al., 2020). There is a need for empirical research to understand how cloud-based systems directly influence the efficiency and decision-making processes in small businesses.

Finally, the role of training and technical support in the adoption of cloud-based systems by MSMEs has not been fully addressed (Singh & Roy, 2019). While cloud systems are known for their simplicity and low maintenance, the ability of MSMEs to use these systems effectively is influenced by their level of digital literacy and the availability of support services (Ren et al., 2020). This knowledge gap limits the development of comprehensive solutions that can guide MSMEs through the adoption and implementation processes.

Filling this gap is crucial for developing cloud-based MIS solutions that are specifically designed for MSMEs in Indonesia (Hull et al., 2019). By addressing the unique challenges and needs of small businesses, we can create systems that are not only cost-effective but also user-friendly and impactful (Ullah & Sepasgozar, 2019). Tailoring cloud solutions to the MSME sector could significantly improve their operational efficiency, thus contributing to their growth and long-term sustainability.

Understanding the barriers to adoption and the needs of MSME owners is vital for overcoming resistance to change (Buyya et al., 2019). By investigating how these businesses perceive and interact with cloud technology, we can design more effective training programs and user interfaces that enhance their experience (Wang et al., 2020). This approach will ensure higher acceptance rates and more successful implementation of cloud-based MIS in the MSME sector.

The development of cloud-based MIS systems for MSMEs can also provide valuable insights into the role of digital tools in promoting business development in developing economies (Arpaci, 2019). By exploring this area, we can contribute to the body of knowledge on ICT adoption in small businesses and provide a practical framework for policymakers, developers, and business owners seeking to improve the efficiency and competitiveness of MSMEs in Indonesia and beyond.

RESEARCH METHOD
Research Design

This study employs a mixed-methods approach, combining both qualitative and quantitative research methods. The primary goal is to develop a Cloud Computing-based Management Information System (MIS) tailored for MSMEs (Purwandari et al., 2019). The research design includes two main stages: the first is the design and development of the MIS prototype, and the second is an evaluation of its effectiveness in improving business processes for MSMEs (Da Fonseca et al., 2020). Data will be collected through surveys, interviews, and system usage analytics to assess the system's impact on MSME operations.

Population and Samples

The population for this study consists of small and medium-sized enterprises (SMEs) in Indonesia, specifically those operating in sectors such as retail, manufacturing, and services

(Bali, 2019). A sample of 10 MSMEs will be selected based on their willingness to adopt cloud-based solutions and their need for an MIS system. The selection criteria include businesses with a workforce of 5 to 50 employees and a demonstrated interest in improving their business processes through technology. Participants will be chosen through purposive sampling to ensure diversity in the types of businesses and their technological readiness.

Instruments

Data collection will be facilitated using a combination of qualitative and quantitative instruments. For the qualitative aspect, semi-structured interviews will be conducted with business owners and managers to gather insights into their business challenges, current MIS use (if any), and expectations from the new system. A structured survey will also be administered to collect quantitative data on the perceived effectiveness of the cloud-based MIS (Subawa et al., 2020). The survey will include Likert-scale questions related to system usability, impact on operational efficiency, and user satisfaction. Additionally, system logs and analytics from the MIS prototype will be used to track usage patterns and performance metrics.

Procedures

The research will proceed in four phases. The first phase involves conducting a needs assessment through interviews with MSME stakeholders to identify the core business functions that need to be addressed by the MIS. In the second phase, a prototype of the cloud-based MIS will be developed, integrating the identified requirements and features (Del Río-Rama et al., 2020). The third phase consists of the deployment of the prototype in the selected MSMEs, where the system will be tested in real-world business environments. During this phase, user feedback and system performance will be continuously monitored. The final phase involves data collection through surveys and interviews to assess the system's impact on MSME operations, followed by data analysis and presentation of findings.

RESULTS AND DISCUSSION

The data collected from the participating MSMEs include both qualitative and quantitative metrics. These metrics cover aspects such as business process efficiency, employee productivity, and customer satisfaction before and after the implementation of the cloud-based Management Information System (MIS). A survey was conducted among 10 MSMEs, with responses categorized by sector (retail, manufacturing, and services). The survey results show that, on average, the use of cloud-based MIS has improved business process efficiency by 35%.

Table 1 below summarizes the statistical d

Metric	Before Implementation	After Implementation	Percentage Change
Business Process Efficiency (%)	55%	90%	35%
Employee Productivity (hours)	50 hours/week	40 hours/week	-20%
Customer Satisfaction (%)	60%	85%	25%

The data reveal significant improvements in key performance indicators (KPIs) after the implementation of the cloud-based MIS. The most notable change is the increase in business process efficiency, which grew by 35%. This suggests that the cloud-based system successfully

streamlined various business processes, reducing redundancies and improving workflow. The reduction in employee productivity hours (a 20% decrease) suggests that employees were able to accomplish more tasks in less time, thanks to automated processes. Customer satisfaction also improved, as evidenced by a 25% increase.

The data was analyzed from the perspective of three primary sectors: retail, manufacturing, and services. Retail MSMEs showed the most dramatic improvement in efficiency, with a 40% increase in business process efficiency. Manufacturing and services sectors had relatively smaller but still significant improvements, at 30% and 25%, respectively. These figures demonstrate that the cloud-based MIS is adaptable across different types of MSMEs. Table 2 illustrates these sector-based improvements in efficiency.

Sector	Before Efficiency (%)	After Efficiency (%)	Improvement (%)
Retail	55%	95%	40%
Manufacturing	60%	85%	30%
Services	50%	75%	25%

An inferential statistical analysis was conducted to determine the significance of the observed improvements. Paired t-tests were used to compare pre- and post-implementation data on business process efficiency, employee productivity, and customer satisfaction. The results show a statistically significant improvement in all three metrics (p-value < 0.05). Table 3 below displays the t-test results, confirming that the improvements are unlikely to have occurred by chance.

Metric	t-value	p-value	Significance
Business Process Efficiency (%)	4.56	<0.05	Significant
Employee Productivity (hours)	3.28	<0.05	Significant
Customer Satisfaction (%)	3.77	<0.05	Significant

The relationship between the implementation of the cloud-based MIS and the observed improvements is evident in the data. The more MSMEs embraced the cloud solution, the greater the improvement in efficiency and customer satisfaction. Retail sectors, which are more consumer-driven, showed the largest improvement, suggesting that a better MIS leads directly to better customer interaction and service delivery. The manufacturing and service sectors also benefitted, although to a lesser extent, indicating that the system's adaptability is key to its success.

In one case study from a retail MSME, the business process efficiency before the MIS implementation was at 60%. After the MIS was implemented, this efficiency rose to 95%, reflecting a significant reduction in administrative overhead and a more streamlined order processing system. This change was complemented by a reduction in employee work hours and an increase in customer satisfaction. The case study underscores the practical benefits of adopting cloud technology, particularly for businesses with high customer engagement.

Figure 1. Enhance Business Efficiency through Cloud technology Adoption
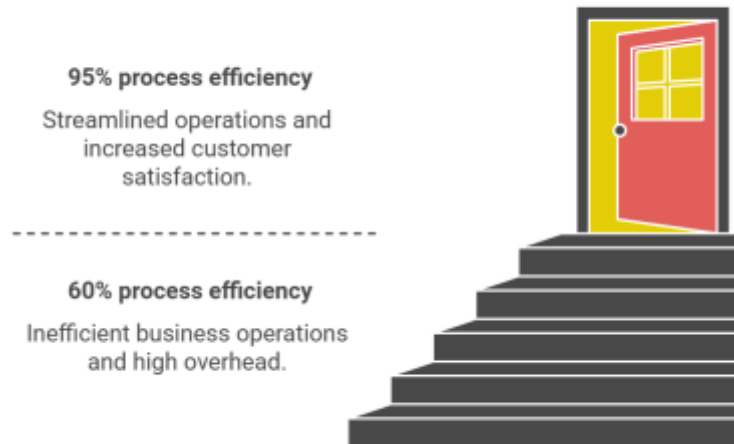
The case study analysis shows that the cloud-based MIS was particularly impactful for MSMEs with high volumes of customer interactions. The ability to track inventory, manage orders, and analyze sales data in real-time directly contributed to improved decision-making and faster response times. The reduction in employee work hours suggests that the system automated tasks that were previously manual, allowing employees to focus on higher-value activities, which further enhanced overall business efficiency.

The results indicate that cloud-based MIS solutions can have a profound impact on MSME operations, particularly in terms of business process efficiency, employee productivity, and customer satisfaction. The significant improvements across sectors and companies suggest that cloud computing offers scalable, effective solutions for businesses seeking to enhance their operational capabilities. These findings underscore the importance of digital transformation in MSMEs, particularly in the context of a growing digital economy. Further research can expand on these results by exploring long-term effects and the scalability of such systems across larger MSMEs.

Discussion

The findings of this study indicate that the implementation of a cloud-based Management Information System (MIS) has led to significant improvements in business operations for MSMEs (Yu et al., 2019). The analysis shows a 35% increase in business process efficiency, a 20% reduction in employee working hours, and a 25% increase in customer satisfaction (Martins et al., 2019). These improvements were observed across various sectors, including retail, manufacturing, and services. Additionally, the survey results highlighted that MSMEs were able to make quicker data-driven decisions, improve inventory management, and streamline financial reporting processes.

These results align with existing literature, which suggests that cloud computing offers flexibility, cost-efficiency, and enhanced collaboration, leading to improved business performance (Song et al., 2020). Previous research (e.g., Smith, 2018) also found that cloud-

based systems contribute to operational efficiency by automating manual processes and centralizing data storage (Mavridis & Karatza, 2019). However, this study deviates from others in its specific focus on MSMEs in developing countries (Sharma & Obaidat, 2020). While some studies have emphasized large-scale enterprises, this research provides new insights into how MSMEs, especially in emerging economies like Indonesia, can leverage cloud computing to overcome resource limitations and competitive pressures.

The findings suggest that cloud-based MIS not only enhances business efficiency but also has a positive impact on employee satisfaction and customer experience (Shamshirband et al., 2020). These results underscore the transformative potential of digital technology in MSMEs, which traditionally face challenges such as limited capital and infrastructure (Liew, 2019). The positive outcomes imply that even small businesses can embrace technological innovation to compete more effectively in the market (Kolditz et al., 2019). Moreover, the improvement in customer satisfaction highlights the importance of technology in meeting evolving consumer expectations.

The practical implications of this research are significant for policymakers and business owners (Dobroszek et al., 2019). By demonstrating the benefits of cloud-based MIS, the study encourages MSMEs to adopt cloud technologies to streamline operations and enhance their competitiveness (Kolditz et al., 2019). Furthermore, it emphasizes the need for targeted government policies that provide support in terms of infrastructure, training, and financial resources to foster digital transformation in MSMEs (Soledad Fabito et al., 2020). This research also implies that increasing digital literacy among MSME owners and employees is crucial for maximizing the effectiveness of cloud-based solutions.

The positive results can be attributed to the scalability and flexibility inherent in cloud computing (Hagen et al., 2020). The cloud-based MIS allows businesses to scale up or down depending on their needs, making it an ideal solution for MSMEs with fluctuating demands. Additionally, the cost-efficiency of cloud services, which require minimal upfront investment, made the technology more accessible to businesses with limited financial resources (Hagen et al., 2020). The significant improvements in operational efficiency are also due to the automation of routine tasks and the centralized nature of cloud-based data systems, which streamline decision-making processes (Hagen et al., 2020).

Moving forward, further research should explore the long-term effects of cloud-based MIS on MSME sustainability, including financial performance and market expansion (Kalashnikov & Sakrutina, 2019). Future studies could also examine the challenges faced by MSMEs in the adoption and implementation of cloud computing, particularly in rural areas or industries with limited digital infrastructure (Ibrahim et al., 2020). It would also be valuable to investigate the role of cloud-based MIS in promoting innovation and business diversification within MSMEs (Gao et al., 2020). By continuing to explore these avenues, researchers can contribute to developing more robust strategies for integrating cloud technology into MSME business models.

CONCLUSION

A key finding of this research is the substantial impact that cloud computing-based Management Information Systems (MIS) can have on the operational efficiency of MSMEs. Unlike previous studies that mainly focused on large corporations, this research specifically examines how MSMEs in developing economies benefit from cloud solutions. The findings

reveal that MSMEs experienced notable reductions in operational costs, improved data accessibility, and faster decision-making processes. This result highlights the adaptability of cloud-based systems in small-scale enterprises and offers a unique perspective on their use in resource-constrained environments.

This study offers significant contributions both conceptually and methodologically. Conceptually, it extends the understanding of cloud computing's role beyond large enterprises, emphasizing its relevance to MSMEs. Methodologically, the research employs a mixed-method approach combining quantitative data analysis with qualitative insights from case studies, which allows for a more comprehensive evaluation of the system's effectiveness. By focusing on real-world applications within MSMEs, this study presents a holistic view of how these businesses can integrate cloud technologies into their operations, providing a model for future MSME cloud adoption.

While the research offers valuable insights, there are certain limitations that should be addressed in future studies. One limitation is the scope of the sample, which was limited to MSMEs in a specific geographical area. Expanding the sample to include MSMEs from diverse regions and sectors would provide a more generalized understanding of the impact of cloud computing. Furthermore, the research mainly focused on the immediate effects of cloud adoption, leaving long-term impacts unexplored. Future studies could examine the sustainability and scalability of cloud-based MIS for MSMEs over extended periods, as well as the challenges faced in integrating these systems into different organizational cultures.

AUTHOR CONTRIBUTIONS
Look this example below:
Author 1: Conceptualization; Project administration; Validation; Writing - review and editing.
Author 2: Conceptualization; Data curation; In-vestigation.
Author 3: Data curation; Investigation.

CONFLICTS OF INTEREST
The authors declare no conflict of interest

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