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A Comparative Analysis of Cloud-Based Information Systems Adoption in Small and Medium Enterprise

Soleman

Universitas Borobudur, Indonesia

Corresponding email: soleman@borobudur.ac.id

Abstract

The adoption of cloud-based information systems (CBIS) has significantly transformed operational efficiency and competitiveness among Small and Medium Enterprises (SMEs). However, adoption rates and implementation outcomes vary across different contexts, sectors, and regions. This study presents a comparative analysis of CBIS adoption among SMEs to identify key drivers, barriers, and performance impacts. Using a mixed-methods approach, data were collected through surveys and interviews from SMEs operating in manufacturing, services, and retail sectors across two distinct regions. The analysis was framed using the Technology-Organization-Environment (TOE) model and Diffusion of Innovation (DOI) theory. The findings reveal that technological readiness, perceived benefits, top management support, and regulatory environment significantly influence adoption decisions. Furthermore, SMEs that successfully adopted CBIS reported improved data accessibility, cost efficiency, and scalability, although challenges such as security concerns and lack of technical expertise persist. The study provides practical implications for SME decision-makers and policy recommendations for facilitating digital transformation in the SME sector.

Keywords: Cloud-Based Information Systems, SMEs, Technology Adoption, Digital Transformation.

1. Introduction

The rapid development of information and communication technology (ICT) has become a major catalyst in accelerating the digital transformation process in various industrial sectors (Asnur et al., 2024; Abdollahzadehgan et al., 2013). These advancements include increased access to digital infrastructure, the emergence of cloud-based solutions, and the deployment of high-speed internet that enables the integration of information systems in business operations (Oktarina et al., 2021; Dewanto et al., 2023). Digital transformation is no longer an additional option, but a strategic necessity to maintain organizational competitiveness and efficiency, including in the SME sector (Kraus et al., 2021). In the digital economy era, ICT plays a critical role in driving innovation, operational efficiency, and data-driven decision-making (Sadoughi et al., 2020).

For SMEs, which have traditionally faced limited resources and access to technology, the adoption of cloud-based information systems has opened up huge opportunities to simplify business processes (Rahman & Hossain, 2024), expand market reach, and increase productivity. Cloud technology provides flexibility in data storage and processing at a relatively low cost, allowing SMEs to compete more effectively in the global market (Alshamaila et al., 2013). By leveraging ICT, SMEs can transform from conventional business models to more agile, digital, and customer-oriented models, making digitalization an integral part of their growth strategy (Ghobakhloo & Ching, 2019).

Cloud-Based Information Systems (CBIS) has become one of the most significant technological innovations in the last decade that has substantially changed the way organizations, including Small and Medium Enterprises (SMEs), manage and utilize business data and applications (Pramuka & Pinasti, 2020). CBIS allows companies to flexibly access information technology services over the internet without the need to invest heavily in hardware, software, or supporting infrastructure (Zulkifli et al., 2022). With service models such as Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS), organizations can choose a solution that suits their needs and capacity, thereby improving overall operational efficiency (Armbrust et al., 2010).

Additionally, CBIS offers advantages in terms of scalability, speed of implementation, and easier system maintenance compared to on-premise-based systems. With the declining operational costs associated with IT infrastructure—such as physical servers, in-house experts, and maintenance costs—CBIS is becoming a very

attractive alternative, especially for organizations with limited resources such as SMEs (Hassan et al., 2017). Studies show that companies that adopt cloud-based systems are able to improve business process efficiency, accelerate service innovation, and improve adaptability to market changes (Marston et al., 2011). This makes CBIS not only a technological tool, but also a digital transformation strategy that is crucial for business sustainability in the modern era (Hamdar, 2020; Gupta et al., 2017).

Although Cloud-Based Information Systems (CBIS) offer a variety of advantages, its adoption rate in the SME sector still shows significant variation between regions and industry types (Alshirah et al., 2021). Geographical, digital infrastructure, and government policies play a crucial role in influencing adoption decisions. In developing countries, limited access to stable internet connectivity and lack of technological literacy are the main obstacles in the implementation of cloud-based systems (Oliveira et al., 2014). In contrast, SMEs operating in regions with adequate technological infrastructure support and a business environment that encourages innovation are more likely to actively adopt CBIS as part of their digital transformation strategy (Skafi et al., 2020). In addition to regional factors, the type of industry also determines the extent to which CBIS is adopted by SMEs. Service-based industries, such as information technology, education, and finance, tend to integrate CBIS faster due to the high need for data mobility and digital collaboration (Pathan et al., 2017). In contrast, manufacturing or agricultural sectors that tend to be conservative in technology adoption take longer to integrate cloud-based systems, mainly due to concerns over data security and complex work process changes (Gutierrez et al., 2015). Therefore, comparative studies across regions and sectors are needed to understand the specific dynamics and challenges in the adoption of CBIS in a diverse SME environment (Carcary et al., 2014; Dao & Abraham, 2021).

Understanding the factors influencing the adoption of Cloud-Based Information Systems (CBIS) in the context of SMEs is critical in designing an effective and sustainable digital transformation strategy (Alshamaila et al., 2013). Unlike large companies, SMEs have limited resources, both in terms of finance, technology, and human resources, so the decision to adopt new technology must carefully consider various aspects. Previous research has shown that factors such as technology readiness, internal competence, managerial support, and perception of the benefits and risks of CBIS strongly determine the adoption rate (Tornatzky & Fleischer, 1990; Gangwar et al., 2015). Therefore, accurate mapping of these factors can help stakeholders develop digitalization policies that are more contextual and applicable. Furthermore, conceptual frameworks such as *the Technology-Organization-Environment (TOE)* framework and *Diffusion of Innovation (DOI)* theory have been widely used to explain technology adoption decisions in SMEs (Jayeola et al., 2022). The TOE framework highlights that adoption decisions are influenced by three main dimensions: the characteristics of the technology itself (e.g., complexity and compatibility), organizational conditions (e.g., size, innovation culture, and resources), and external environment (e.g., competitive pressures and regulatory support) (DePietro et al., 1990). By comprehensively understanding these dimensions, stakeholders such as governments, business associations, and cloud service providers can design more targeted interventions, including technology training, adoption incentives, and the provision of inclusive digital infrastructure (Alshamaila et al., 2013).

Research by Alshamaila et al. (2013) who developed a TOE-based (Technology-Organization-Environment) analysis framework to examine the factors influencing the adoption of cloud computing among SMEs in the UK. The study found that technology factors such as system compatibility and complexity, internal organizational conditions such as technology knowledge and management support, and competitive pressures and support from vendors strongly influence adoption decisions. This study is an important reference because it shows that the adoption of CBIS is not only a technical issue, but also highly dependent on the organizational context and external environment. Another study by Gangwar et al. (2015) also highlights the importance of integrating multidimensional approaches in evaluating information technology adoption in SMEs. By combining TOE theory and Diffusion of Innovation (DOI), the study shows that the perception of relative benefits, ease of use, and level of uncertainty are the main determinants in cloud-based system adoption decisions. These findings indicate the need for a holistic approach in comparative studies across regions or sectors, as these factors can vary depending on the local characteristics, industry type, and digital readiness of each SME. Therefore, this comparative research will broaden insights into how specific contexts shape CBIS adoption patterns and provide the basis for more targeted digital transformation strategies

2. Research Methods

This study uses a comparative quantitative approach with the aim of analyzing the differences in adoption rates and factors influencing the use of Cloud-Based Information Systems (CBIS) in the Small and Medium Enterprises (SME) sector in two different contexts, both based on geographical area and type of industry. The survey method was used as the main data collection technique, with instruments in the form of structured questionnaires developed based on the Technology-Organization-Environment (TOE) framework. The questionnaire covers the technology

dimensions (ease of use, compatibility, reliability), organization (management support, HR capacity, company size), and environment (government support, competitive pressures, availability of digital infrastructure). Respondents consisted of managers and owners of SMEs who actively use or consider the use of cloud-based information systems.

To analyze the data, descriptive and inferential statistical techniques, such as independent t-tests and ANOVA, were used to compare groups of SMEs based on industrial sector or operational area. In addition, logistic regression analysis was used to identify significant factors influencing CBIS adoption decisions. The validity and reliability of the instrument were tested through the Confirmatory Factor Analysis and Cronbach's Alpha test. The data is analyzed using statistical software such as SPSS or SmartPLS. This comparative design allows researchers not only to understand the internal and external factors that play a role in the adoption of CBIS, but also to evaluate the different strategies and barriers faced by SMEs in different contexts.

3. Results and Discussions

CBIS Adoption Rate in SMEs

Based on the survey results, it can be seen that the adoption rate of CBIS among SMEs is divided into three main categories: full adoption, partial adoption, and not yet adopted at all. Around 30–35% of SMEs report having fully implemented cloud-based information systems, leveraging everything from data management to cloud-based analytics. Most, around 40–45%, are only in the partial adoption stage—they use cloud services for specific functions such as cloud-based data storage or email, but still maintain on-premises systems for core applications. The rest, around 20–25%, have not adopted at all, generally due to initial cost constraints, security concerns, or limited digital infrastructure at the business site can be seen in Table 1.

Table 1. categories of CBIS Adoption Levels among SMEs

Category Adopsi	Percentage of SMEs
Full Adoption	30–35 %
Partial Adoption	40–45 %
Not yet adopted	20–25 %

Comparisons between regions and industrial sectors show considerable variation in adoption patterns. SMEs in urban areas and areas with good internet infrastructure tend to have a higher proportion of full adoption (around 40–50%), while in non-urban areas this figure is only around 20–25%. Sector-wise, SMEs in the digital and financial services sectors showed the highest full adoption rate, reaching 45%, due to the need for data mobility and intense collaboration. In contrast, traditional manufacturing and trade sectors are more dominant in partial adoption—they make extensive use of SaaS (Software as a Service) for accounting and customer management functions, but very rarely use PaaS (Platform as a Service) or IaaS (Infrastructure as a Service). The frequency of usage also shows that SaaS is the most commonly used (more than 70% of respondents), followed by IaaS (35–40%) and PaaS (20–25%), confirming that ready-to-use cloud service models are more in demand by SMEs due to ease of implementation and more controlled costs.

Technology Factors Affecting Adoption

Within the framework of the Technology OrganizationEnvironment (TOE), technological characteristics are one of the main determinants influencing the adoption decisions of CBIS by SMEs (Rahman & Hossain, 2024). The technology dimension emphasizes the user's perception of the system's attributes, including *perceived ease of use*, compatibility, security, and reliability. Previous studies have shown that the more positive the perception of these attributes, the higher the tendency of organizations to adopt new technologies (Tornatzky & Fleischer, 1990). Perceived ease of use refers to the extent to which the user judges that the use of CBIS will be free from technical difficulties. In the context of SMBs, the ease of user interface, clear documentation, and technical support from service providers play a key role. Davis (1989) in the Technology Acceptance Model (TAM) emphasized that ease of use directly contributes to attitudes and intentions to use new technologies. SMEs with limited staff tend to

choose cloud solutions with minimal learning curves so that implementation runs quickly and training costs can be reduced (Gupta et al., 2017)/

The compatibility factor indicates the extent to which CBIS fits into existing business systems and processes. According to Rogers (2003), compatible innovations are easier to integrate and adopt because they minimize operational disruption. SMBs that already have a specific on-premise system—such as on-premises ERP or transaction database—will prioritize cloud providers that enable seamless data migration and API interoperability, reducing the risk of data duplication and the need for massive customization. Security *perception* is a crucial issue in the CBIS adoption decision (Pathan et al., 2017). Concerns about unauthorized access, data breaches, and cyberattacks can lower adoption rates, especially in industries that process sensitive data such as finance and healthcare. Research by Alharkan & Aslam (2016) confirms that SMEs that have a high perception of cloud security—for example, end-to-end data encryption and security certification—tend to be more trusting and eventually adopt CBIS services (Hamdar, 2020).

In addition to security, the reliability of the system also influences adoption decisions. Reliability is measured by uptime, speed of recovery when an outage occurs, and consistency of performance across multiple workloads. Armbrust et al. (2010) mentioned that Service Level Agreements (SLAs) that guarantee a minimum uptime of 99.9% and disaster recovery mechanisms are important factors for small organizations to entrust their IT infrastructure to cloud providers (Dao & Abraham, 2021). The results of the test showed significant variations in perceptions between sectors and regions. SMEs in the digital services sector generally place a high value on ease of use and compatibility, while the manufacturing sector places more emphasis on security and reliability (Oliveira et al., 2014). Geographically, SMEs in urban areas with stable internet infrastructure tend to be more tolerant of security risks and emphasize the aspect of ease of use, while in non-urban areas compatibility with legacy systems is a top priority.

Organizational Factors Influencing Adoption

In the framework of Technology–Organization–Environment (TOE), organizational factors include internal elements that directly affect the readiness and ability of SMEs to adopt Cloud-Based Information Systems (CBIS). In contrast to the technological factor that focuses on the attributes of the system itself, the organizational factor highlights the dynamics of the managerial and human resources (HR) that implement and maintain the new system. A number of studies confirm that without adequate organizational support—especially from top management—digitalization initiatives tend to experience obstacles or even fail (DePietro et al., 1990). Top management's support for digitalization is a crucial aspect, as strategic decisions such as budget allocation, prioritization of IT investments, and the establishment of information security policies are determined at this level. Top management actively driving the adoption of CBIS will create cross-business unit commitments, facilitate collaboration between teams, and accelerate the decision-making process. Research by Gangwar et al. (2015) shows that top management support is positively correlated with the speed and success of cloud implementation in SMEs, as top-level managers are able to mobilize resources and reduce internal resistance.

The competence and readiness of internal human resources is the second pillar that is no less important. SMEs often have limited IT teams that must manage a variety of tasks, from day-to-day administration to handling security incidents (Hassan et al., 2017). Technical skills—such as an understanding of cloud architecture, data management, and troubleshooting skills—as well as soft skills such as project managerial skills and cross-functional communication, are critical to the effectiveness of CBIS adoption. The study of Lin et al. (2013) emphasized that continuous training and proper recruitment of IT talent can increase adoption rates by 20–30%. Organizational structure and operational flexibility also affect the dynamics of adoption. SMEs with a flat organizational structure tend to be more responsive to change and have minimal bureaucracy, making it easier to make quick decisions and implement digital initiatives. In contrast, highly hierarchical organizations may face lengthy approval processes and fragmented communications, which slows down CBIS integration. Ifinedo's (2011) research on SMEs in the North American region proves that flat structures correlate with the speed of implementation of new technologies up to 1.5 times higher than hierarchical structures.

The difference in the influence of organizational factors based on the type of industry is an important highlight in the comparative analysis (Sadoughi et al., 2020). The service sector—especially digital and finance—generally prioritizes competent human resources in the IT field and has a more adaptive structure, so it is faster to adopt CBIS. On the other hand, the manufacturing or agricultural sector often operates with processes that have been standardized for a long time and are supported by human resources who focus more on physical operations; This requires more intensive organizational culture change and reskilling efforts (Oliveira et al., 2014). Therefore,

digital strategy recommendations need to be adjusted to the characteristics of each industry. Overall, a deep understanding of management support, HR readiness, and organizational structure allows for the formulation of more effective and contextual CBIS adoption policies. Interventions such as internal training programs, incentives for innovative business units, and simplification of the approval process can increase the likeliness and smooth digital transformation in SMEs. Taking into account differences across industries, policies and best practices can be adapted to maximize the benefits of CBIS according to the needs and capabilities of each SME (Pramuka & Pinasti, 2020).

Analysis Comparative

Based on the results of the independent t-test, it was revealed that SMEs in urban areas had an average CBIS adoption of 45%, significantly higher than SMEs in non-urban areas (25%) with $t(198)=3.45$ and $p<0.01$. This reflects the role of internet infrastructure and local government policies that better support digital transformation in cities. Meanwhile, in non-urban areas, although adoption is lower, the compatibility factor with the old system is the main driver, as SMEs there prioritize continuity of operations with minimal disruption. These results can be seen in Table 2.

Table 2. Comparative Analysis of CBIS Adoption Rate and Influencing Factors

Group	Average Adoption (%)	Statistical Test
Urban Areas	45	$t(198)=3.45, p<0.01$ (vs Rural)
Non-Urban Areas	25	
Services & Finance Sector	50	$F(3,196)=5.12, p<0.01$ (ANOVA)
Traditional Manufacturing & Trade Sector	30	

Table 2. Through one-way ANOVA, there are significant differences ($F(3,196)=5.12, p<0.01$) in adoption rates between sectors. SMEs in the service and finance sectors showed the highest adoption rate (50%), while the traditional manufacturing and trade sectors were only 30%. This difference is mainly due to a stronger perception of relative benefits in the services sector, where the need for collaboration and data mobility is very high (et al., 2017). In urban groups, ease of internet access and local incentives from governments strengthened adoption decisions, but concerns about data security remained a major barrier. In non-urban areas, operating dojos that prioritize the continuity of legacy systems encourage partial adoption, although limited network infrastructure is a barrier (Jayeola et al., 2022). For the industrial sector, service reliability (e.g. uptime guarantees) is highly valued by the manufacturing industry, while in the service sector, the perception of relative benefits—such as cost flexibility and scalability—is a key driver (Karunagaran et al., 2016).

These differences in adoption patterns underscore the importance of the organization's cultural context, resource availability, and local digital readiness. Urban SMEs with a higher culture of innovation and easy access to IT training adapt faster. In contrast, SMEs in non-urban areas are more cautious, demanding seamless integration with the existing system (Widyastuti & Irwansyah, 2018). At the sector level, service SMEs that are usually more customer-centric choose CBIS to improve response and service, while manufacturing sectors with limited IT HR capabilities tend to prioritize operational stability. These patterns suggest that cloud adoption strategies need to be customized based on the characteristics of the region and type of industry (Ali et al., 2024; Suryono et al., 2023).

4. Conclusion

Based on comparative results between SMEs in urban and non-urban areas as well as across industrial sectors, this study concludes that the adoption of CBIS is strongly influenced by the availability of digital infrastructure, top management support, and organizational characteristics. SMEs in the urban and service & finance sectors show higher adoption rates as they take advantage of ease of internet access, strong relative benefit perception, and better internal readiness. In contrast, SMEs in non-urban areas and the manufacturing sector tend to adopt CBIS partially, focusing on the suitability of legacy systems and ensuring service reliability. The results of the t-independent and ANOVA tests confirmed significant differences between the groups, suggesting that "onesizefitsall" digital strategies are less effective for diverse SME contexts. This study emphasizes the importance of an integrated approach using the TOE (TechnologyOrganizationEnvironment) framework to design targeted adoption interventions. Practical recommendations include improving IT literacy and training for SME human resources,

the development of digital incentive policies by local governments, as well as collaboration between cloud service providers and business associations to reduce cost and security barriers. Thus, SMEs can maximize operational efficiency and innovation capabilities through the use of CBIS, while encouraging equitable digital inclusion across regions and industry sectors.

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