

Effect of Cloud-Based Data Accessibility on the Operational Efficiency of SMEs in Abuja, Nigeria

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Abstract

This study examines the persistent operational inefficiencies among Nigerian SMEs, largely stemming from outdated data management systems and the slow uptake of cloud technologies. Despite the global shift toward digitally enabled operations, cloud adoption among SMEs in Abuja remains below 30%, constraining real-time decision-making and collaboration. Guided by the Resource-Based View (RBV), the study assessed how cloud-based data accessibility specifically real-time access and remote collaboration enhances operational efficiency. Using a cross-sectional survey design, data were collected from 385 SME owners and managers in the Wuse and Garki business clusters through structured questionnaires. Analysis using Partial Least Squares Structural Equation Modelling (PLS-SEM) in SmartPLS showed that real-time access ($\beta = 0.243$, $p = 0.002$) and remote collaboration ($\beta = 0.550$, $p < 0.001$) significantly and positively influence operational efficiency, with remote collaboration exerting a stronger effect. The study concluded that cloud-based data accessibility is a strategic capability that drives operational efficiency among Nigerian SMEs and recommended that SMEs should invest in secure, scalable cloud systems and collaborative digital platforms to strengthen productivity and resilience.

Keywords: Cloud-Based Data Accessibility, Real-Time Access, Remote Collaboration, Operational Efficiency, SMES and Abuja.

Introduction

In today's global economy, technological innovation has become central to organizational competitiveness, adaptability, and long-term sustainability. Digital transformation, driven by advancements in cloud computing, artificial intelligence (AI), and data analytics, has reshaped how firms store information, coordinate activities, and deliver value. The rapid global uptake of cloud technologies has been particularly transformative, enabling seamless data storage, retrieval, and collaboration across devices and locations. Cloud adoption improves organizational adaptability and lowers operational expenses, thereby facilitating the transformation of traditional business processes (Mkhize et al., 2025). For developing economies such as Nigeria, this shift presents an opportunity to strengthen the performance of small and medium-sized enterprises (SMEs), which form the backbone of employment generation and national output.

Cloud-based data accessibility refers to the ability of an organization to store, retrieve, and share information in real time through online servers rather than local hardware. This capability supports secure access to business data from any location, thereby promoting

data-driven decision-making and reducing the inefficiencies associated with manual record-keeping. Increasingly, cloud accessibility is recognized not only as a technological tool but also as a strategic enabler of organizational efficiency and sustainability. Real-time access to data and remote collaboration emerge as two core dimensions that jointly underpin the transformative potential of cloud systems (Mithun, 2024; Hayat et al., 2023). Real-time access allows employees and managers to retrieve up-to-date information instantly, improving decision-making speed, customer responsiveness, and workflow integration. Remote collaboration, on the other hand, enables teamwork among geographically dispersed employees through shared digital platforms and communication tools. These capabilities enhance organizational agility by supporting faster adaptation to shifting market conditions. Consequently, cloud-based data accessibility offers SMEs a means of overcoming persistent structural challenges such as fragmented communication, outdated data systems, and limited physical infrastructure (Adebimpe & Lola, 2024). Operational efficiency represents a firm's ability to utilize resources time, labour, technology, and finances in a cost-effective manner to deliver high-quality outputs. Within the SME sector, operational efficiency is commonly assessed using two dimensions: cost reduction and process optimization. Cost reduction focuses on minimizing operational waste, while process optimization emphasizes improving speed, accuracy, and reliability of internal processes. SMEs operating in dynamic and resource-constrained environments rely heavily on operational efficiency to maintain competitiveness and ensure business continuity (Abid et al., 2023)

Existing literature increasingly confirms a positive relationship between cloud-based data accessibility and operational efficiency. Studies report that firms adopting cloud systems benefit from improved collaboration, enhanced data reliability, and streamlined resource management. Nevertheless, these potential gains are often moderated by contextual challenges. Limited digital literacy, unstable internet connectivity, cybersecurity concerns, and high adoption costs continue to constrain the effectiveness of cloud technologies in many developing contexts (Malik et al., 2019). These barriers highlight the importance of examining how cloud accessibility contributes to operational outcomes within specific local environments.

In Nigeria, SMEs continue to face entrenched inefficiencies arising from manual record-keeping, poor information flow, and low technological adoption. Although agencies such as the National Information Technology Development Agency (NITDA) and the Small and Medium Enterprises Development Agency of Nigeria (SMEDAN) promote digital inclusion, empirical studies show that cloud adoption remains limited. Buhari, Muhammad, Bodinga, and Sifawa (2022) report that fewer than 30% of SMEs utilize cloud-based systems, with most relying on traditional storage methods that restrict scalability and collaboration. This persistent digital gap weakens productivity and reduces the resilience of SMEs in an increasingly competitive, technology-driven business environment.

Given these challenges, investigating the effect of cloud-based data accessibility on the operational efficiency of SMEs in Abuja is both necessary and timely. By examining how real-time access and remote collaboration influence operational outcomes, this study provides empirical insights that can guide technology providers, policymakers, and SME operators. The findings are expected to support the development of strategies that promote digital transformation, strengthen operational performance, and contribute to sustainable SME growth in Abuja, Nigeria.

Statement of the Problem

In an ideal business environment, small and medium-sized enterprises (SMEs) would fully harness cloud-based data accessibility to achieve seamless information flow, real-time decision-making, and efficient coordination across organizational units. Such digital integration enables organizations to retrieve operational data instantly, collaborate remotely without constraints, and optimize internal processes for enhanced productivity and reduced costs capabilities that have become global benchmarks of competitiveness in the modern economy (Pavan et al., 2025).

However, the experience of Nigerian SMEs diverges considerably from this global standard. Despite the widespread adoption of cloud technologies worldwide, utilization among local enterprises remains low. Nigerian SMEs face multiple barriers beyond cost and infrastructure, including unreliable internet connectivity, limited access to modern digital tools, and inadequate digital skills. Consequently, many businesses continue to rely on manual or locally stored data systems, which constrain real-time information access and slow routine operations (Sadiq et al., 2022). These limitations often manifest as delayed decision-making, duplicated tasks, and poor customer responsiveness, thereby weakening overall performance.

The rapid advancement of digitally enabled firms and fintech-driven startups has further intensified competitive pressures. Enterprises equipped with cloud infrastructures now benefit from enhanced scalability, responsiveness, and data management capabilities, widening the gap between technology-driven firms and traditional SMEs. As observed by Ewuga et al. (2023), this digital divide continues to expand, posing risks to the long-term survival of small enterprises that are central to Nigeria's economic structure (Oke et al., 2021).

Although prior research has examined the general link between information technology adoption and firm performance, limited empirical attention has been given to how cloud-based data accessibility particularly real-time access and remote collaboration affects the operational efficiency of Nigerian SMEs. Existing studies, such as Studies on cloud computing adoption tend to focus on large enterprises, offering only limited insight into the specific constraints faced by smaller firms and SMEs (Haddara et al., 2022). Moreover, evidence from Ajala, Omotoso, and Rotipin (2025) suggests that while real-time digital insights can strengthen managerial decision-making, their adoption among SMEs remains

weak. These gaps highlight the need for focused empirical inquiry into the operational implications of cloud accessibility within resource-limited business contexts.

Given these challenges, examining how cloud-based data accessibility influences the operational efficiency of SMEs in Abuja is both timely and essential. Understanding the role of real-time access and remote collaboration can inform strategies aimed at enhancing digital adoption, strengthening productivity, and supporting the long-term sustainability of SMEs in Nigeria.

Research Objectives

The main objective was to investigate Effect of Cloud-Based Data Accessibility on Operational Efficiency of SMEs in Abuja, Nigeria. The specific objectives include:

- i. To examine the effect of real-time access on the operational efficiency of SMEs in Abuja, Nigeria.
- ii. To assess how remote collaboration through cloud-based systems influences the operational efficiency of SMEs in Abuja, Nigeria.

Statement of Hypotheses

In line with the research objectives, the following null hypotheses were formulated and tested:

H₀₁: Real-time access to cloud-based data has no significant effect on the operational efficiency of SMEs in Abuja, Nigeria.

H₀₂: Remote collaboration through cloud-based systems has no significant effect on the operational efficiency of SMEs in Abuja, Nigeria.

Literature Review

Conceptual Review

Concept of Cloud-based Data Accessibility

Cloud-based data accessibility is defined by the capacity to retrieve information and software over the internet without needing to manage the physical hardware directly. This represents a fundamental shift in data management, moving from a model requiring significant upfront investment in local servers to one operating on a pay-as-you-go basis that emphasizes scalability, remote access, and adaptability. A key advantage is enabling seamless collaboration and informed choices in real-time across different locations, thereby enhancing organizational agility (Alashhab et al., 2021). To fully grasp this concept, it is essential to juxtapose it with traditional on-premise systems. The latter provides complete physical command over data assets but typically cannot match the cloud's elastic resource allocation and potential for reduced costs. On the other hand, cloud models raise important issues related to jurisdictional control over data, potential delays in access, and a security framework where the vendor manages the infrastructure's security while the user is accountable for protecting their data and access (Subramanian & Thangavel, 2020). The

central intellectual conflict thus revolves around the balance between total control and operational flexibility.

A comprehensive academic examination of technological changes demands a thorough analysis of conflicting perspectives. When this critique is underdeveloped, it leads to a simplistic and potentially misguided comprehension. The discourse on cloud computing, for example, frequently pits enthusiastic support for its economic and scalable benefits against reservations concerning data protection and privacy. A shallow approach would simply acknowledge these two sides. A more profound analysis would question their foundational premises, such as investigating if the promised financial benefits are consistently achieved for all organizations or if they are diminished by hidden expenses like data transfer fees (Sen & Gopinath, 2022). Furthermore, it would synthesize these views by considering how advancements in encryption and security models are transforming the conversation, pushing it past a rudimentary debate into a more sophisticated appraisal of risks and benefits contingent on specific circumstances (Kumar & Goyal, 2021).

The usefulness of technological concepts is significantly increased when they are articulated with the intended audience in mind, such as Small and Medium-sized Enterprises (SMEs). Broad, technical jargon can be obstructive for SME owners who often do not have specialized technical staff. Definitions tailored for SMEs would instead connect these ideas to tangible business results and everyday operational needs. For instance, rather than using a technical definition for cloud scalability, an SME-centric explanation would describe it as the capability to manage an unexpected spike in customer traffic without service interruption, while only being charged for the additional power used during that period (Oliveira et al., 2019). This method connects the technology directly to the common SME challenges of finite budgets and the pressure to remain nimble, thereby making the research more contextually meaningful and actionable for this important economic segment.

Real-Time Access

Real-time access refers to an organization's capacity to obtain, process, and utilize information instantly as events unfold, thereby enabling rapid and evidence-based decision-making. Within cloud computing, it involves the continuous retrieval and synchronization of current data from remote servers, allowing firms to bypass the constraints of physical storage and location-dependent systems. Ajala et al., (2025) argue that real-time cloud technologies reduce informational delays by supporting instantaneous data updates and system monitoring, which helps decision makers respond to emergent operational needs. Zhang (2025) further contends that integrating real-time analytics into cloud environments enhances accuracy and responsiveness, especially in dynamic market settings.

For SMEs, this capability is particularly valuable because they often operate with limited staff, smaller inventories, and high customer response expectations. Real-time access therefore strengthens their ability to detect fluctuations in demand, respond to customer

inquiries promptly, and maintain operational continuity despite resource constraints. Conceptually, while some scholars describe real-time access as a technological feature, recent studies increasingly frame it as a strategic capability that enhances adaptability, productivity, and competitive advantage. This shift suggests that SMEs' digital maturity, not merely technology adoption, determines the extent to which real-time access improves performance.

Remote Collaboration

Remote collaboration refers to the use of digital and cloud-driven platforms that allow individuals and teams to work together, exchange information, and manage tasks irrespective of geographical location. These platforms support co-editing, communication, document sharing, and project tracking, all of which are enabled by cloud infrastructure. Mithun (2024) observes that cloud-supported systems strengthen remote work effectiveness by improving communication flows among dispersed teams, while Honga, Dorasamy, Hong, and Malarvizhi (2024) emphasize their role in facilitating knowledge exchange and organizational learning.

Conceptually, the literature distinguishes between remote collaboration as a technological enabler and as a productivity-enhancing organizational practice. While some authors highlight its operational benefits such as rapid communication and reduced coordination delays others emphasize its strategic value in fostering innovation, cross-functional teamwork, and organizational agility. For SMEs, which typically face constraints in staffing, physical infrastructure, and expertise, remote collaboration offers a pathway to extend their operational capabilities, coordinate with external partners, and execute complex tasks with minimal overhead costs. This duality highlights remote collaboration not merely as a tool but as an organizational resource that contributes to improved flexibility and performance.

Operational Efficiency

Operational efficiency denotes a firm's ability to streamline its internal processes, utilize resources optimally, and deliver outputs at minimal cost without compromising quality. It reflects the extent to which inputs such as time, labour, capital, and technology are converted effectively into productive outcomes. Abdalla et al., (2024) show that cloud computing enhances SME performance by reducing operational overheads, supporting business process integration, and enabling scalable digital operations. Odukoya (2024) similarly notes that cloud-based systems automate workflows, simplify data management, and promote evidence-based strategic decisions.

A conceptual comparison within the literature reveals two viewpoints: one group frames operational efficiency primarily as cost reduction, while another emphasizes process improvement, quality enhancement, and long-term capability building. In the SME context, the latter perspective is more relevant because cost savings alone do not guarantee

competitiveness; rather, sustained efficiency depends on continuous process refinement, timely information flows, and flexible resource allocation. Cloud technologies support these outcomes by automating routine tasks, reducing system maintenance burdens, improving coordination, and strengthening managerial decision-making. Thus, operational efficiency emerges as a core indicator of how digital transformation contributes to sustainable growth among SMEs.

Theoretical Framework

This study is underpinned by the Resource-Based View (RBV), originally articulated by Wernerfelt (1984) and later advanced by Barney (1991). RBV argues that a firm achieves sustained competitive advantage when it possesses and effectively leverages internal resources that are valuable, rare, inimitable, and non-substitutable (VRIN). The theory highlights that organizations vary in the types and quality of resources they control, and these disparities account for differing performance levels even when firms operate within similar external contexts. Trinova, Ode, and Susanto (2025) contend that technological tools such as cloud computing constitute strategic resources when they enhance efficiency, foster innovation, and strengthen competitive outcomes. Cloud-based management systems are widely recognised as strategic capabilities that enhance decision quality by enabling real-time data access and structured, analytics-driven information flows for managers (Younas et al., 2021).

The RBV is especially suitable for this research because cloud-based data accessibility operationalized through real-time access and remote collaboration extends beyond mere technological adoption to embody an integrated organizational capability. These capabilities are not easily duplicated by competitors, as they depend on a combination of technological infrastructure, employee expertise, process integration, and managerial routines. This reflects RBV's premise that competitive advantage arises from complex resource bundles that are difficult to imitate.

While models such as the Technology Organization–Environment (TOE) framework and the Diffusion of Innovation (DOI) theory offer valuable insights into why firms adopt new technologies, they are less effective in explaining how such technologies lead to improved performance outcomes. RBV, however, directly addresses the mechanisms through which internal technological capabilities like cloud-based data accessibility translate into measurable gains in operational efficiency. Thus, RBV provides a more aligned theoretical lens for examining the influence of cloud capabilities on SME performance in Abuja.

Although RBV is critiqued for underemphasizing external environmental and institutional factors (Priem & Butler, 2001), it remains a relevant and robust framework for evaluating how firm-specific resources shape performance differences. Within the context of this study, cloud-based data accessibility, which includes real-time data retrieval and remote collaborative functions, is conceptualized as a strategic internal resource that improves operational coordination, minimizes inefficiencies, and strengthens decision-making among SMEs. By grounding the study in RBV, cloud capabilities are positioned as vital

internal resources that drive operational efficiency and enhance SMEs' competitive positioning.

Empirical Review

Ajala et al. (2025) examined the influence of real-time financial insights generated from cloud-based accounting systems on managerial decision-making within SMEs. Using a survey research design, data were collected primarily from professionals aged 31–44 years, most of whom held bachelor's or postgraduate degrees. Hypotheses were tested using Chi-square analysis, and findings showed that cloud accounting enhanced financial management, scalability, and cost reduction. However, while 67.7% of respondents agreed that cloud accounting shortened decision-making time, 62.4% disagreed that real-time access improved decision quality. This contradiction suggests possible gaps in data interpretation, user expertise, or contextual challenges affecting system use. The absence of a supporting theoretical model and causal validation created a research gap regarding the behavioral and organizational factors mediating the link between cloud accounting and managerial effectiveness.

Hamdat et al. (2024) examined the impact of Management Information Systems (MIS) on organizational decision-making efficiency, focusing on how real-time data, advanced analytics, and emerging technologies such as AI and cloud computing enhance managerial decisions. The study adopted a mixed-methods approach, using structured surveys and theoretical frameworks (TAM and RBV) to analyze responses from senior managers and IT professionals across industries. Findings indicated that MIS significantly improves decision-making by providing timely, accurate, and relevant information, leading to greater organizational agility, accuracy, and speed. However, the effectiveness of MIS depends on factors such as organizational culture, user competence, and continuous technological updates. Despite these contributions, the study was limited by the absence of a specified sample size, a focus on only senior and IT personnel, and its cross-sectional design, which restricted generalizability and long-term insights, as well as limited exploration of sector-specific and resource-constrained contexts.

Ekawaty et al., (2025) examined the effect of digital transformation strategies including cloud computing, data analytics, digital marketing, and automation on operational efficiency, customer engagement, and overall performance among SMEs in Tangerang, Indonesia. Using a quantitative approach, the authors analysed survey data from 150 SMEs through Partial Least Squares Structural Equation Modeling (SmartPLS). Their findings indicated that cloud computing and data analytics significantly improved operational efficiency, while digital marketing and automation strengthened customer engagement and market competitiveness. However, the study's exclusive focus on a single geographic region limited the generalizability of its conclusions, and it did not isolate the specific contribution of cloud computing from other digital transformation components.

Soleman (2025) conducted a comparative analysis of cloud-based information systems (CBIS) adoption across SMEs in different sectors and regions to identify key adoption drivers, barriers, and performance outcomes. Utilizing a mixed-methods design framed by the Technology-Organization-Environment (TOE) model and Diffusion of Innovation (DOI) theory, the study gathered data through surveys and interviews from SMEs in manufacturing, services, and retail. The results showed that technological readiness, perceived benefits, top management support, and regulatory context significantly influenced CBIS adoption, with adopters reporting gains in data accessibility, cost efficiency, and scalability. Nevertheless, the study lacked a longitudinal perspective and did not quantify the magnitude of performance improvements attributable specifically to CBIS, leaving a gap in understanding causal relationships.

Mkhize et al., (2025) undertook a systematic review to evaluate the impact of cloud computing on SME performance, focusing on cost-efficiency, operational reliability, and competitive advantage. Applying the PRISMA 2020 framework, the authors analysed 90 studies published between 2014 and 2024. They found that 82% of the studies reported improved operational efficiency, 76% noted cost savings, and 64% identified enhanced competitive advantage due to cloud adoption. While comprehensive, the review did not offer new empirical evidence and was constrained by the heterogeneity of methodologies and performance metrics across the included studies, limiting its ability to draw unified causal inferences.

Khayer et al., (2020) investigated the predictors of cloud computing adoption and its subsequent impact on SME performance. Using a dual-stage analytical approach that combined structural equation modelling (SEM) and artificial neural network (ANN) analysis, the study identified relative advantage, service quality, top management support, and perceived risks as significant adoption drivers, and confirmed a positive relationship between cloud adoption and firm performance. However, the study was conducted in a limited regional context and did not account for sector-specific variations in cloud adoption outcomes, representing a notable contextual gap.

Abdalla et al., (2024) explored how perceived ease of use and perceived usefulness influence cloud computing adoption and, in turn, organizational performance among SMEs in Bahrain. The authors employed a mixed-methods survey design with 314 valid responses and analysed the data using SmartPLS 4. Their findings supported the mediating role of cloud computing adoption between user perceptions and performance outcomes. A key limitation was the cross-sectional nature of the data, which precluded causal or longitudinal interpretations, and the study did not examine external barriers such as policy or infrastructure constraints.

Odukoya (2024) provided a theoretical and qualitative exploration of the transformative potential of cloud computing for SMEs, emphasizing benefits such as scalability, cost-effectiveness, and alignment with emerging technologies like AI and IoT. The paper reviewed major cloud service models SaaS, PaaS, and IaaS and discussed cybersecurity and compliance challenges. Although insightful, the study did not present empirical data or test

hypotheses, thereby lacking measurable evidence of performance outcomes or adoption patterns in real-world SME contexts.

Nawaz and Thelijjagoda (2025) examined the determinants of cloud computing adoption and its impact on SME performance in Sri Lanka by integrating the TOE framework, Technology Acceptance Model (TAM), and individual-level factors. Using a quantitative cross-sectional design, they collected 418 responses and applied a hybrid PLS-SEM and ANN methodology. The results confirmed that cloud adoption significantly enhanced SME performance and underscored the critical role of top management support. However, as the first study of its kind in Sri Lanka, it lacked comparative benchmarks from other developing economies and did not assess post-adoption challenges such as data migration or vendor lock-in.

Methodology

This study employed a cross-sectional survey research design, which was deemed suitable because it enabled the collection of data from a sample of SME owners and managers at a single point in time. The design facilitated the examination of the relationship between cloud-based data accessibility and operational efficiency without any manipulation of the study environment. It further allowed the researcher to efficiently gather responses from a large group of participants, thereby providing a clear snapshot of the variables under investigation within the study population.

The population of the study comprised owners and managers of Small and Medium Enterprises (SMEs) operating within the Federal Capital Territory (FCT), Abuja. The accessible population included SME owners and managers from two major business clusters situated in Wuse and Garki. According to data obtained from the Small and Medium Enterprises Development Agency of Nigeria (SMEDAN) and the Abuja Chamber of Commerce, these clusters collectively hosted 2,791 registered SMEs, which served as the population frame (N) for the study. The unit of analysis was the individual SME owner or manager, as they are directly responsible for overseeing daily operations, adopting technological innovations, and making strategic decisions on cloud-based systems. Consequently, they were identified as the most appropriate respondents for providing insights into how data accessibility affects operational efficiency.

The sample size was determined using Yamane's (1967) formula for a finite population, ensuring statistical adequacy and representativeness. Given a total population (N) of 2,791 and a precision level (e) of 0.05, the sample size was computed using the following formula:

$$n = \frac{N}{1 + N(e)^2} = \frac{2791}{1 + 2791(0.05)^2} = \frac{2791}{1 + 6.9775} = \frac{2791}{7.9775} \approx 350$$

To compensate for potential non-response, the sample size was augmented by 10%, resulting in a final sample of 385 respondents. A two-stage sampling procedure was implemented: initially, a purposive sampling technique identified and selected owners and managers with direct experience in cloud-based data systems. Following this, convenience

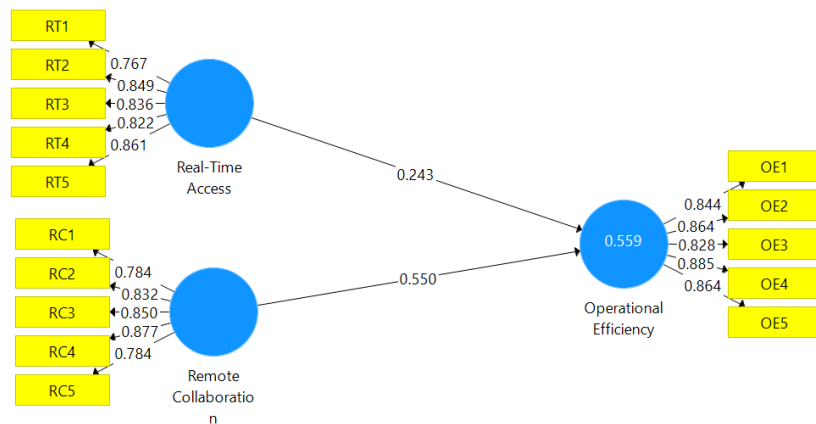
sampling was used to distribute the questionnaire to accessible and willing individuals from this pre-qualified group. Data collection was carried out using a structured questionnaire. This instrument featured a five-point Likert scale (from 1=Strongly Disagree to 5=Strongly Agree) and was divided into sections, including 5 items for cloud-based data accessibility (covering real-time access and remote collaboration) and 5 items for operational efficiency. Ethical standards were rigorously maintained by securing informed consent from all participants and guaranteeing confidentiality through the anonymization of data and its secure storage. The data were subsequently examined using Multiple Regression Analysis in SmartPLS Version 3 to assess the impact of cloud-based data accessibility on the operational efficiency of the SMEs.

Results and Discussion

Response Rate

The data collection process yielded a high response rate of 93%, with 359 completed questionnaires returned out of 385 distributed, indicating strong participant engagement and enhancing the reliability and representativeness of the study's findings.

Measurement Model



Merged Measurement Model Assessment Table

Construct	Indicator	Outer Loading	VIF	Cronbach's Alpha	rho_A	Composite Reliability
Operational Efficiency	OE1	0.844	2.590	0.910	0.913	0.933
	OE2	0.864	2.916			
	OE3	0.828	2.359			
	OE4	0.885	3.231			
	OE5	0.864	2.813			

Construct	Indicator	Outer Loading	VIF	Cronbach's Alpha	rho_A	Composite Reliability
Real-Time Access	RT1	0.767	1.744	0.884	0.886	0.916
	RT2	0.849	2.345			
	RT3	0.836	2.263			
	RT4	0.822	2.207			
	RT5	0.861	2.535			
Remote Collaboration	RC1	0.784	1.862	0.883	0.888	0.915
	RC2	0.832	2.353			
	RC3	0.850	2.248			
	RC4	0.877	2.854			
	RC5	0.784	2.012			

Source: Smart PLS Version 3.0

The measurement model results indicate that all constructs exhibit satisfactory reliability and validity in line with recommended PLS-SEM standards. The outer loadings for all indicators are above the acceptable threshold of 0.70, demonstrating that each item adequately contributes to measuring its respective construct. Additionally, the values of Cronbach's alpha, rho_A, and composite reliability for all constructs exceed 0.70, confirming strong internal consistency among the indicators. The collinearity assessment further shows that all VIF values fall below the critical limit of 5.0, suggesting that multicollinearity is not a concern. These findings collectively imply that the constructs Operational Efficiency, Real-Time Access, and Remote Collaboration are measured reliably and are appropriate for subsequent structural model evaluation (Hair et al., 2019; Henseler et al., 2015).

Heterotrait-Monotrait Ratio (HTMT)			
	Operational Efficiency	Real-Time Access	Remote Collaboration
Operational Efficiency			
Real-Time Access	0.721		
Remote Collaboration	0.806	0.838	

Source: Smart PLS Version 3.0

The Heterotrait-Monotrait Ratio (HTMT) results indicated that all values were below the conservative threshold of 0.85, demonstrating satisfactory discriminant validity among the constructs. Specifically, the HTMT values between Operational Efficiency and Real-Time Access (0.721), Operational Efficiency and Remote Collaboration (0.806), and Real-Time Access and Remote Collaboration (0.838) suggest that each construct was empirically distinct and measured unique aspects of cloud-based data accessibility and operational

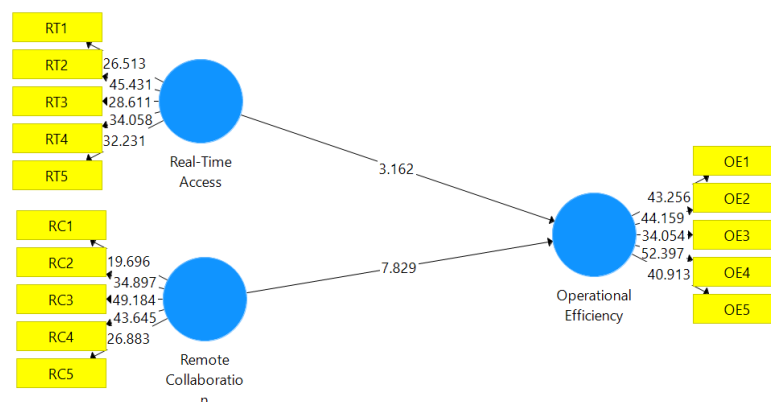
efficiency. According to Henseler, Ringle, and Sarstedt (2015), HTMT values below 0.85 confirm adequate discriminant validity, implying that the constructs do not overlap conceptually and can be reliably interpreted as separate dimensions within the measurement model.

Model_Fit		
	Saturated Model	Estimated Model
SRMR	0.058	0.058
d_ULS	0.404	0.404
d_G	0.245	0.245
Chi-Square	497.805	497.805
NFI	0.871	0.871

Source: Smart PLS Version 3.0

The model fit indices indicated an acceptable and well-fitting measurement model for the study. The Standardized Root Mean Square Residual (SRMR) value of 0.058 was below the recommended threshold of 0.08, confirming a good model fit. Similarly, the Normed Fit Index (NFI) value of 0.871 exceeded the minimum acceptable value of 0.80, further indicating that the model adequately represented the observed data. The d_ULS (0.404), d_G (0.245), and Chi-square (497.805) values also supported the overall consistency between the saturated and estimated models, implying that the hypothesized relationships among constructs were statistically sound. According to Hair, Hult, Ringle, and Sarstedt (2019), SRMR values below 0.08 and NFI values above 0.80 demonstrate acceptable model fitness, suggesting that the measurement model achieved a satisfactory level of structural validity.

Structural Model



Path Coefficients					
	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (O/STDEV)	P Values
Real-Time Access -> Operational Efficiency	0.243	0.241	0.077	3.162	0.002
Remote Collaboration -> Operational Efficiency	0.550	0.552	0.070	7.829	0.000

Source: Smart PLS Version 3.0

The path coefficient results revealed that both dimensions of cloud-based data accessibility real-time access and remote collaboration had significant positive effects on operational efficiency of SMEs in Abuja, Nigeria. Specifically, real-time access ($\beta = 0.243$, $t = 3.162$, $p = 0.002$) indicated a statistically significant contribution to operational efficiency, implying that instant access to data enhances timely decision-making, productivity, and process optimization within SMEs. Similarly, remote collaboration ($\beta = 0.550$, $t = 7.829$, $p = 0.000$) showed a stronger and highly significant effect, suggesting that seamless teamwork and information sharing through cloud-based systems greatly improve coordination, innovation, and performance outcomes. Since both p-values were below the 0.05 significance level, the hypothesized relationships were supported. These findings align with Hair, Hult, Ringle, and Sarstedt (2019), who emphasized that significant path coefficients demonstrate the strength and relevance of predictive relationships in structural equation modelling, confirming that cloud-based data accessibility substantially enhances operational efficiency among SMEs.

R Square		
	R Square	R Square Adjusted
Operational Efficiency	0.559	0.557

Source: Smart PLS Version 3.0

The R Square value of 0.559 indicates that Real-Time Access and Remote Collaboration jointly explain about 55.9% of the variance in Operational Efficiency among SMEs in Abuja. This represents a substantial level of explanatory power in social science research, aligning with Hair et al.'s (2021) classification that values around 0.50 are considered moderate to strong within PLS-SEM models. The adjusted R Square of 0.557 further confirms the stability of the model by accounting for the number of predictors, showing only a minimal reduction from the unadjusted value. Overall, these results suggest that cloud-based data accessibility captured through real-time access and remote collaboration plays a meaningful and significant role in shaping operational efficiency.

F Square			
	Operational Efficiency	Real-Time Access	Remote Collaboration
Operational Efficiency			
Real-Time Access	0.060		
Remote Collaboration	0.310		

Source: Smart PLS Version 3.0

The f-square results show the relative contribution of each predictor to Operational Efficiency, revealing differing effect strengths. Remote Collaboration has an f^2 value of 0.310, which, according to Cohen's (1988) criteria and reaffirmed by Hair et al. (2021), represents a medium to large effect, indicating that it is a substantial driver of operational efficiency among SMEs. In contrast, Real-Time Access has an f^2 value of 0.060, which falls within the small effect range, suggesting that although it contributes meaningfully to operational efficiency, its impact is considerably weaker than that of remote collaboration. Overall, these findings highlight that both cloud-based capabilities matter, but remote collaboration exerts a more pronounced influence on improving SME operational performance.

PLS				
	RMSE	MAE	MAPE	Q ² _predict
OE1	0.822	0.628	23.744	0.450
OE2	0.849	0.620	23.236	0.358
OE3	0.947	0.703	28.841	0.292
OE4	0.805	0.599	22.714	0.441
OE5	0.782	0.608	21.599	0.446

Source: Smart PLS Version 3.0

The PLS predictive assessment shows that the model demonstrates strong predictive relevance for Operational Efficiency, as indicated by the positive Q²_predict values for all indicators, ranging from 0.292 to 0.450. According to Hair et al. (2021), Q² values above zero confirm that the model has meaningful out-of-sample predictive power. The RMSE and MAE values remain within acceptable ranges across the five indicators, suggesting consistent prediction errors without signs of substantial model bias. Likewise, the MAPE values, which fall between 21.599 and 28.841, indicate moderate prediction accuracy, aligning with common thresholds in social science predictive modeling. Overall, the combination of positive Q², reasonable RMSE and MAE levels, and manageable MAPE values confirms that the model possesses adequate predictive strength and reliability in forecasting operational efficiency outcomes among SMEs.

Discussion of Findings

From the analysis, it became clear that real-time access to cloud-based data played a significant role in improving the operational efficiency of SMEs in Abuja, Nigeria. This finding aligns with the conclusions of Mkhize, Mokhothu et al. (2025), whose systematic review showed that cloud computing supports real-time data analytics that help SMEs minimize downtime and improve day-to-day operations. Ekawaty et al. (2025) similarly observed that cloud computing and data analytics streamline business processes, strengthen data-driven decision-making, and enhance overall firm performance. In the Nigerian SME context, having immediate access to accurate business data allows managers and employees to make decisions more quickly, monitor inventory in real time, track important performance indicators, and respond swiftly to changes in customer behaviour or market conditions. These advantages translate into cost savings by reducing operational delays, errors, and redundancies and into process improvements, as workflows become more automated, better coordinated, and easier to manage. Consistent with the Resource-Based View (RBV), real-time cloud access can be considered a strategic resource: it is valuable because it improves responsiveness; rare because many SMEs still depend on manual systems; difficult to imitate due to the specialized infrastructure and expertise required; and non-substitutable since no alternative provides the same level of immediate, reliable access to data. When effectively implemented, this capability strengthens SMEs' internal operations, helps them maintain a competitive edge, and supports efficient functioning even in environments where infrastructure is weak and information gaps are common.

The analysis also showed that remote collaboration through cloud-based systems significantly improved the operational efficiency of SMEs in Abuja. This finding is consistent with Hamdat et al. (2024), who found out that MIS significantly improves decision-making by providing timely, accurate, and relevant information, leading to greater organizational agility, accuracy, and speed. Similarly, Soleman (2025) and Odukoya (2024) emphasized that cloud platforms promote cross-functional collaboration and support flexible work arrangements through scalable solutions such as SaaS and PaaS, which strengthen team coordination and improve stakeholder engagement. For SMEs in Abuja, remote collaboration tools reduce the need for physical meetings, allow continuous communication between staff, clients, and partners, and speed up decision-making processes especially during periods of infrastructural challenges, mobility restrictions, or public health disruptions. These tools also help reduce operational costs by lowering travel and meeting expenses, while improving processes through faster information sharing, joint problem-solving, and more aligned task execution. Within the RBV lens, cloud-based remote collaboration also meets the VRIN criteria: it is valuable because it increases organizational flexibility; rare because many SMEs in Abuja have not fully adopted collaborative cloud tools; inimitable because effective collaboration requires a unique blend of technology, skills, and organizational routines; and non-substitutable because traditional

communication channels cannot provide the same level of efficiency or scalability. As a strategic capability, cloud-enabled collaboration helps SMEs better coordinate their resources, reduce communication and coordination costs, improve workflow integration, and achieve stronger operational outcomes contributing to long-term competitiveness, resilience, and sustainable performance.

Conclusion and Recommendation

This paper has analysed how availability of cloud-based data affects the productivity of SMEs in Abuja, Nigeria, focusing on its aspects, which are real-time access and remote collaboration. The results showed that the accessibility of data on the cloud was critical in increasing the level of operation by accelerating the speed of decision-making, resource utilization, and coordination of workflow. Particularly, access to the cloud-based information in real-time enhanced operational efficiency greatly as it helps to get timely and valid information, minimize time loss, and provide quicker responses in business. Similarly, remote cooperation based on cloud-based systems produced a positive impact to the operation efficiency significantly, because the ability to communicate and work in synchrony with the colleagues despite the geographical location increased flexibility, innovativeness, and productivity. In general, the research determined that SMEs that embraced and properly leveraged cloud-based solutions had better chances of attaining greater operational efficiency, sustainability in terms of competitiveness, and performance in the dynamic digital business world.

Based on the findings and conclusions of this study, several practical recommendations were proposed to help SMEs, policymakers, and technology stakeholders strengthen cloud-based data accessibility and improve operational efficiency.

- i. SMEs ought to invest in sound and safe cloud infrastructure that can be used to access data in real time. This involves selecting cloud service providers that have good uptime history, sufficient storage space as well as high security levels. This would make SMEs have a faster and more precise decision-making process, minimize delays due to manual operations, and enhance general speed and quality of operations.
- ii. It would also be advisable that SMEs embrace cloud-based teamwork tools that facilitate collaboration with any individual in a team no matter the physical location. Tools that facilitate collective documents, online conferences, and real-time communication may assist the groups to remain connected, work more effectively, and react to customer demands promptly. This will not only lead to a better coordination of operations, but also the innovation and flexibility characteristics that are being demanded in the contemporary business world which is dynamic.
- iii. The SMEs ought to focus on digital literacy and cybersecurity training to its employees. A high number of businesses cannot get the maximum out of cloud technology because of a lack of technical knowledge or ineffective cybersecurity.

Basic cloud training, data safety, password security, and secure Internet use can help considerably to minimize the risks and boost the confidence in using online tools.

- iv. The regulators and policy makers ought to develop enabling policies and incentives that would enable more SMEs to adopt cloud technology at a lower cost. This can be through tax credits on digital investment, subsidized broadband or national digital literacy programs. Clear regulatory guidelines on data privacy and cloud security would also promote the uptake of cloud services with more confidence and adoption by the SMEs.

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