

A Systematic Review of Data Management Practices in Cloud systems: Challenges and Opportunities for Businesses in Kenya

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ABSTRACT

This study reviews how businesses in Kenya manage data in cloud systems, examining the challenges and opportunities they face. The research used the PRISMA methodology to analyze academic literature from 2011 to 2026, drawing on Google Scholar, the ACM Digital Library, and IEEE Xplore. It also considered policy documents from Kenyan regulatory bodies to contextualize the findings. Guided by the Technology-Organization-Environment (TOE) framework, the review focused on four main areas: cloud adoption and data management, challenges in cloud data management, opportunities for improvement and digital transformation, and regulatory and governance issues. The results show that while Kenyan businesses are adopting cloud computing, they still face cybersecurity risks, limited ICT infrastructure, a shortage of skilled workers, regulatory uncertainty, and concerns about data sovereignty and privacy. The study also found that Kenya's Data Protection Act (2019) and related ICT policies have had a strong impact on how organizations manage their data.

Keywords: Cloud Computing, TOE, Data Management, PRISMA, Data Protection Act

INTRODUCTION

Cloud computing has become an important part of modern information technology, changing how organizations handle and use computing resources. Around the world, more organizations are using cloud systems to process, manage, and securely store large amounts of data. Mell and Grance (2011) describe cloud computing as a model that gives easy, on-demand access to shared resources that can be quickly set up or released. In practice, this means organizations can get the resources they need without spending heavily on physical infrastructure. As a result, cloud computing helps organizations become more flexible, reduce costs, and encourage innovation.

In developing countries, cloud computing is helping drive digital transformation and economic growth. It offers clear benefits over traditional computing, including lower costs, scalability, and easier access, which help businesses innovate, improve services, and support sustainable development (Oredo & Dennehy, 2023; Jayeola et al., 2022; Avram, 2014). In Africa, especially East Africa, organizations are turning to cloud technologies to boost competitiveness and service quality. This trend is fueled by the fast growth of the digital economy, the rise of mobile money platforms like M-Pesa, widespread internet access, and supportive ICT policies that build trust in cloud solutions (Odun-Ayo et al., 2021; Ministry of Information, Communications, and the Digital Economy, 2024). These factors together create a strong environment for innovation and digital transformation in Kenya.

With Kenya's growing economy, cloud computing gives businesses new opportunities to innovate, grow, and accelerate digital transformation. Cloud systems enable companies to monitor their operations in real time, automatically adjust to changes in demand, and leverage edge computing for fast data processing (Adane, 2018). They also make it easier to use advanced technologies like artificial intelligence and analytics, helping businesses make better decisions while saving on infrastructure costs.

Even as more organizations use cloud computing, managing data effectively is still difficult. Cloud data management covers storage, security, governance, backup and recovery, following regulations, access control, and managing data throughout its life cycle (Banerjee, 2024). Doing these tasks well is essential for meeting

legal requirements, protecting data from threats, and ensuring data is reliable and secure, which is important for business stability and trust.

Kenyan businesses continue to face operational and oversight challenges that make managing data in the cloud difficult. Compared to more developed countries, Kenya deals with unique cybersecurity risks, limited ICT infrastructure, not enough technical experts, few local cloud providers, dependence on international vendors, unreliable internet, data protection concerns, and regulatory compliance challenges. The Kenya Data Protection Act (2019) sets legal rules for processing, storing, and transferring data, as well as protecting people's rights. Organizations using cloud services must make sure their data management practices follow these laws to stay compliant and keep sensitive information secure.

In summary, cloud computing offers many opportunities for developing countries like Kenya, but there is still limited research on how data is managed in cloud systems (Oredo & Dennehy, 2023). This review examines data management practices in cloud systems and looks at the specific opportunities and challenges faced by Kenyan businesses. By bringing together academic research and policy documents, the study provides a thorough analysis of cloud data governance in Kenya. Reviewing the literature, regulations, and technical standards, the study offers insights to help businesses improve their cloud data management and achieve secure, compliant, and sustainable digital transformation in Kenya.

The review was guided by the following research questions;

- RQ1: What data management practices are currently adopted by businesses in Kenya in cloud computing environments?
- RQ2: What are the main challenges that constrain effective cloud data management for Kenyan enterprises?
- RQ3: What opportunities exist for businesses in Kenya to improve their cloud data management practices?
- RQ4: How do regulatory systems, particularly the Kenya Data Protection Act (2019), influence cloud data governance outcomes?

This review used the Technology-Organization-Environment (TOE) framework to examine the factors that influence effective cloud data management. Developed by Tornatzky and Fleischer (1990), the TOE framework provides a multi-level model to understand how organizations adopt new technologies. According to TOE, technological innovation is driven by three key factors: technological, organizational, and environmental (Merlo et al., 2025). The technological factors comprise internal and external technologies available to the organization. The organizational context considers factors such as company size, management structure, and resource capacity. The environmental context considers the competitive environment, regulatory systems, and industry-specific characteristics (M'rhaouarh et al., 2018).

When applied to cloud data management in Kenya, the TOE framework provides a structured way of analyzing cloud computing adoption through its three lenses. First, the technological component assesses the availability and quality of cloud infrastructure, including hardware, software, and network capabilities that enable optimal data storage and processing (Njenga et al., 2019; Senyo et al., 2016). Second, the organizational component assesses the organization's skills, expertise, and overall preparedness to adopt and use cloud technologies efficiently. This includes managerial support, staff training, and resource provisioning to ensure successful implementation (M'rhaouarh et al., 2018; Njenga et al., 2019). Third, the environmental component examines the regulatory environment, which comprises laws (Kenya Data Protection Act 2019), policies (Kenya Cloud Policy 2025), and standards governing data security and privacy (ICT Authority cloud standard), as well as competitive pressures from industry rivals that can influence an organization's motivation to adopt cloud solutions and innovate.

Together, these factors drive the effectiveness of cloud data management in Kenya, affecting the extent of adoption, security, and operational functionality (M'rhaouarh et al., 2018; Senyo et al., 2016). The TOE

framework, therefore, provides a basis for synthesizing findings from the heterogeneous literature reviewed in this study and for identifying the obstacles and potentials for Kenyan businesses.

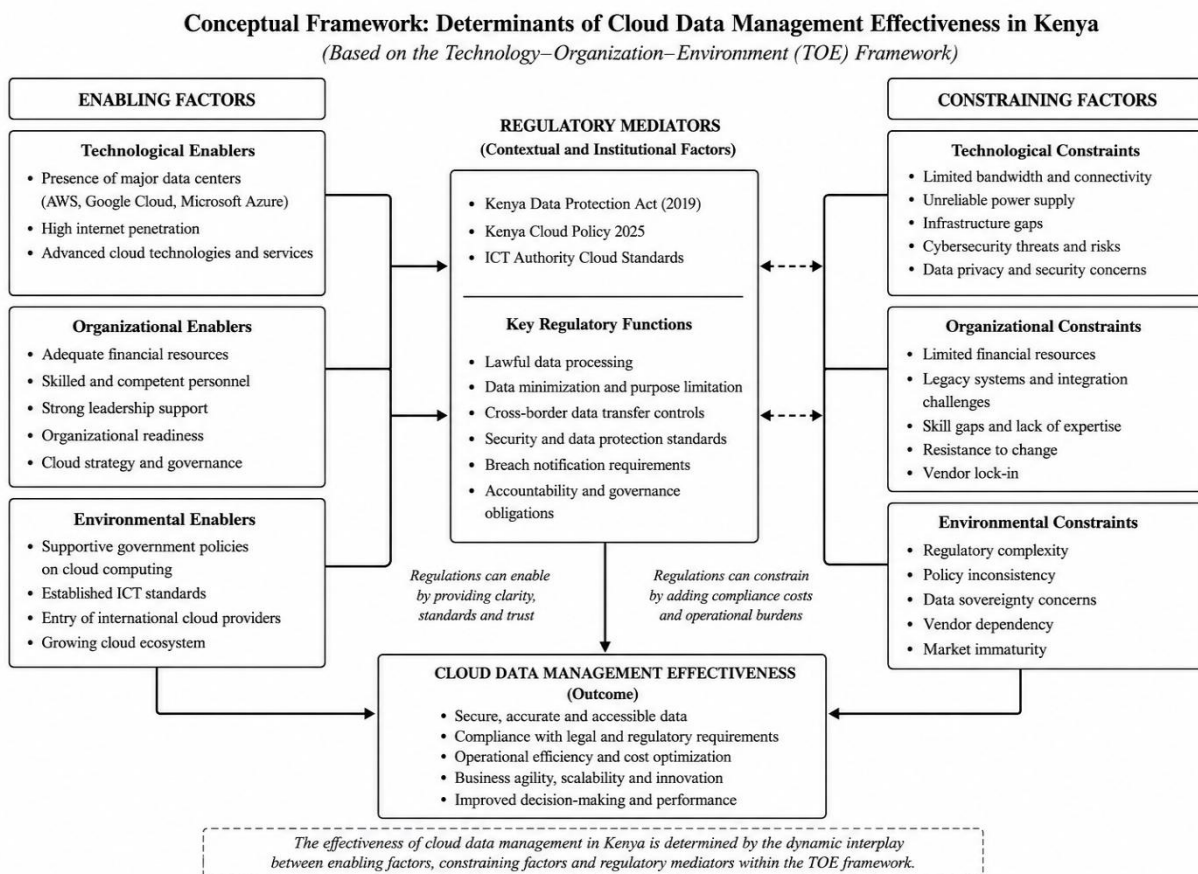
Using the TOE framework, this review's conceptual model interprets cloud data management effectiveness as the outcome of complicated interactions among three key domains: enabling factors, constraining factors, and regulatory factors. In Kenya, enabling technological factors include prominent public and private data centers such as AWS, Google Cloud, and Microsoft Azure, complemented by high internet penetration rates that facilitate widespread connectivity. Organizational enabling factors comprise sufficient financial resources, skilled personnel, and strong leadership support, all of which are essential for adopting and maintaining effective cloud solutions. Environmental enabling factors include government policies on cloud computing, established ICT standards, and the entry of international cloud providers into the local market, which together create a favorable environment for cloud growth.

Similarly, constraining factors pose major obstacles to efficient cloud data management. These include infrastructure issues such as limited bandwidth and unstable power supplies; organizational obstacles such as resource limitations, outdated legacy systems, and staff skill shortages; and environmental issues such as complex regulations, vendor lock-in, and cybersecurity threats that jeopardize data security and functional agility.

Regulatory factors such as the Kenya Data Protection Act (2019), the Kenya Cloud Policy 2025, and the ICT Authority Cloud Standards help shape the interactions between enabling and restricting forces. These regulations set requirements for lawful data processing, data limitation, controls on cross-border data transfers, security standards, and breach notification protocols.

Although these regulations are meant to improve data governance, they can also add costs and create challenges for businesses that already have limited resources. In Kenya, how well cloud data management works depends on how these factors interact, with regulations playing a central role that can either boost or prevent progress, depending on how they are designed and implemented.

Figure 1: Conceptual framework



METHODOLOGY

This study employed a systematic literature review design in accordance with PRISMA guidelines. PRISMA provides a well-defined framework for identifying, screening, selecting, and synthesizing scholarly literature to ensure methodological transparency, replicability, and quality assurance (Page et al., 2021).

An extensive search was conducted in three academic databases, namely the IEEE Xplore Digital Library, Google Scholar, and ACM Digital Library. These databases contain peer-reviewed literature on cloud computing and data management. The search took place in April 2026 and covered publications from January 2011 to March 2026, a 15-year period aligned with the rise of mainstream cloud computing and the evolution of Kenya's digital economy.

The following search string was used to sort literature in all three databases:

("cloud computing" OR "cloud data management" OR "cloud storage" OR "cloud services") AND ("Kenya" OR "East Africa" OR "sub-Saharan Africa" OR "developing countries") AND ("data management" OR "data governance" OR "data security" OR "data protection" OR "cloud adoption")

In addition to scholarly resources, policy documents such as the Data Protection Act 2019, the Kenya Cloud Policy 2025, the National ICT Masterplan 2022–2032, the ICTA cloud computing standard, and associated regulations were retrieved from the official Kenyan government websites of the Communication Authority (ca.go.ke), the ICT Authority (icta.go.ke), the Office of the Data Protection Commissioner (odpc.go.ke) and the Ministry of Information, Communication, and the Digital Economy (ict.go.ke).

The studies included matched the following criteria: (1) were published between January 2011 and April 2026; (2) were peer-reviewed articles, conference papers, or official policy documents; (3) addressed cloud computing, data management, or data governance in Kenya, East Africa, sub-Saharan Africa, or developing countries; (4) were written in English; and (5) addressed at least one of the four research questions.

The studies were excluded if they: (1) focused exclusively on technical cloud infrastructure without governance or data management implications; (2) were limited to sectors unrelated to business; (3) were duplicate publications; or (4) lacked accessible full text.

Table 1 presents the PRISMA flow diagram summarizing the study selection process.

Table 1. PRISMA 2020 Study Selection Flow

Phase	Action	Records (n)	Cumulative Total
Identification	Records identified via IEEE Xplore	45	45
	Records identified via Google Scholar	140	185
	Records identified via ACM Digital Library	35	220
	Policy documents (MICDE, CA, ICTA, ODPC)	18	238
Screening	Duplicates removed	-62	176
	Records screened (title/abstract)	176	176
	Records excluded (irrelevant)	-112	64
Eligibility	Full-text articles assessed for eligibility	64	64

	Full-text excluded (outside scope)	-42	22
Included	Studies included in the final synthesis	22	22

Two independent reviewers collected data using a structured template that included the author, year, source, theories, methods, context, main findings, and how each study related to the research questions. If they disagreed, they discussed to reach an agreement. The reviewers used a thematic synthesis approach to find and develop key themes from the data. These themes were first developed based on the research questions and then refined using the TOE theory.

FINDINGS

Based on the thematic analysis, the findings were grouped into four themes as shown in Table 2.

Table 2. Summary of thematic findings

Theme	Sub-themes	Key Sources
1. Cloud data management practices by businesses in Kenya	Data backup and recovery Virtualization and resource sharing Access control and authentication Data analytics and automation Hybrid cloud adoption	Adane, M. (2018). M’rhaouarh et al. (2018) Oredo et al. (2019) Senyo & Addae (2016) Wachanga & Ndiege (2018) Mhlongo et al. (2024) Odun-Ayo et al. (2021)
2. Challenges constraining effective cloud data management	Cybersecurity threats Data privacy and confidentiality concerns Regulatory compliance challenges Infrastructure limitations Skills and expertise gaps Data sovereignty concerns Cost and vendor lock-in	Avram, M. G. (2014). Communications Authority of Kenya. (2020). Banerjee, S. (2024). Jamsheed, J. T., & deRham, Z. P. (2023). Sithole & Ruhode (2021). Jayeola et al. (2022) Makena, J. (2013) Mhlongo et al., (2024) Mwavali, A. (2021)
3. Opportunities for optimizing cloud data management practices	Digital transformation Scalability and flexibility	Wachanga & Ndiege (2018). Munene, Z. W. (2017).

	Artificial intelligence, big data, and advanced analytics integration Business continuity and disaster recovery Remote work and collaboration	Oredo, J., & Dennehy, D. (2023). Mhlongo et al., (2024) Njenga et al., (2019)
4. Regulatory Frameworks and Cloud Data Governance	Kenya Data Protection Act (2019) Kenya Cloud Policy (2025) ICTA Cloud Computing Standard (2023) Kenya’s National ICT policy guidelines (2020)	Kenya Law. (2019). Ministry of Information, Communications, and the Digital Economy. (2024). ICT Authority. (2023). Communications Authority of Kenya. (2020)

Cloud data management practices by businesses in Kenya

The reviewed studies show that Kenyan businesses are progressively adopting cloud-based data management solutions, especially in telecommunications, banking, education, and small and medium-sized enterprises (SMEs). Cloud systems are mostly used in data backup and recovery, which ensures business continuity and reduces data loss. Adane (2018) and Wachanga and Ndiege (2018) note that organizations often use cloud storage services to automate backups, allowing faster disaster recovery and strengthening operational resilience.

Another key practice is virtualization and resource sharing. Businesses use cloud systems to optimize computing resources, saving on hardware costs. M’rhaouarh et al. (2018) and Senyo and Addae (2016) highlight that virtualization enables scalability and efficient workload distribution, especially benefiting SMEs with limited ICT budgets. This strategy improves resource handling and strengthens flexibility in meeting varying business demands.

There has also been a noticeable increase in the adoption of cloud-based access control and authentication mechanisms. These security practices respond to rising remote-access data breaches, as noted by Oredo et al. (2019). Applying strong access controls protects sensitive business data and enables secure remote operations, which are increasingly important today.

Data analytics and automation powered by cloud platforms have grown to be strategic assets for businesses. The literature shows organizations use these capabilities to process large data volumes and generate instant insights, supporting knowledgeable decision-making (Jamsheed & deRham, 2023). This trend is prominent in fintech, where rapid data analysis offers a competitive advantage and improves customer service.

Hybrid cloud adoption has gained momentum, especially following the enactment of the Kenya Data Protection Plan. Medium and large enterprises increasingly favor hybrid models to balance on-premises control with the cloud's scalability and flexibility. This approach helps organizations comply with regulations while optimizing IT infrastructure (Kenya Law, 2019; Ministry of Information, Communications, and the Digital Economy, 2024).

Challenges constraining effective cloud data management

The review identified several interrelated challenges hindering effective cloud data management in Kenyan businesses. A primary concern is cybersecurity threats. Avram (2014) and Banerjee (2024) emphasize that cloud environments expand the attack surface, increasing vulnerability if proper security controls are lacking. Data privacy and confidentiality concerns, especially in finance and telecommunications, are closely related

(Banerjee, 2024). Jamsheed and deRham (2023) report that many businesses remain uncertain about how cloud providers handle and secure their data.

Regulatory compliance is also a major challenge to small and medium-sized businesses, which struggle to align cloud practices with evolving legal frameworks (Oredo et al., 2019). Jamsheed and deRham (2023) note that ambiguity and uncertainty about compliance often delay cloud migration decisions. Infrastructure limitations such as unreliable internet, limited data centers, and unstable electricity are significant hindrances in Kenya, especially in secondary towns. These challenges constrain cloud performance and accessibility, particularly in rural and peri-urban areas (Mwavali, 2021; Sithole & Ruhode, 2021).

The literature also highlighted a skills and expertise gap, where businesses struggle to find adequately trained cloud professionals to manage complex cloud environments (Mhlongo et al., 2024; Ministry of Information, Communications, and the Digital Economy, 2024). This challenge contributes to increased security risks, poor configurations, and inefficient use of resources, among other issues (Wachanga & Ndiege, 2018).

The enactment of the Kenya Data Protection Act raised concerns about data sovereignty, emphasizing where citizens' data is stored and managed (Ministry of Information, Communications, and the Digital Economy, 2024). As a result, businesses are reconsidering the use of cloud systems to avoid potential legal complications.

Finally, costs and vendor lock-in are among the major challenges for using cloud systems over the long term. Many businesses worry about relying too much on one cloud provider, which can reduce their flexibility and bargaining power. Unexpected increases in operational costs can also make planning difficult and raise the total cost of ownership. These issues show that structural and governance barriers still limit the full benefits of cloud systems in Kenya.

Opportunities for optimizing cloud data management practices

Despite the data management challenges businesses face when leveraging cloud-based systems, the literature also highlights substantial opportunities to improve cloud data management in Kenyan businesses. A key opportunity lies in digital transformation, where cloud computing services serve as a foundational enabler of modernizing business operations and service delivery. Wachanga and Ndiege (2018) argue that cloud adoption accelerates organizational efficiency and innovation in business enterprises. The Kenyan Ministry of ICT encourages businesses to leverage cloud systems to provision their ICT infrastructure needs without making substantial capital investment. This is beneficial for growing enterprises and seasonal businesses.

Another noteworthy opportunity highlighted in the literature review is the integration of cloud systems with advanced technologies to enhance data processing and decision-making (Banerjee, 2024). The cloud also promotes business continuity and disaster recovery for businesses that may experience system failures and cyber incidents.

With global shifts in workplace models that introduced remote work and virtual collaboration, cloud systems are useful for businesses today. Studies claim that cloud platforms enable geographically distributed teams to collaborate efficiently and securely, highlighting an opportunity to leverage cloud systems in data management.

Regulatory Frameworks and Cloud Data Governance

The review showed that Kenya has made considerable progress in establishing a regulatory framework for cloud data management, though implementation and oversight challenges remain. The Kenya Data Protection Act (2019) serves as the primary authority for data governance in Kenya, providing guidelines on how businesses handle, store, and process data in cloud environments (Kenya Law, 2019). This means cloud deployments must be designed to enforce purpose limitation, data retention policies must be implemented in technical terms, and encryption and access controls must meet standards for integrity and confidentiality. This legal requirement has significantly influenced how businesses adopt and use cloud systems.

In 2024, the Ministry of Information, Communications, and the Digital Economy established the Kenya Cloud Policy (2025), which mandates a cloud-first approach for all public entity ICT investments. It establishes data

classification requirements that directly influence how organizations design cloud data management architectures. Additionally, the ICT Authority established a cloud computing standard (2023) that provides technical and operational guidelines for cloud deployments, thereby assisting the government entities and businesses in effectively adopting cloud systems. The National ICT policy Guidelines (2020) further support digital transformation by promoting ICT infrastructure development, building ICT capacity, and innovation systems. Together, these frameworks provide foundational support for businesses to leverage cloud computing.

Even though regulatory frameworks have been developed, enforcement and awareness are still uneven. Many businesses do not fully understand the regulatory requirements, and there is a gap between making policies and putting them into practice for cloud data governance.

DISCUSSION

The findings indicate that cloud computing continues to play a critical role in Kenya's digital economy, enabling businesses to improve operational efficiency, scalability, collaboration, and innovation. These findings align with the TOE framework, as the effectiveness of cloud data management in Kenya is shaped by the interplay among technological readiness, organizational/business capacity, and the broader regulatory and business environment. The increasing adoption of practices such as cloud-based backup and recovery, virtualization and resource sharing, hybrid cloud models, and cloud analytics and automation suggests that Kenyan businesses are gradually embracing cloud technologies in their strategic operations to enhance resilience and competitiveness.

Despite the benefits of cloud systems, the review highlighted persistent structural and governance challenges that constrain effective cloud data management. Cybersecurity risk, data privacy concerns, and infrastructure limitations emerged as significant hindrances to effective cloud data management. These findings suggest that technological advancements alone are insufficient without parallel investment supporting digital infrastructure. Shortage of skilled cloud professionals also emerged as a challenge affecting governance and operational efficiency. Businesses lacking adequately trained personnel experience poor configuration that may expose cloud systems to security threats. The findings reinforced the organizational dimension of the TOE framework, which emphasizes the importance of human and leadership capacity in technology adoption.

The Kenya Data Protection Act (2019) and other regulatory frameworks provide a foundation for lawful and secure cloud adoption in Kenya. These frameworks encourage businesses to strengthen their cloud adoption strategies. However, the review revealed that small and medium-sized businesses struggle to navigate the regulatory landscape, unintentionally complicating effective cloud data management. The opportunities highlighted by the review, such as integration with emerging technologies like AI and analytics, remote work and collaboration, and business continuity, suggest that cloud computing can drive sustainable economic growth if the challenges are adequately addressed.

CONCLUSION

The systematic review examined data management practices in cloud systems and explored the challenges and opportunities affecting businesses in Kenya, using the PRISMA methodology to synthesize scholarly literature and policy documents published between 2011 and 2026. The review used the TOE theoretical framework to guide the synthesis of the literature and to address the four research questions. Four thematic areas were identified, demonstrating current cloud data management practices, challenges, and opportunities for Kenyan businesses, as well as the implications of Kenyan regulatory frameworks for cloud data governance. The findings revealed that Kenyan businesses are increasingly adopting cloud-based technologies for data storage, backup, analytics, collaboration, and business continuity. However, significant challenges hinder many businesses from fully realizing the benefits of cloud systems. The review also established that cloud computing presents major opportunities for digital transformation and economic growth.

WAY FORWARD

Future research should look at how Kenyan businesses actually manage data in the cloud and explore cloud governance models for specific sectors.

CONFLICT OF INTEREST

None

NOTES TO THE EDITOR

None

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