A FRAMEWORK FOR ADOPTION OF CLOUD COMPUTING SERVICES IN UGANDA'S PUBLIC INSTITUTIONS

CASE STUDY: KAMPALA CAPITAL CITY AUTHORITY

A dissertation presented to

FACULTY OF SCIENCE

in partial fulfillment of the requirements for the award of the degree

Master of Science in Information Systems

UGANDA MARTYRS UNIVERSITY

MAYENGO Tom Kizito

2023-M312-21514

Supervisor: Sarah Hanghujja

August 2025

UGANDA MARTYRS UNIVERSITY

DIRECTORATE OF GRADUATE STUDIES, RESEARCH AND ENTERPRISE

Master's Dissertation

Declaration

I have read the rules of Uganda Martyrs University on plagiarism and academic honesty, and hereby state that this work is my own.

It has not been submitted to any other institution for another degree or qualification, either in full or in part.

Throughout the work I have acknowledged all sources used in its compilation.

I finally grant Uganda Martyrs University permission to store and reproduce this dissertation, in whole or in part, in any manner or format, which Uganda Martyrs University may deem fit.

Researcher's name: MAYENGO TOM KIZITO

Researcher's signature: ____________________

Date of submission: 29-08-2025

Submitted to the Directorate of Graduate Studies, Research and Enterprise

UGANDA MARTYRS UNIVERSITY

DIRECTORATE OF GRADUATE STUDIES, RESEARCH AND ENTERPRISE

Master's Dissertation

Approval

This dissertation has been produced under my/our supervision and submitted for examination with my/our approval as the appointed academic supervisor/s.

Name of Supervisor (1): Sarah Hanghujja

Signature of Supervisor: Hangh

Name of Supervisor (2): ______

Signature of Supervisor: ______

Date of submission: 29th / August /2025

Submitted to the Directorate of Graduate Studies, Research and Enterprise

DEDICATION

This thesis is dedicated to my family, whose unwavering support and encouragement have been the cornerstone of my academic journey. Your belief in my abilities and the sacrifices you have made have fuelled my determination to pursue and complete this research. This achievement is as much yours as it is mine, and I am profoundly grateful for your love and steadfast presence throughout this endeavour.

I also dedicate this work to my mentors and colleagues who have provided invaluable guidance and inspiration. Your insights and encouragement have been instrumental in shaping my academic and professional growth. Your willingness to share knowledge and offer support has been a beacon of light during challenging times.

To my friends and extended family, your encouragement and understanding have been a source of strength. The moments of laughter and the words of motivation have reminded me of the importance of balance and joy in the pursuit of knowledge. Your presence in my life has been a constant reminder of the community that stands behind me.

Finally, this thesis is dedicated to the broader academic community and future researchers who strive to make meaningful contributions to their fields. May this work inspire and pave the way for further exploration and innovation in the realm of cloud computing and beyond. Your dedication to advancing knowledge and seeking solutions to complex problems is what drives progress and change in our world.

ACKNOWLEDGEMENT

First and foremost, I give thanks to the Almighty God for the strength, wisdom, and guidance provided throughout this academic journey. Your grace has been my constant source of inspiration and resilience, enabling me to overcome challenges and achieve this milestone.

I would like to express my deepest gratitude to my academic advisors, mentors and supervisor for their invaluable guidance and support throughout the course of this research. Your expertise, patience, and encouragement have been instrumental in shaping this thesis and helping me navigate the challenges of academic research. Your dedication to my growth and development has been a source of inspiration and motivation.

I am also profoundly grateful to my family for their unwavering support and understanding during this journey. Your love and encouragement have been my anchor, providing me with the strength and resilience to pursue my academic goals. Thank you for standing by me through every challenge and celebrating each milestone.

To my colleagues and friends, your camaraderie and support have made this journey enjoyable and fulfilling. The discussions, collaborations, and shared experiences have enriched my academic life and broadened my perspectives. I am thankful for the friendships that have been forged and strengthened during this time.

Lastly, I extend my gratitude to the academic community and the countless individuals who have, in various ways, contributed to my academic journey. Your collective support, knowledge, and encouragement have been pivotal in achieving this milestone. This thesis is a testament to the collaborative spirit and the shared pursuit of knowledge and innovation.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

UDTR	Uganda Digital Transformation Roadmap
NIST	National Institute of Standards Technology
ICT	Information Communication Technology
UAE	Automated Teller Machines
API	United Arab Emirates
ISO	International Organization for Standardization
NITA-U	National Information Technology Authority Uganda
TOE	Technology-Organization-Environment
TAM	Technology Acceptance Model
DOI	Diffusion of Innovations
UTAUT	Unified Theory of Acceptance and Use of Technology
MDAs	Ministries, Departments, and Agencies
DDA	Dubai Digital Authority
KCCA	Kampala Capital City Authority
GSMA	Global System for Mobile Communications Association
KOICA	Korean International Cooperation Agency
MoICT&NG	Ministry of Information Communication Technology and National Guidance
UCC	Uganda Communications Commission
SPSS	Statistical Package for the Social Sciences
CCA	Cloud Computing Adoption
IDC	International Data Cooperation
GDPR	General Data Protection Regulation
UBOS	Uganda Bureau of Statistics
IBM	International Business Machines Corporation
VIF	Variance Inflation Factor
CVI	Content Validity Index
CSFs	Critical Success Factors
EFs	Existing Frameworks

DEFINITION OF KEY TERMS

Cloud Computing

A model that enables on-demand access to shared computing resources, such as servers, storage, and applications, over the internet, allowing organizations to enhance scalability and efficiency without investing in extensive hardware infrastructure (Smith et al., 2018).

Digital Transformation

The integration of digital technology into all areas of an organization, fundamentally changing how it operates and delivers value to stakeholders (Baker, 2020). For public institutions like KCCA, digital transformation is key to modernizing service delivery and meeting growing urban demands (UCC, 2022).

Technology-Organization-Environment (TOE) Framework

A theoretical model that examines how technological, organizational, and environmental factors influence an organization's decision to adopt new technology (Bibri & Krogstie, 2019). The framework serves as a foundation for evaluating KCCA's readiness for cloud adoption.

Data Security

Measures and protocols implemented to protect digital information from unauthorized access, breaches, and theft. In cloud computing, data security is crucial to ensuring confidentiality, integrity, and availability, particularly in sectors managing sensitive public information, such as KCCA (Nabukenya, 2023).

Hybrid Cloud

A computing environment that combines on-premises infrastructure (private cloud) with public cloud services, allowing data and applications to be shared between them. This model is particularly relevant for KCCA as it enables retention of sensitive data on local servers while leveraging public cloud resources for scalable operations (NITA-U, 2023).

Interoperability

The ability of different information systems, devices, and applications to access, exchange, and use data in a coordinated manner. For KCCA, interoperability between cloud platforms and existing legacy systems is critical for seamless service delivery and data integration across departments (MoICT&NG, 2024).

ABSTRACT

This thesis presents a comprehensive framework for the adoption of cloud computing services within public institutions, with a focus on Kampala Capital City Authority (KCCA) in Uganda. The study integrates theoretical insights from established models such as TOE, DOI, and TAM to evaluate the multifaceted dynamics of technology adoption. Empirical data and expert opinions validate the framework's practical applicability, highlighting its potential to enhance operational efficiency, data security, and service delivery.

The Structural Equation Model (SEM) evaluation revealed strong positive relationships between key components of the framework—technological readiness (coefficient of 0.41), organizational preparedness (coefficient of 0.33), regulatory and security factors (coefficient of 0.18), and perceived benefits and risks—and the level of cloud computing adoption. The research employed a mixed-methods approach, combining quantitative surveys and qualitative interviews to assess technological readiness, organizational preparedness, and regulatory and security factors, and perceived benefits and risks.

Findings indicate that technological readiness is the most critical driver of successful cloud adoption, underscoring the necessity of robust IT infrastructure and technical capabilities. Organizational preparedness and regulatory factors also play significant roles, with leadership commitment, staff training, and compliance measures being crucial for a smooth transition to cloud services. The prototype testing phase demonstrated the framework's effectiveness in integrating these components, receiving positive feedback from IT staff, department heads, policymakers, and technical consultants.

The study addresses the urgent need for scalable, secure, and efficient IT infrastructure to manage urban growth and service demands in Kampala. By proposing a tailored framework for cloud computing adoption, this research provides actionable solutions to overcome technological, organizational, and regulatory barriers. The framework's potential to drive digital transformation and enhance operational efficiency, data security, and service delivery is underscored by empirical data, expert opinions, and prototype testing. Ultimately, this thesis contributes to the broader digital transformation ambitions in Uganda, offering a robust and effective tool for public institutions to transition to cloud services.

CHAPTER ONE

GENERAL INTRODUCTION

This chapter presents a comprehensive overview of the study that aims to design a framework for adoption of cloud computing services within public institutions in Uganda using, a case study of Kampala Capital City Authority (KCCA). This is digested through; the background of the study, problem statement, objectives of the study, research questions, study significance, study justification, scope of the study, and thesis outline.

1.1 Background of Study

1.1.1 Historical Background

Cloud computing emerged as a transformative paradigm in the early 2000s, fundamentally reshaping how organizations manage and deploy IT resources. The National Institute of Standards and Technology (NIST) formally defined cloud computing in 2011, establishing its five essential characteristics: on-demand self-service, broad network access, resource pooling, rapid elasticity, and measured service (Mell & Grance, 2016). This technological shift gained significant traction in the public sector globally, with governments recognizing its potential to enhance operational efficiency and service delivery.

Estonia stands out as a pioneer, having implemented its X-Road data exchange layer as early as 2001, which by 2023 supported over 3,000 digital services and facilitated 99% of government transactions being conducted online (Hardy, 2024). Similarly, the United Arab Emirates' "Smart Dubai" initiative achieved remarkable success, migrating 90% of government workloads to cloud platforms by 2025 and reducing service delivery times by an average of 40% (Dubai Digital Authority, 2025). These examples demonstrate cloud computing's capacity to drive substantial cost savings while improving governance outcomes.

In the African context, cloud adoption has progressed more gradually due to persistent infrastructural and regulatory challenges. Recent data from the Global System for Mobile Communications Association (GSMA) reveals that average broadband speeds in sub-Saharan Africa reached just 10 Mbps in 2023, significantly below the global average of 67 Mbps (GSM, 2023). Despite these constraints, several African nations have made notable strides in cloud adoption. Kenya's "Cloud First" policy, implemented in 2021, and Rwanda's Irembo e-government platform have both achieved approximately 35% migration of government workloads to cloud systems by 2024 (World Bank, 2024). Uganda's Digital Transformation Strategy (2021–2025) explicitly prioritizes cloud computing as a key enabler of public sector modernization, with specific targets to migrate 50% of central government services to hybrid cloud models by 2025 (NITA-U, 2023). This strategic focus reflects growing recognition of cloud technology's potential to address persistent challenges in government service delivery.

For public institutions like KCCA, the limitations of legacy IT systems have become increasingly apparent amidst rapid urban growth and escalating demands for efficient service delivery. Recent studies indicate that outdated systems contribute to operational inefficiencies, including prolonged service processing times and limited data accessibility. According to a 2023 ICT readiness assessment by the National Information Technology Authority (NITA-U), over 60% of local government authorities, including KCCA, continue to rely on fragmented, on-premises systems, resulting in slower service delivery compared to regional digital leaders such as Nairobi City County (NITA-U, 2023).

Furthermore, Kampala’s urban growth places increasing strain on these systems, reinforcing the urgent need for scalable cloud-based solutions to improve efficiency and service delivery (MoICT&NG, 2024). Recent research on African municipal governments demonstrates that cloud adoption can yield significant improvements, including 22% reductions in operational costs and 58% enhancements in data accessibility (Abdelbasset et al., 2024). However, successful implementation in public institutions would need to address several critical challenges. Data governance remains a pressing concern, with 70% of Ugandan public institutions lacking compliant data management protocols according to (UCC, 2022). Security vulnerabilities are another key issue, as only 40% of local agencies currently meet ISO 27001 cloud security standards (NITA-U, 2024).

1.1.2 Theoretical Background

This study integrates three complementary theoretical frameworks to analyse cloud computing adoption in Uganda's public sector: the Technology-Organization-Environment (TOE) framework, Diffusion of Innovations (DOI) theory, and the Technology Acceptance Model (TAM). The TOE framework provides a structural analysis of contextual factors, examining how technological infrastructure, organizational readiness, and environmental regulations influence adoption decisions (Tornatzky & Fleischer, 1990).

Recent applications in African public sectors demonstrate its effectiveness in identifying infrastructure gaps and policy barriers, particularly relevant to legacy system challenges (Kalinaki et al., 2022). DOI theory complements this by explaining the innovation diffusion process through five key attributes: relative advantage, compatibility, complexity, trialability, and observability (Rogers et al., 2019). This is particularly pertinent for KCCA, where perceived benefits of cloud solutions must outweigh institutional resistance to change, as shown in similar municipal technology adoption cases (Nabukenya, 2023).

The Technology Acceptance Model (TAM) adds a crucial behavioural dimension by focusing on perceived usefulness and ease of use as determinants of technology adoption (Davis, 1989). Adapted for organizational contexts, TAM helps explain how KCCA staff's perceptions of cloud computing's utility and usability may accelerate or hinder adoption, as evidenced in recent studies of Ugandan public sector digital transformation (Kisambira et al., 2024). When combined with TOE's structural analysis and DOI's innovation characteristics, TAM provides a tripartite lens that captures technological, organizational, and individual-level adoption factors which are effective.

The synthesis of these frameworks offers a comprehensive approach to designing KCCA's cloud adoption strategy. TOE's environmental dimension aligns with Uganda's evolving regulatory landscape, including the Data Protection Act (2019) and emerging cloud policies (NITA-U, 2024). DOI's emphasis on observability supports phased pilot implementations to demonstrate cloud benefits, while TAM's focus on perceived usefulness informs training programs to address skill gaps. This multidimensional perspective mirrors successful approaches in comparable African cities, where integrated theoretical models have overcome similar adoption barriers (Alshamaila & Papagiannidis, 2013).

1.1.3 Contextual Background

Uganda's public sector has made gradual but measurable progress in adopting cloud computing technologies, driven by national digital transformation goals and increasing recognition of the need for modernization. The National Information Technology Authority (NITA-U) reports that as of 2024, approximately 35% of government ministries, departments, and agencies (MDAs) have migrated at least some workloads to cloud platforms, primarily email systems and document storage (NITA-U, 2024). However, adoption remains uneven across sectors, with financial institutions like the Uganda Revenue Authority leading in cloud utilization while local governments lag behind due to infrastructure constraints and limited technical capacity

(MoICT&NG, 2024). The Uganda Communications Commission notes that public sector cloud spending reached $12 million in 2023, representing a 25% increase from the previous year but still accounting for less than 10% of total government IT expenditure (UCC, 2022).

Several key initiatives are shaping Uganda's cloud computing landscape. The government's UGhub platform, officially launched in September 2021, serves as a centralized cloud-based service delivery portal that integrates 47 government services across 15 Ministries, Departments, and Agencies (MDAs) (MoICT&NG, 2024). Additionally, the National Data Centre and Disaster Recovery Site were established under the Regional Communications Infrastructure Program (RCIP), funded by the World Bank, to improve data storage, security, and processing capabilities for critical government systems (NITA-U, 2022).

Despite these advancements, significant challenges persist. A 2024 assessment by the Makerere University School of Computing identified three major barriers: inadequate broadband connectivity in 60% of government offices, cybersecurity concerns reported by 72% of IT managers, and budget constraints affecting 85% of MDAs (Kisambira et al., 2024). The same study found that only 30% of public institutions have developed formal cloud migration strategies, highlighting the need for more structured approaches to adoption.

Kampala Capital City Authority reflects both the progress and ongoing challenges of Uganda's public sector digitalization journey. While KCCA has implemented digital platforms such as the e-Citie system for revenue collection and development approvals, many of its core systems—including land management and internal document workflows—continue to operate on-premises or use legacy infrastructure with limited cloud integration (MoICT&NG, 2024). Recent pilot projects in other urban authorities demonstrate cloud computing's potential for improving urban service delivery, suggesting opportunities for KCCA to adopt similar solutions in the near future (World Bank, 2024).

However, KCCA faces unique urban governance challenges that require tailored solutions, particularly regarding data integration across departments and real-time service delivery for Kampala's rapidly growing population. The authority has emphasized digital technologies, including cloud computing, as key enablers for achieving its smart city objectives, as reflected in its participation in national digital transformation initiatives and the Smart Cities Innovation Programme spearheaded by the Ministry of ICT and National Guidance (MoICT&NG, 2024). While specific cloud migration targets have not been publicly disclosed, KCCA has expressed commitment to adopting scalable digital solutions to improve urban service delivery.

1.2 Problem Statement

Kampala Capital City Authority (KCCA) faces a persistent adoption gap: core city functions continue to run on fragmented, on-premises systems despite national directives and demonstrated public-sector benefits of cloud computing (NITA-U, 2023). Barriers driving this gap include uneven broadband connectivity, skills shortages among technical staff, budget constraints, data-protection concerns, and siloed legacy applications that are hard to integrate (Kisambira et al., 2024). The result is slow uptake rather than outright rejection of the technology—KCCA remains constrained not by the absence of cloud options, but by the absence of an adoptable path tailored to its governance, compliance, and operational realities.

The impact of this lag is material. Without elastic compute and unified data platforms, KCCA experiences longer service turnaround times, limited real-time analytics for revenue, land administration, and waste operations, and higher total cost of ownership for ageing infrastructure (UBOS, 2023). Fragmented data estates impede evidence-based decision-making and amplify cyber and continuity risks because security controls and backups are inconsistently implemented across departments (MoICT&NG, 2024). In comparative terms, peer municipalities leveraging cloud platforms report improved availability, better citizen-facing service levels, and measurable OPEX efficiencies—outcomes KCCA cannot reliably achieve on legacy stacks (World Bank, 2024).

KCCA's difficulty is not explained merely by resistance to change; it stems from the lack of a fit-for-purpose adoption model. Widely cited frameworks—TOE, DOI, and TAM—are invaluable for diagnosing readiness and explaining user behaviour, but they do not prescribe KCCA-specific migration paths, control baselines, procurement guardrails, or data-governance operating models needed for regulated public services. In short, these frameworks explain "why" and "what" influences adoption; KCCA needs a structured "how" that aligns national policy (e.g., Data Protection and Privacy Act, NITA-U standards) with city workflows, funding cycles, and risk posture (MoICT&NG, 2024).

This study therefore proposes a cloud computing adoption framework tailored to KCCA that operationalizes security, scalability, and efficiency into an implementable roadmap. The framework integrates: (i) a governance layer mapping roles, procurement and compliance to national regulations; (ii) a reference architecture favouring hybrid cloud for critical workloads, with interoperability to UGhub and the National Data Centre; (iii) a data-management blueprint covering classification, residency, retention, interoperability, and ISO 27001-aligned controls; and (iv) a phased migration and change-management plan anchored by training and KPI tracking for service levels and cost baselines. Through translating diagnostic insights from TOE/DOI/TAM into prescriptive steps, the framework enables KCCA to establish a secure, scalable, and efficient cloud estate that strengthens data management and measurably enhances service delivery.

1.3 Objectives of the Study

1.3.1 Major Objective

To design a framework that facilitates the adoption of cloud computing services within the public institutions in Uganda, with a focus on Kampala Capital City Authority (KCCA).

1.3.2 Specific Objectives

1. To evaluate the existing cloud computing frameworks within the public institutions.
2. To design a framework that facilitates the adoption of cloud computing services at Kampala Capital City Authority, Uganda.
3. To validate the framework that aims to facilitate the adoption of cloud computing at Kampala Capital City Authority, Uganda.

1.4 Research Questions

1. What are the key requirements for designing a Framework that facilitates the adoption of cloud computing services within public institutions?
2. How can a framework that facilitates the adoption of cloud computing services at Kampala Capital City Authority, Uganda be effectively designed?
3. How effective is framework that facilitates the adoption of cloud computing services at Kampala Capital City Authority, Uganda?

1.5 Scope of the Study

1.5.1 Geographical Scope

This study is geographically centered on Kampala, the capital and largest city of Uganda, specifically focusing on the Kampala Capital City Authority (KCCA). KCCA is responsible for managing Kampala's urban infrastructure, public services, and administrative functions, making it an ideal case for examining cloud computing adoption in Uganda's public sector.

With Kampala's urban population growing at approximately 4.5% annually, there is a critical need for scalable digital solutions to support sustainable urban management (UBOS, 2023).

1.5.2 Time Scope

The timeframe of this study spans from 2024 to 2025, a period marked by rapid advancements in cloud computing and digital transformation efforts in public administration. This period allows for a comprehensive examination of the evolving cloud adoption trends within KCCA, considering both global and regional influences on the public sector (Kalinaki et al., 2022).

1.5.3 Content Scope

The content scope of this research encompasses key elements essential to understanding and facilitating cloud computing adoption within KCCA. It includes evaluating the existing cloud infrastructure, identifying regulatory and security barriers, and proposing a comprehensive adoption framework tailored to KCCA's needs (Kehinde, 2022). Focus areas include technological readiness, organizational preparedness, data security measures, and compliance with Uganda's ICT policies, which are critical for effective cloud integration (UCC, 2022).

1.6 Significance of the Study

This study is significant as it provides a practical framework to guide public institutions like Kampala Capital City Authority (KCCA) in transitioning from fragmented legacy systems to secure, scalable cloud-based infrastructures, thereby improving service delivery and operational efficiency (NITA-U, 2023). For policymakers, the research offers evidence-based insights into the regulatory, infrastructural, and security challenges affecting cloud adoption, supporting more informed decision-making aligned with national strategies such as the Digital Uganda Vision (MoICT&NG, 2024). Academically, the study contributes to existing literature by integrating the TOE, DOI, and TAM frameworks to model technology adoption in an African urban governance context—filling a gap in empirical studies on ICT-enabled transformation in the Global South (Kalinaki et al., 2022).

1.7 Justification of the Study

Cloud computing offers significant benefits for public institutions, including improved scalability, reduced operational costs, enhanced data accessibility, and streamlined service delivery. In rapidly growing urban environments like Kampala, these benefits are particularly critical for improving the efficiency of services such as revenue collection, waste management, and land administration (NITA-U, 2023). Uganda's increasing focus on digital transformation through initiatives like the Digital Uganda Vision informs the timely nature of this study that provides a context-specific framework to guide KCCA and other public institutions in adopting cloud solutions that align with national digital priorities (MoICT&NG, 2024).

Despite these potential benefits, cloud computing adoption within Uganda's public sector faces considerable challenges, including limited broadband connectivity, cybersecurity risks, insufficient funding, and inadequate technical expertise (Nabukenya, 2023). The absence of clear cloud migration strategies, especially at the local government level, has slowed progress and left many institutions reliant on inefficient legacy systems. This study is therefore timely as it directly addresses these challenges by proposing a practical, evidence-based framework that accounts for technological, organizational, and regulatory factors, ultimately supporting informed cloud adoption and enhancing digital governance capacity in Uganda.

CHAPTER TWO

LITERATURE REVIEW

This chapter introduces the transformative potential of cloud computing in enhancing public institutions' efficiency, highlighting the challenges faced in its adoption within Uganda, particularly by KCCA. It sets the stage for designing a framework to overcome these barriers, aligning with global trends and Uganda's vision for digital transformation.

2.1 Level of Cloud Computing Adoption in Public Institutions in Uganda

Cloud computing adoption in Uganda's public institutions remains in its nascent stages, with a cloud adoption rate of less than 15%, compared to 23% in Kenya and 20% in Rwanda (UCC, 2022). The potential of cloud computing to revolutionize public service delivery is significant, yet institutions like Kampala Capital City Authority face multiple barriers, including limited infrastructure, regulatory challenges, and organizational resistance.

2.1.1 Current State of Cloud Computing Adoption in Public Institutions

Cloud computing adoption in Uganda's public sector is characterized by limited implementation, largely confined to pilot projects and selective applications (Kalinaki et al., 2022). Institutions like KCCA primarily rely on traditional on-premises IT systems that lack scalability, leading to inefficiencies in data management and service delivery (Muhumuza, 2023). Despite Uganda's efforts to integrate digital solutions under the Digital Uganda Vision, public institutions lag behind private sector counterparts in leveraging cloud technology.

A 2023 survey revealed that only 12% of government agencies in Uganda have adopted any form of cloud-based systems, and most of these deployments are limited to email hosting and document storage (UBOS, 2023). The lack of localized cloud infrastructure, compounded by low internet penetration in rural areas, further impedes widespread adoption (UCC, 2022). By contrast, Kenya's public institutions benefit from local data centers established by global providers like Microsoft and Google, which have spurred adoption rates (IDC, 2024).

The absence of a cohesive cloud adoption strategy in Uganda's public sector exacerbates the challenges. Fragmented decision-making and a lack of inter-agency collaboration hinder coordinated efforts to integrate cloud computing effectively (Kalinaki et al., 2022). Addressing these issues requires a clear roadmap tailored to Uganda's unique socio-economic and technological landscape. Despite these challenges, there is a growing recognition of the importance of cloud technologies for achieving efficiency and transparency in public governance. Emerging initiatives, such as partnerships between the Ugandan government and international ICT firms, signal a promising shift towards broader cloud adoption.

2.1.2 Benefits of Adopting Cloud Computing in Public Institutions

The adoption of cloud computing in public institutions offers transformative benefits, including cost savings, scalability, and improved service delivery (Bibri & Krogstie, 2019). For KCCA, cloud solutions could reduce IT operational costs by transitioning from capital expenditure on hardware to pay-as-you-go operational models, freeing up resources for other critical urban management activities (UBOS, 2023). Cloud computing also enhances scalability, enabling public institutions to handle increasing workloads without investing in additional infrastructure. This is particularly relevant for KCCA, which faces a 4.5% annual urban population growth, leading to escalating demands for public services (UCC, 2022). Scalable cloud platforms can support dynamic urban governance by facilitating efficient resource allocation and real-time data access.

Furthermore, cloud adoption can improve transparency and accountability in public service delivery. By centralizing data and enabling real-time monitoring, cloud systems enhance decision-making and minimize corruption risks, aligning with Uganda's broader governance objectives (Nabukenya, 2023). For example, implementing cloud-based waste management systems could significantly improve resource tracking and service efficiency. Finally, cloud computing fosters collaboration and innovation. Cloud platforms enable seamless data sharing and integration across departments, fostering inter-agency cooperation and innovative public service solutions. Lessons from Kenya and Rwanda highlight how collaborative cloud initiatives have bolstered e-governance, offering valuable insights for Uganda (IDC, 2024).

2.1.3 Barriers to Adopting Cloud Computing in Public Institutions

Despite its benefits, several barriers hinder the adoption of cloud computing in Uganda's public sector. Inadequate infrastructure remains a significant challenge, with unreliable electricity supply and limited broadband access impeding cloud readiness (UCC, 2022). Additionally, the absence of local data centers increases latency and raises data sovereignty concerns (Kalinaki et al., 2022). Organizational resistance to change is another critical barrier. Many public sector employees perceive cloud adoption as a threat to job security or a disruption to established workflows, limiting buy-in (Muhumuza, 2023).

Furthermore, the lack of training and awareness about cloud benefits exacerbates resistance, underscoring the need for capacity-building initiatives. Regulatory and security concerns also deter adoption. Uganda's legal framework lacks comprehensive guidelines for cloud computing, creating uncertainty around compliance and data protection (UCC, 2022). Public institutions are particularly wary of data breaches, which could compromise sensitive information and erode public trust (Nabukenya, 2023). Finally, financial constraints remain a major obstacle. Initial migration costs and recurring subscription fees make cloud adoption prohibitive for many public institutions. Exploring cost-sharing models and public-private partnerships could help mitigate these challenges.

2.2 Cloud Computing Adoption Framework Components

The successful adoption of cloud computing in public institutions requires a multidimensional framework that addresses not only technological capacity but also organizational dynamics, regulatory landscapes, and user perceptions. The Cloud Computing Adoption Framework for Public Institutions provides a comprehensive structure that integrates these factors through its foundational pillars and phased implementation approach.

2.2.1 Technological Readiness

Technological readiness is the cornerstone of cloud computing adoption, and the framework meticulously incorporates this through its Technological Readiness pillar. This pillar prioritizes essential infrastructural elements such as the establishment of local data centers, which are critical for reducing latency, ensuring compliance with data sovereignty laws, and enhancing system reliability (World Bank, 2024). Furthermore, the framework emphasizes improving reliable infrastructure, particularly stable broadband internet and electricity supply—areas where Uganda has traditionally faced significant challenges due to underdeveloped national infrastructure (GSM, 2023). The framework also highlights the integration of advanced technologies such as Artificial Intelligence (AI) and Machine Learning (ML), reflecting a progressive approach that moves beyond basic cloud storage to promote data analytics, automation, and predictive decision-making (Bibri & Krogstie, 2019). These technological prerequisites are directly linked to the Assessment Phase of the framework, where institutions like KCCA are guided to conduct in-depth evaluations of their IT infrastructure, identify existing gaps, and determine the technical feasibility of cloud adoption. By creating a phased adoption pathway—from readiness assessment to full-scale deployment—the framework ensures that public institutions systematically build their technological capabilities, closing the gap with regional leaders such as Kenya and Rwanda (IDC, 2024).

2.1.2 Organizational Preparedness

Organizational preparedness plays a pivotal role in shaping the success of cloud computing initiatives, especially in public sector environments characterized by complex bureaucratic structures and resistance to change. The Cloud Computing Adoption Framework explicitly incorporates this dimension through its Organizational Preparedness pillar, which comprises three interrelated components: leadership buy-in, staff training, and change management. Leadership buy-in is crucial for driving institutional commitment and aligning cloud strategies with organizational goals, particularly in institutions like KCCA where top-level endorsement often dictates project success (Nabukenya, 2023). The framework also addresses the pervasive skills gap in Uganda's public sector by emphasizing targeted staff training programs, ensuring that employees are equipped to handle cloud-based operations effectively (Kalinaki et al., 2022). Moreover, it recognizes the importance of structured change management to address resistance and foster an innovation-supportive culture within government agencies (Rogers et al., 2019). The framework operationalizes these aspects through both the Assessment and Pilot Phases, allowing institutions to gradually test cloud solutions, build organizational confidence, and reinforce internal capacities before moving toward full implementation. This systematic integration of organizational dynamics makes it highly adaptable to the bureaucracy in Ugandan institutions where inertia is a barrier to digital transformation (MoICT&NG, 2024).

2.1.3 Regulatory and Security Factors

Regulatory compliance and data security remain among the most significant barriers to cloud computing adoption in Uganda's public sector, given the sensitive nature of government data and the country's evolving legal frameworks. The Cloud Computing Adoption Framework comprehensively addresses these concerns through its Regulatory and Security Compliance pillar, which includes the development of robust data protection policies, stringent security protocols, and adherence to applicable regulatory standards. This pillar ensures alignment with Uganda's Data Protection and Privacy Act of 2019, as well as regional frameworks such as the African Union's Convention on Cyber Security and Personal Data Protection (UCC, 2022). The framework integrates these considerations throughout its implementation phases. During the Assessment Phase, institutions are guided to evaluate their regulatory gaps, while the Pilot and Full Adoption Phases include ongoing security assessments and compliance checks. The built-in feedback loops between these phases allow institutions to continuously refine their security and legal frameworks, adapting to emerging threats or policy changes as they arise (World Bank, 2024). This ensures not only initial compliance but also long-term sustainability in cloud adoption, particularly in high-risk areas such as financial services, land registries, and healthcare where KCCA operates (Abdelbasset et al., 2024).

2.1.4 Perceived Benefits and Risks

Perceptions regarding the benefits and risks of cloud computing are often decisive in determining the pace and extent of adoption, particularly within cautious and risk-averse public institutions. The Cloud Computing Adoption Framework addresses these subjective factors systematically by embedding them across its core structure. Through the Assessment Phase, the framework encourages broad stakeholder engagement to surface both optimism about benefits and concerns about risks such as vendor lock-in, data breaches, and operational disruptions (Muhumuza, 2023). By introducing a dedicated Pilot Phase, the framework allows institutions to test cloud solutions in low-risk, controlled environments, where practical benefits like operational efficiency and cost savings can be clearly demonstrated while minimizing exposure to unforeseen risks (Kalinaki et al., 2022). Additionally, the Full Adoption Phase is designed not as a static endpoint but as a dynamic process involving continuous monitoring and iterative improvements, further reducing risk perceptions through ongoing adaptation and learning (Baker, 2020). The framework's emphasis on measurable Key Outcomes—namely, operational efficiency, financial benefits, and data-driven governance—reinforces positive perceptions by making the advantages of cloud computing tangible and institution-specific (Nabukenya, 2023). In doing so, the framework provides not only a technical roadmap but also a psychological and managerial guide for building acceptance and trust in cloud technologies within Uganda's public sector institutions.

2.3 Existing Frameworks (EFs) for Cloud Computing Adoption

Cloud computing adoption frameworks provide structured methodologies to guide institutions in transitioning to cloud-based solutions effectively. For Uganda's public sector, existing frameworks such as the Technology-Organization-Environment (TOE) framework, Diffusion of Innovation (DOI) theory, and the Cloud Adoption Risk and Benefit Framework.

2.3.1 EF1: Technology-Organization-Environment (TOE) Framework

The TOE framework, developed by Tornatzky and Fleischer, provides a comprehensive approach to technology adoption by examining technological, organizational, and environmental factors (Bibri & Krogstie, 2019).

Strengths:

a) Holistic Approach. It integrates three critical dimensions—technology, organization, and environment—offering a balanced perspective on adoption (Kalinaki et al., 2022).
b) Scalability. Its adaptability allows application across diverse organizational sizes and industries, making it suitable for Uganda's public sector (Kalinaki et al., 2022).
c) Framework Flexibility. It can be tailored to specific institutional needs, addressing unique challenges faced by entities like KCCA (Muhumuza, 2023).

Weaknesses:

a) Limited Prescriptive Guidance. It does not provide detailed implementation steps, requiring additional methodologies for execution (Nabukenya, 2023).
b) Heavy Data Dependency. Accurate evaluation of the environmental dimension requires extensive data, which may not always be available in public institutions (UBOS, 2023).
c) Overemphasis on Readiness. It focuses heavily on pre-adoption readiness, often neglecting post-adoption challenges such as optimization (Bibri & Krogstie, 2019).

2.3.2 EF2: Diffusion of Innovation (DOI) Theory

Formulated by Everett Rogers, the DOI theory examines how innovations are adopted within social systems, focusing on factors such as relative advantage, compatibility, complexity, trialability, and observability (Rogers et al., 2019). This framework is particularly useful for understanding user perceptions and driving cultural change within organizations.

Strengths:

a) Focus on User Perception. It emphasizes user attitudes and experiences, which are critical for gaining organizational buy-in (Muhumuza, 2023).
b) Proven Applicability. Widely applied in technology adoption studies, it provides a robust foundation for analysing adoption behaviours (Kalinaki et al., 2022).
c) Incorporation of Innovation Characteristics. It highlights key attributes of cloud computing, such as scalability that influence adoption decisions (Kalinaki et al., 2022).

Weaknesses:

a) Lack of Organizational Context. It focuses on individuals rather than institutional structures, limiting its application in organizational settings (Bibri & Krogstie, 2019).
b) Limited Regulatory Focus. The theory does not address external constraints such as data privacy regulations, which are critical in Uganda's public sector (UCC, 2022).
c) Complexity in Measuring Attributes. Assessing factors like trialability and observability can be subjective and challenging in resource-limited settings (Kalinaki et al., 2022).

2.3.3 EF3: Cloud Adoption Risk and Benefit Framework

This framework evaluates cloud adoption by assessing associated risks and benefits, focusing on financial implications, security concerns, and operational efficiencies (Baker, 2020).

Strengths:

a) Cost-Benefit Analysis. It provides a structured method for evaluating financial viability, which is critical for budget-constrained public institutions (UBOS, 2023).
b) Risk Mitigation Strategies. It emphasizes identifying and addressing potential risks, enhancing trust in cloud adoption (Kalinaki et al., 2022).
c) Focus on Decision-Making. It supports evidence-based decision-making by quantifying both risks and benefits (Bibri & Krogstie, 2019).

Weaknesses:

a) Limited Scope. It primarily addresses financial and security concerns, overlooking organizational and environmental factors (UCC, 2022).
b) Static Framework. It lacks adaptability for dynamic environments, where emerging technologies continually reshape the cloud landscape (IDC, 2024).
c) Absence of Cultural Considerations. It does not account for institutional culture or employee resistance, critical barriers in Uganda's public institutions (Nabukenya, 2023).

2.3.4 EF4: Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM), developed by (Davis, 1989), explains technology adoption by focusing on user attitudes, specifically perceived usefulness and perceived ease of use. It has been widely applied to study technology adoption across various organizational contexts, including the public sector.

Strengths:

a) TAM effectively captures the role of user perceptions in technology adoption, making it suitable for assessing staff attitudes toward cloud computing (Kalinaki et al., 2022).
b) The model is easy to implement and interpret, offering clear insights into how user acceptance influences technology uptake (Bibri & Krogstie, 2019).
c) TAM has been extensively validated in diverse technology adoption studies, ensuring reliability in analyzing behavioral factors related to ICT use (Nabukenya, 2023).

Weaknesses:

a) TAM focuses primarily on individual users and does not adequately account for organizational or regulatory factors that are critical in cloud adoption (UCC, 2022).
b) It overlooks external influences such as infrastructure, policies, or funding constraints, which are relevant in resource-constrained environments (Kalinaki et al., 2022).
c) While useful for initial adoption studies, TAM may oversimplify complex decision-making processes in large public institutions by reducing them to user perceptions alone.

2.4 Comparative Analysis of Existing Frameworks and Cloud Computing Framework

A comparative analysis of the existing frameworks—Technology-Organization-Environment (TOE), Diffusion of Innovation (DOI), the Cloud Adoption Risk and Benefit (CRB) Framework, and the Technology Acceptance Model (TAM)—reveals their strengths in addressing specific aspects of cloud computing adoption, such as readiness, user perceptions, and financial risks. However, their limitations in regulatory focus, adaptability, and institutional alignment underscore the need for a tailored framework.

Table 2. 1: Comparative Assessment of the Existing and Cloud Computing Frameworks

Aspect	**EF1: TOE**	**EF2: DOI**	**EF3: CRB**	**EF4: TAM**	**Cloud Computing Adoption Framework**
Technological Readiness	Y	N	N	N	Y
Organizational Preparedness	Y	N	N	N	Y
Regulatory and Security	Y	N	Y	N	Y
Adaptability	Y	N	N	N	Y
Scalability and Sustainability	Y	N	N	N	Y
Institutional Culture Alignment	N	N	N	Y	Y

Note: Y = Yes and **N** = No

Table 2.1 presents a comparative assessment of the—TOE, DOI, CRB, and TAM—against the proposed proposed CCA framework. The TOE framework demonstrates more strengths in technological readiness, organizational preparedness, regulatory considerations, adaptability, and scalability, making it useful for assessing cloud adoption readiness. However, it lacks emphasis on institutional culture alignment, which is critical in public sector environments like KCCA. The DOI framework primarily focuses on user perceptions and innovation attributes but falls short in addressing technological, organizational, regulatory, and scalability aspects, limiting its applicability for complex institutional contexts.

The CRB framework provides valuable insights into financial viability and security concerns, yet it lacks a broader organizational or technological perspective and does not address institutional culture. TAM, on the other hand, focuses on user acceptance and institutional culture but overlooks infrastructure, security, and regulatory factors. In contrast, the CCA framework holistically integrates all key aspects. This comprehensive approach makes it well-suited for guiding cloud adoption in Uganda's public sector, addressing both technical and institutional barriers to successful implementation.

Table 2. 2: Summary of the Strengths and Weaknesses of the Existing Frameworks

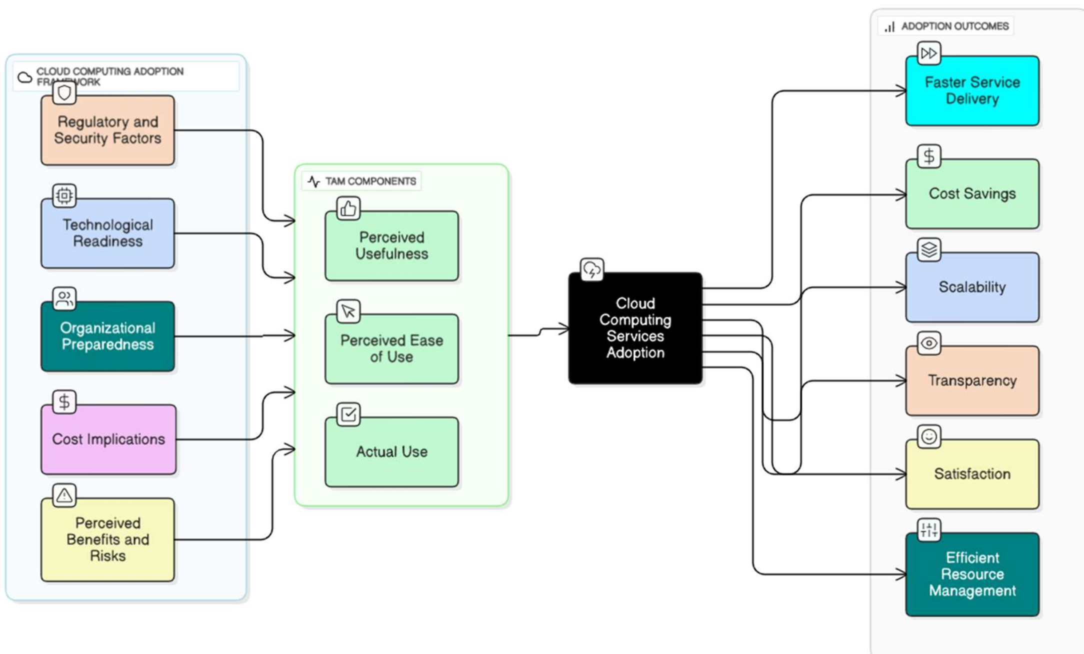
Framework	Notes
Technology-Organization-Environment (TOE)	Strong on technological readiness, organizational preparedness, regulatory factors, adaptability, and scalability—but limited on institutional culture alignment.
Diffusion of Innovation (DOI)	Focuses mainly on user perceptions and innovation characteristics—lacks technological, organizational, regulatory, or scalability focus.
Cloud Adoption Risk and Benefit (CRB)	Primarily emphasizes financial risks and security—limited in technology, organizational, adaptability, or scalability dimensions.
Technology Acceptance Model (TAM)	Focused on user perceptions and institutional culture but lacks coverage of infrastructure, regulations, or scalability.
Cloud Computing Adoption Framework	Covers all critical dimensions: technological readiness, organizational preparedness, regulatory/security compliance, adaptability, scalability/sustainability, and institutional culture alignment.

2.5 Research Conceptualization

2.5.1 Conceptual Framework of the Study

The conceptual framework as a theoretical lens for understanding how various internal and external factors influence the adoption of cloud computing services in public institutions. Unlike the practical Cloud Computing Adoption Framework, the study aims to design, which will prescribe actionable steps, compliance guidelines, and migration phases, this conceptual framework maps out the key relationships and variables that explain adoption behavior.

Figure 2. 1: Conceptual Framework of the Study



Source*; Rogers et al., 2019 & improved by the researcher*

At the core of the framework is the interaction between the independent variable (Cloud Computing Adoption Framework) and the dependent variable (Cloud Computing Services Adoption), mediated by the Technology Acceptance Model (TAM). The five sub-components of the independent variable—technological readiness, organizational preparedness, regulatory and security factors, cost implications, and perceived benefits and risks—are shown to influence the TAM constructs: Perceived Usefulness, Perceived Ease of Use, and Actual Use. These TAM elements capture the cognitive and behavioural processes that determine how users respond to cloud computing solutions, bridging the gap between organizational conditions and actual technology adoption outcomes. The final component of the framework illustrates the tangible benefits of successful cloud adoption through six outcome indicators: faster service delivery, cost savings, scalability, transparency, user satisfaction, and efficient resource management. These are the intended results that KCCA and similar institutions aim to achieve by transitioning to cloud-based systems. The framework thus provides a holistic view that connects strategic readiness and environmental conditions with behavioural factors and measurable adoption outcomes, offering a foundational model upon which the study's practical framework will be built.

2.5.2 Independent Variable

The independent variable in this study is cloud computing adoption readiness, which encompasses multiple critical dimensions that collectively influence adoption outcomes. These include technological readiness, such as the availability of robust IT infrastructure and internet penetration; organizational preparedness, which evaluates leadership commitment, staff training, and adaptability to digital transformation; and regulatory and security factors, including compliance frameworks and data protection policies (UCC, 2022).

2.5.3 Dependent Variable

The dependent variable in this study is Cloud Computing Services Adoption, which refers to the extent to which cloud-based technologies are integrated into the operations of public institutions like Kampala Capital City Authority (KCCA). This adoption is measured through key indicators such as improved service delivery speed, cost efficiency, scalability, transparency, user satisfaction, and effective resource management (NITA-U, 2023). These outcomes represent the practical benefits that institutions seek to achieve by transitioning from legacy systems to cloud-based infrastructures.

2.5.4 Hypothesis of the Study

H_1: Technological readiness positively influences the adoption of cloud computing services in Uganda's public sector.

H_2: Organizational preparedness significantly affects the level of cloud computing adoption within public institutions in Uganda.

H_3: Regulatory and security factors are critical determinants of successful cloud computing adoption in Uganda's public sector.

H_4: Positive perceptions of benefits mitigate adoption barriers and enhance operational efficiency in cloud-integrated public institutions.

2.6 The Cloud Computing Adoption Framework for Public Institutions

The Cloud Computing Adoption Framework for Public Institutions is a structured and holistic pathway for transitioning from traditional IT systems to cloud-based solutions. The framework is visually organized into three major sections: Foundational Pillars, Implementation Phases, and Key Outcomes, all connected by a logical and sequential flow that emphasizes the interdependence of technological, organizational, and regulatory factors throughout the cloud adoption journey.

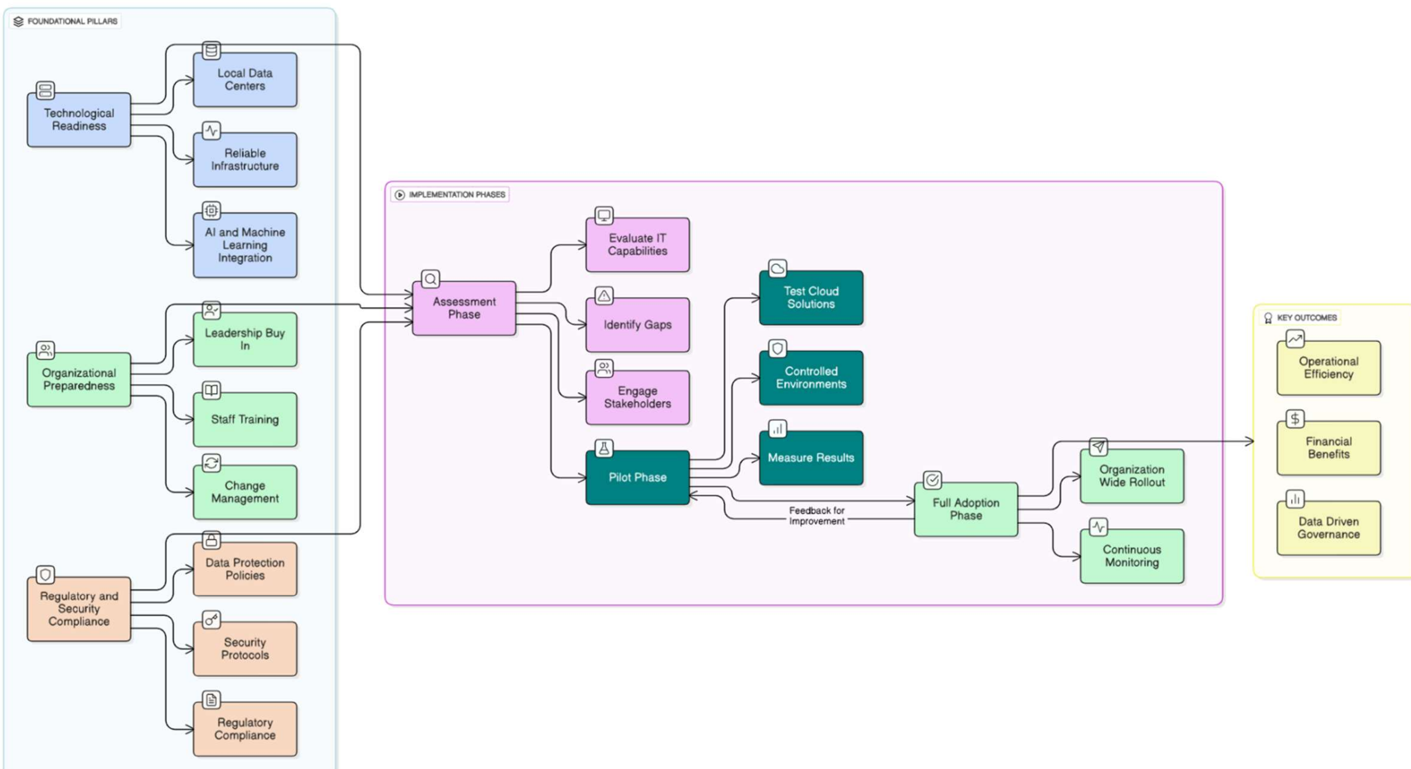


Figure 2. 2: The Cloud Computing Adoption Framework for Public Institutions

On the left side of the diagram, the Foundational Pillars form the core building blocks necessary to initiate and sustain cloud adoption. The first foundational pillar is Technological Readiness, which addresses the critical technological enablers required for cloud computing. This pillar emphasizes the establishment of Local Data Centers, which ensure data sovereignty, reduce latency, and improve service reliability. It also highlights the need for Reliable Infrastructure, encompassing robust broadband connectivity and uninterrupted electricity supply—both essential for seamless cloud operations. Furthermore, it includes AI and Machine Learning

Integration, underscoring the growing importance of advanced technologies in optimizing cloud systems for predictive analytics, automation, and enhanced decision-making.

Adjacent to this is the pillar of Organizational Preparedness, which focuses on the internal capacities required for successful cloud integration. It stresses the need for Leadership Buy-In, as commitment from top management is vital for driving digital transformation initiatives. Staff Training is another key component, ensuring that employees at all levels possess the technical skills necessary to manage and utilize cloud technologies effectively. Change Management rounds out this pillar, reflecting the importance of structured strategies to navigate resistance to change, promote acceptance, and foster a culture of continuous improvement.

The third foundational pillar addresses Regulatory and Security Compliance, recognizing the critical role of governance and risk management in the public sector. This includes the formulation and enforcement of Data Protection Policies to safeguard citizen data, the establishment of stringent Security Protocols to prevent breaches and cyber threats, and strict adherence to Regulatory Compliance frameworks to ensure that cloud initiatives operate within legal and institutional boundaries. These three foundational pillars feed directly into the Implementation Phases, represented in the middle section of the diagram. The process begins with the Assessment Phase, where institutions thoroughly Evaluate IT Capabilities to understand their current technological landscape, Identify Gaps in their systems and processes, and Engage Stakeholders to gather input and build consensus around cloud adoption. This phase lays the groundwork for making informed and strategic decisions.

Following the assessment, institutions transition into the Pilot Phase, where cloud solutions are tested in controlled environments. This phase allows for practical experimentation through the deployment of Test Cloud Solutions in selected departments or services. Controlled Environments ensure that testing is done within manageable parameters, minimizing risks. Throughout this phase, institutions Measure Results to assess the effectiveness, efficiency, and scalability of the solutions under consideration. Notably, there is a feedback loop from the Full Adoption Phase back to the Pilot Phase, allowing institutions to revisit earlier stages based on the insights gained during full-scale implementation. This feedback mechanism ensures continuous learning and iterative improvement, which is critical in adapting to evolving technologies and operational realities.

The final step within the Implementation Phases is the Full Adoption Phase, where successful solutions are rolled out organization-wide. During this phase, Organization-Wide Rollout ensures that cloud systems are deployed across all relevant departments and processes, fully replacing outdated systems. Continuous Monitoring is a key activity in this phase, enabling institutions to track performance, detect issues, and make adjustments as needed to sustain the effectiveness of cloud services over time. The culmination of this framework is reflected in the Key Outcomes section, located on the right side of the diagram. Here, the tangible benefits of cloud adoption are clearly identified. Operational Efficiency is enhanced as cloud systems automate manual processes, streamline workflows, and enable faster service delivery. Financial Benefits arise from shifting IT expenses from capital investments in hardware to flexible, pay-as-you-go operational costs, allowing better budget management and resource allocation. Data-Driven Governance becomes achievable through real-time access to integrated data, empowering decision-makers to design responsive, evidence-based policies and services.

2.7 Gaps in the Literature

While global research highlights the transformative potential of cloud computing, existing studies fail to address Uganda's unique challenges, such as infrastructural deficits, limited technical expertise, and unclear regulatory frameworks (UCC, 2022). Additionally, there is limited empirical evidence on how cost, institutional culture, and regulatory barriers specifically influence cloud adoption readiness in public institutions like Kampala Capital City Authority (KCCA) (Kalinaki et al., 2022). This gap underscores the need for a tailored framework that integrates global best practices with Uganda's socio-economic realities to achieve sustainable digital transformation in the public sector.

CHAPTER THREE

RESEARCH METHODOLOGY

This chapter follows the research onion to outline the methodology employed. This study employed a mixed methods approach. Quantitative surveys (for measurement reliability and SEM testing) were complemented by qualitative interviews and document analysis (to capture regulatory, organizational, and implementation context), enabling triangulation and an actionable framework. It details the research philosophy, approach, methodology, data collection methods, and analysis techniques, ensuring scientific rigor and contextual relevance.

3.1 Research Philosophy

The study adopted pragmatism (Bryman, 2021), privileging useful knowledge for solving KCCA's real cloud-adoption problems over strict allegiance to any single paradigm; in practice, this meant formulating questions around "what works" for secure, scalable, compliant migration and then combining methods accordingly—administering a structured survey to quantify determinants of adoption, conducting semi-structured interviews to surface regulatory, organizational, and capacity constraints, and iteratively refining a design-oriented framework as insights accumulated from both strands and stakeholder feedback (e.g., technical staff and unit heads) (Saunders et al., 2019).

3.2 Research Approach

An abductive approach was employed (Tashakkori & Teddlie, 2010), moving back-and-forth between theory and data to progressively refine explanations and the resulting framework: initial propositions from TOE/DOI/TAM informed the draft questionnaire and interview guide; a pilot with a small subset of KCCA staff led to construct and wording adjustments; full survey results (EFA/CFA and SEM path estimates) revealed patterns and outliers; and targeted follow-up interviews plus document analysis (policies, standards, memos) were used to explain anomalies and sharpen the migration logic, culminating in a prescriptive model grounded in both evidence and context (Bryman, 2021).

3.3 Methodological Choice

A mixed-methods convergent design was used and integrated at interpretation : quantitatively, a Likert-scale questionnaire was administered to technical/managerial KCCA staff, with reliability and validity checks (e.g., Cronbach's alpha, EFA/CFA) (Creswell & Poth, 2018) and

SEM to estimate effects of technological readiness, organizational preparedness, and regulatory/security on adoption; qualitatively, semi-structured interviews captured barriers, enablers, and implementation nuance, and transcripts were thematically coded; finally, a triangulation step merged results in joint displays to reconcile convergences/divergences and directly inform the phased, governance-aligned framework (Denzin & Lincoln, 2018).

3.4 Research Strategy

This study employed a case study research strategy, using KCCA as the primary case to provide an in-depth analysis of cloud computing adoption within Uganda's public sector. The case study approach enabled a detailed examination of the specific technological, organizational, and regulatory factors influencing cloud adoption at KCCA, allowing for rich contextual insights (Yin, 2014). A mixed-methods design was adopted to enhance the depth and breadth of data, combining quantitative surveys with IT staff, department heads, and policymakers to capture measurable indicators of cloud readiness, alongside qualitative semi-structured interviews to explore deeper institutional barriers and perceptions (Creswell & Creswell, 2018). This dual approach facilitated data triangulation, ensuring more reliable and comprehensive findings (Bryman, 2021). The research was guided by the TOE framework and DOI theory to structure both the data collection and analysis processes, ensuring a systematic, theory-driven investigation while remaining grounded in KCCA's real-world environment.

Research Objectives and How to Achieve Them

3.5 Identification of Requirements for the CCA Frameworks

The framework requirements were derived from a systematic review of existing frameworks, followed by surveys, interviews, expert consultations, and before evaluating with the prototype to ensure the framework was practical, and adaptable to Uganda's digital transformation goals.

3.5.1 Current Cloud Computing Environment at KCCA

At the time of the study, the cloud computing environment at Kampala Capital City Authority was characterized by minimal adoption and a continued reliance on legacy, on-premises IT systems. Most of KCCA's critical operations, such as land management, internal document processing, and workflow systems, remained hosted on local servers, limiting scalability and flexibility (MoICT&NG, 2024). Cloud utilization was restricted to basic services, including email hosting and limited document storage, with no fully developed or institution-wide cloud strategy in place. Infrastructure gaps—particularly unstable internet connectivity, intermittent power supply, and low digital literacy among staff—posed major obstacles to cloud adoption (UBOS, 2023). Additionally, concerns related to data security, lack of local data centers, and unclear regulatory frameworks further constrained progress toward cloud integration (UCC, 2022). Despite these challenges, KCCA had expressed interest in expanding its use of cloud technologies, particularly for enhancing service delivery and participating in national digital initiatives such as UGhub and the Smart Cities Innovation Programme (MoICT&NG, 2024).

3.5.2 Target Population Size

The target population was deliberately customized to technical actors—KCCA IT staff, department heads with ICT oversight, policymakers responsible for digital governance, and external technical consultants—because the study required informed judgments on cloud architectures, security and compliance controls, interoperability with national platforms, and migration trade-offs; restricting participation to technically literate decision-makers and practitioners maximized the quality, validity, and actionability of feedback, reduced measurement noise from non-specialists (Saunders et al., 2019), and aligned with best-practice guidance to match respondent expertise to construct complexity in mixed-methods, design-oriented research (Kumar, 2019).

3.5.3 Sample Size

A stratified random sampling method was employed to select the sample size from a total population of 50 respondents and ensured diverse representation. The sample included; IT staff, policymakers, departmental heads, and technical consultants, providing a balanced perspective on cloud adoption. The researcher computed the sample size for known population size (N=100) according to solvent formula by Slovin, below at 5% level of precision.

$$\boldsymbol{n} = \frac{\boldsymbol{N}}{\mathbf{1+}\boldsymbol{N}(\boldsymbol{e})\mathbf{2}}$$

Where n is the sample size, N is the population size, e is level precision, N=100, n=? e=5% (0.05) at 95% confident.

$$\boldsymbol{n} = \frac{\mathbf{50}}{\mathbf{1 + 50}(\boldsymbol{e}^{\mathbf{2}})}$$

$$\boldsymbol{n} = \frac{\mathbf{50}}{\mathbf{1 + 50}(\mathbf{0.05}^{\mathbf{2}})}$$

= 44.444 respondents

Table 3. 1: Summary of Sample Size and Respondents

Responsibility	Population	Sample	Sampling Technique
IT Staff	20	20	Stratified Random sampling
Department Heads	10	10	Stratified Random sampling
Policymakers	5	4	Stratified Random sampling
Technical Consultants	15	10	Stratified Random sampling
Total	**50**	**44**	

Table 3.2 illustrates the distribution of the total population and sample population across four respondent categories: IT Staff, Department Heads, Policymakers, and Technical Consultants. These categories ensure comprehensive representation, capturing diverse insights on technological readiness, organizational dynamics, and policy frameworks critical to cloud computing adoption.

3.5.4 Sampling Frame

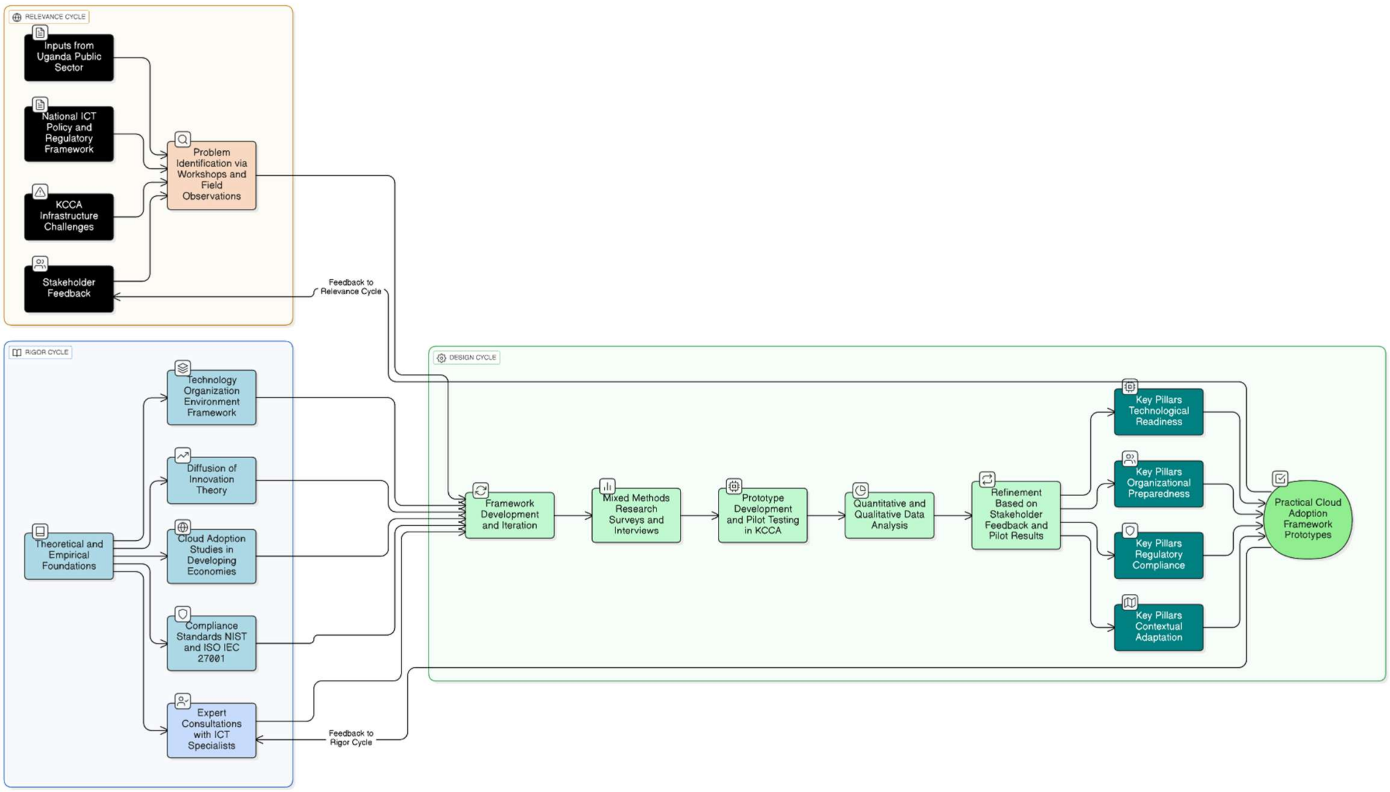
The sampling frame was constructed using KCCA's 2022 staff registry, which identified all IT personnel, department heads, and policymakers involved in digital transformation initiatives. The target population was stratified into three key subgroups based on their operational roles in cloud adoption decisions, following the sampling methodology recommended by (Saunders et al., 2019). This approach ensured representation across technical, managerial, and policy levels, while maintaining focus on personnel with direct experience in ICT infrastructure.

3.6 Design of the Cloud Computing Adoption Framework

3.6.1 Framework Design Methodology: Design Science Research (DSR)

Figure 3.1 illustrates how three interrelated cycles—Relevance, Rigor, and Design—work together to guide the development of a practical and context-specific cloud computing framework for Uganda's public sector. The Relevance Cycle anchors the framework in Uganda's institutional realities, drawing on critical inputs such as the National ICT Policy, regulatory guidelines, KCCA-specific infrastructure challenges, and extensive stakeholder consultations. Through workshops and field observations, this cycle identifies operational barriers like limited broadband, power outages, and fragmented systems, ensuring that the framework responds directly to the needs and constraints of the local environment.

The Rigor Cycle provides the theoretical and empirical backbone of the framework. It integrates well-established models such as the Technology-Organization-Environment (TOE) framework and Diffusion of Innovation (DOI) theory, alongside empirical studies from similar developing contexts and global compliance standards such as NIST and ISO/IEC 27001. In addition, expert consultations with ICT specialists and academics strengthen the academic rigor of the framework. This cycle ensures that the framework is not only grounded in practical realities but also aligned with international best practices, allowing it to address both local



challenges and broader technological trends.

Figure 3. 1: DSR Model for the Cloud Computing Framework

At the centre of the model lies the Design Cycle, where the actual framework development takes place. This cycle uses mixed-methods research—including surveys and interviews—to gather both quantitative and qualitative data, leading to iterative framework development and refinement. It incorporates pilot testing of cloud prototypes within KCCA, allowing for real-world performance evaluation and adjustments. The Design Cycle focuses on four critical pillars: Technological Readiness, Organizational Preparedness, Regulatory Compliance, and Contextual Adaptation, ensuring a balanced and holistic framework tailored to Uganda's socio-technical landscape.

The model emphasizes continuous learning and improvement through its feedback loops. Insights from the Design Cycle feed back into both the Relevance and Rigor Cycles, enabling ongoing refinements based on stakeholder feedback, pilot results, and emerging research. This cyclical process ensures that the resulting cloud computing adoption framework remains adaptable, scalable, and responsive to changing needs, making it a robust tool for accelerating digital transformation in Uganda's public institutions, starting with KCCA and potentially extending to other agencies across the country.

3.6.2 Framework Design Architecture

The Design Architecture presents the structural blueprint used to develop the Cloud Computing Adoption Framework. This architecture was employed to ensure the framework was not only contextually relevant but also grounded in academic rigor and practical utility. It draws from Design Science Research, which emphasizes iterative, problem-solving cycles that blend empirical evidence with stakeholder engagement. By using this architecture, the study ensures that the resulting framework is not merely theoretical but actionable, adaptable, and aligned with the unique digital transformation landscape of Uganda.

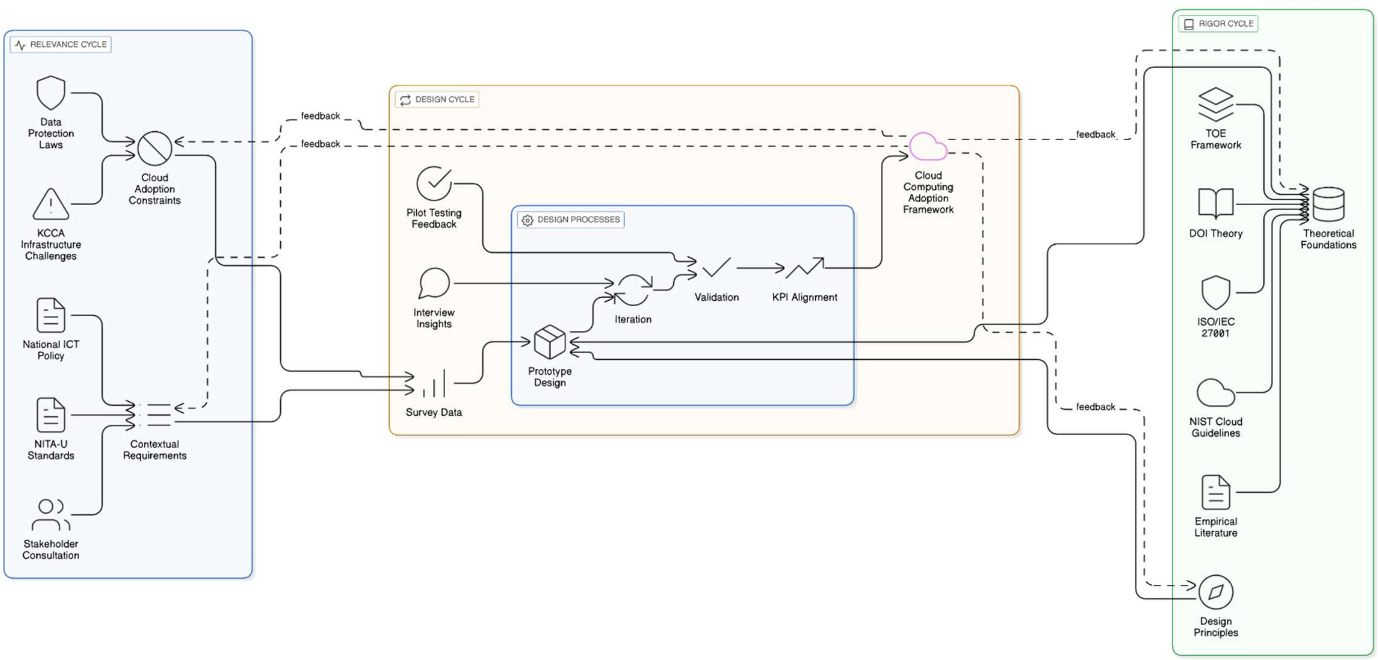


Figure 3. 2: Cloud Computing Adoption Framework Architecture

The architecture is organized into three interrelated cycles—Relevance, Rigor, and Design—each serving a distinct function in the framework development process. The Relevance Cycle ensures that the framework responds to real-world conditions by incorporating local context factors such as national ICT policies, NITA-U standards, infrastructure limitations at KCCA, and stakeholder consultations. These inputs generate contextual requirements and adoption constraints that feed directly into the design process, ensuring alignment with institutional realities and regulatory environments.

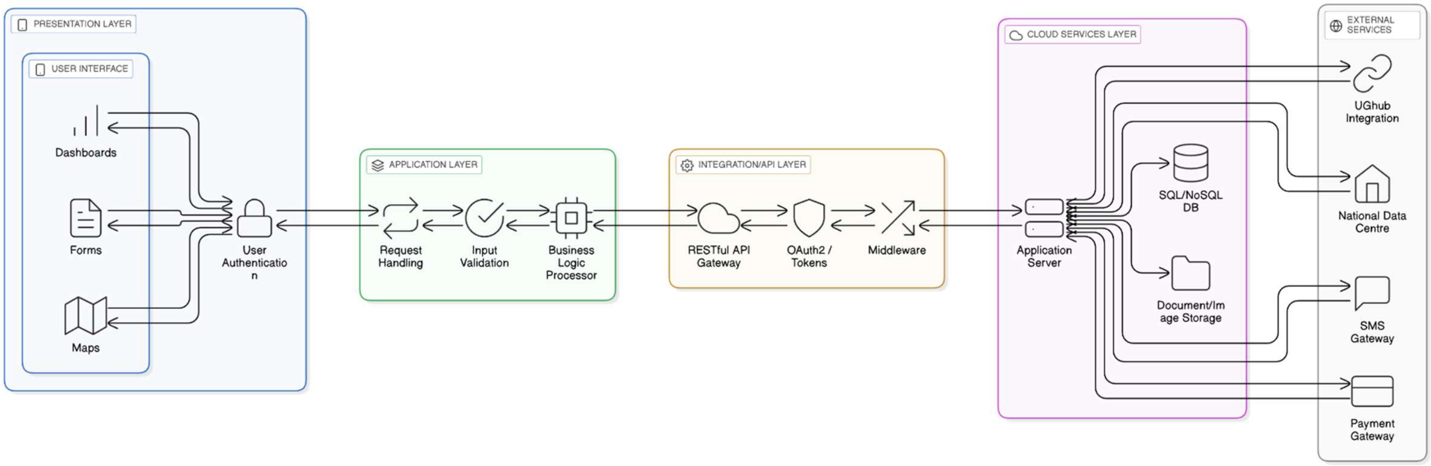
The Rigor Cycle, on the other hand, provides the theoretical and empirical foundation for the framework. It includes scholarly inputs such as the Technology-Organization-Environment (TOE) framework, Diffusion of Innovation (DOI) theory, and international standards like ISO/IEC 27001 and NIST guidelines. These elements contribute to the formulation of design principles and theoretical foundations, which serve as benchmarks for quality, security, and interoperability in the resulting cloud adoption framework. This cycle ensures the framework adheres to both global best practices and academic integrity. At the core is the Design Cycle, where the actual creation and refinement of the framework occur.

This cycle integrates empirical data gathered from surveys, interviews, and pilot testing. Within this loop, iterative processes—prototype design, validation, and KPI alignment—are used to refine the framework based on both stakeholder feedback and performance assessments. The central output is a validated, scalable, and regulation-compliant Cloud Computing Adoption Framework. The feedback loops from the design cycle to both the relevance and rigor cycles ensure that continuous improvement is embedded into the process, making the framework dynamic and capable of evolving with changing institutional and technological demands.

3.6.3 Mobile Application Design Architecture

The Mobile Application Design Architecture presents a structured blueprint for a cloud-integrated mobile application tailored for public institutions. The architecture was developed to provide a scalable, secure, and interoperable solution capable of connecting users with government services via mobile platforms. Given Uganda's increasing mobile penetration and the demand for digital public services, this layered architecture ensures modularity, maintainability, and seamless integration with national platforms like UGhub and the National Data Centre. This application architecture also ensures the solution can evolve with emerging technologies and citizen expectations.

At the top of the architecture is the Presentation Layer, which focuses on the mobile user interface (UI). This includes interactive components such as forms, maps, and dashboards that allow citizens to engage with government services. User authentication ensures secure access and protects sensitive data, especially for services involving personal or transactional



information. This layer is critical for delivering a responsive and intuitive experience to users, which directly affects adoption and satisfaction.

Figure 3. 3: Illustration of the Mobile Application Design Architecture

Beneath that is the Application Layer, where business logic resides. This layer handles incoming requests, validates inputs for accuracy and completeness, and processes the logic needed to fulfill service requests. By isolating business rules from the user interface and cloud operations, the architecture supports agility—allowing the institution to update workflows or service logic without disrupting the user experience or backend systems. The Integration/API Layer, Cloud Services Layer, and External Services Layer handle data transmission, processing, and external interactions.

The API layer manages secure communication between the app and backend via OAuth2 and tokens, routed through a RESTful gateway and middleware. The Cloud Services Layer hosts the core infrastructure—including the application server, database, and storage services—while the External Services Layer integrates essential national systems like UGhub, SMS gateways, payment processors, and the National Data Centre. These layers ensure the mobile app can deliver reliable, real-time services while maintaining compliance, security, and data interoperability across government platforms.

3.6.4 Data Persistence and MySQL Schema

The Data Persistence and MySQL Schema illustrates the data flow and storage structure that underpins a public institutions' mobile application system. This schema was used to ensure structured, secure, and efficient storage of transactional and operational data collected through both citizen-facing mobile apps and internal administrative dashboards. Data persistence using MySQL ensures that critical information—such as user requests, service interactions, and payment records—is stored reliably and can be retrieved consistently for analytics, reporting, or operational decision-making. The layered architecture also supports separation of concerns, which enhances scalability, security, and system maintainability.

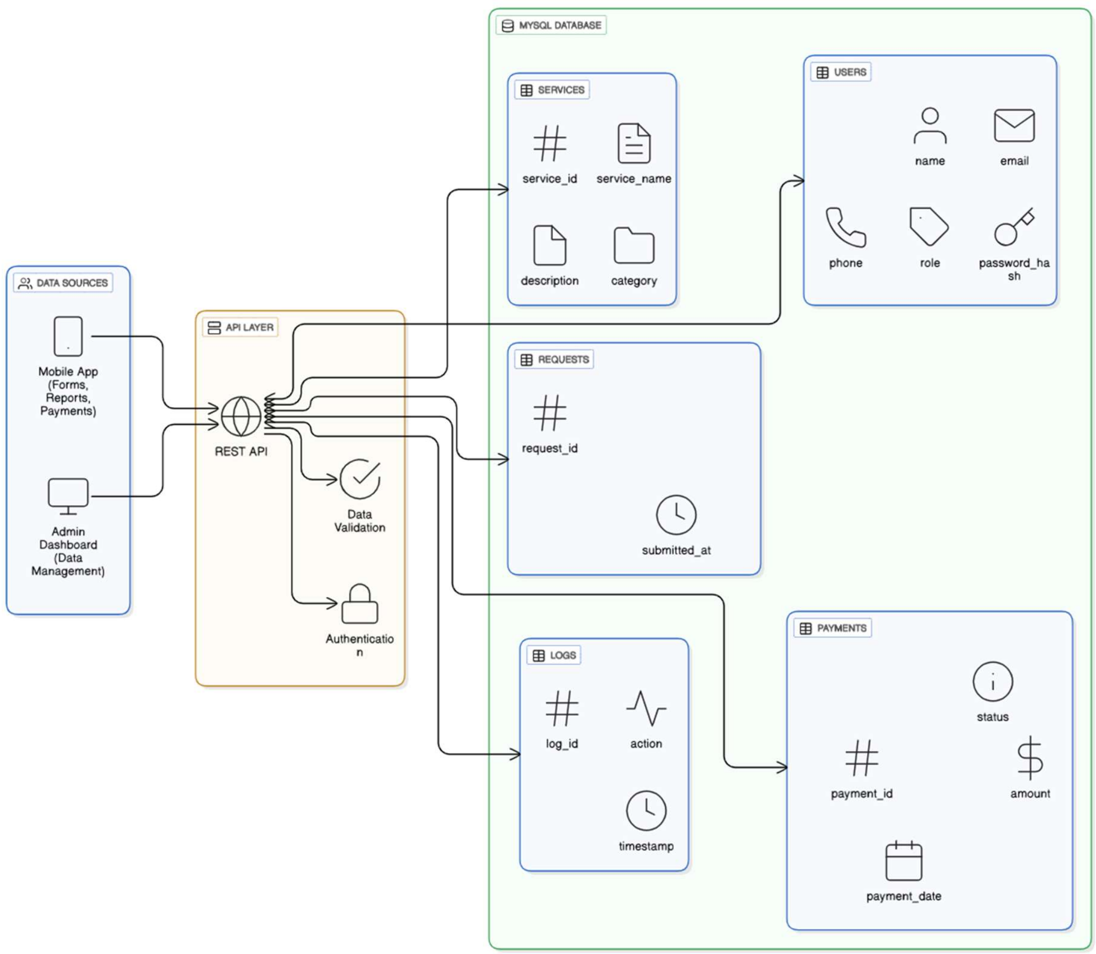


Figure 3. 4: Illustration of Data Persistence and MySQL Schema

At the top of the architecture are the data sources, which include the *Mobile App* and the *Admin Dashboard*. The mobile app allows citizens to submit forms, file service requests, and make payments, while the admin dashboard provides backend users with tools for managing data and monitoring system activity. These sources send structured data requests to the system through the API layer, enabling interaction with the underlying MySQL database. By separating input interfaces from business logic and database functions, the architecture remains modular and user-focused.

The API Layer acts as the intermediary between the application frontends and the MySQL backend. It contains a *RESTful API* that handles HTTP requests, along with components for *data validation* and *authentication* (e.g., login verification and access control). This ensures that only verified and correctly formatted data is allowed into the system, reducing the risk of data corruption or unauthorized access. This middle layer is critical for enforcing data integrity and application security while providing a consistent interface for frontend interactions.

At the base is the MySQL Database Layer, which contains multiple normalized tables including *Users*, *Services*, *Requests*, *Payments*, and *Logs*. Each table is designed with primary and foreign keys to establish clear relationships and ensure referential integrity. For instance, the *Requests* table links users to specific services, while the *Payments* table tracks financial transactions. The *Logs* table captures user actions for audit purposes. This schema supports data-driven operations and accountability within the digital public service ecosystem, making it a foundational component for cloud-integrated mobile governance platforms.

3.6.5 Framework Security Design

The Framework Security Design presents a layered security architecture designed to protect cloud-based public institutions' applications against internal and external threats. This design was chosen to reflect a defense-in-depth strategy, ensuring that multiple, independent layers of protection are in place to secure data, applications, and infrastructure. The architecture also aligns with compliance obligations under Uganda's Data Protection and Privacy Act and global standards like ISO/IEC 27001. By organizing security controls in concentric layers surrounding the core system, the framework ensures that if one layer is breached, successive layers continue to provide protection.

The outermost layer, Perimeter Security, is the first line of defense and includes traditional network-level safeguards such as firewalls, intrusion detection and prevention systems (IDPS), and network segmentation. These mechanisms are essential for filtering traffic, blocking unauthorized access attempts, and isolating different parts of the network to contain potential breaches. This layer prevents threats from entering the system in the first place, forming the base of any secure cloud deployment.

Within the next layer is Application Security, which protects the mobile app, dashboards, and APIs through controls like input validation, rate limiting, HTTPS encryption, and a secure API gateway. This ensures that user-submitted data is sanitized, encrypted, and rate-controlled to prevent abuse such as injection attacks or denial-of-service attempts. Following that, the Identity & Access Management (IAM) layer enforces authentication and authorization policies. Tools like multi-factor authentication (MFA), role-based access control (RBAC), and OAuth2 token-based access ensure that only verified users access the right resources at the right permission levels.

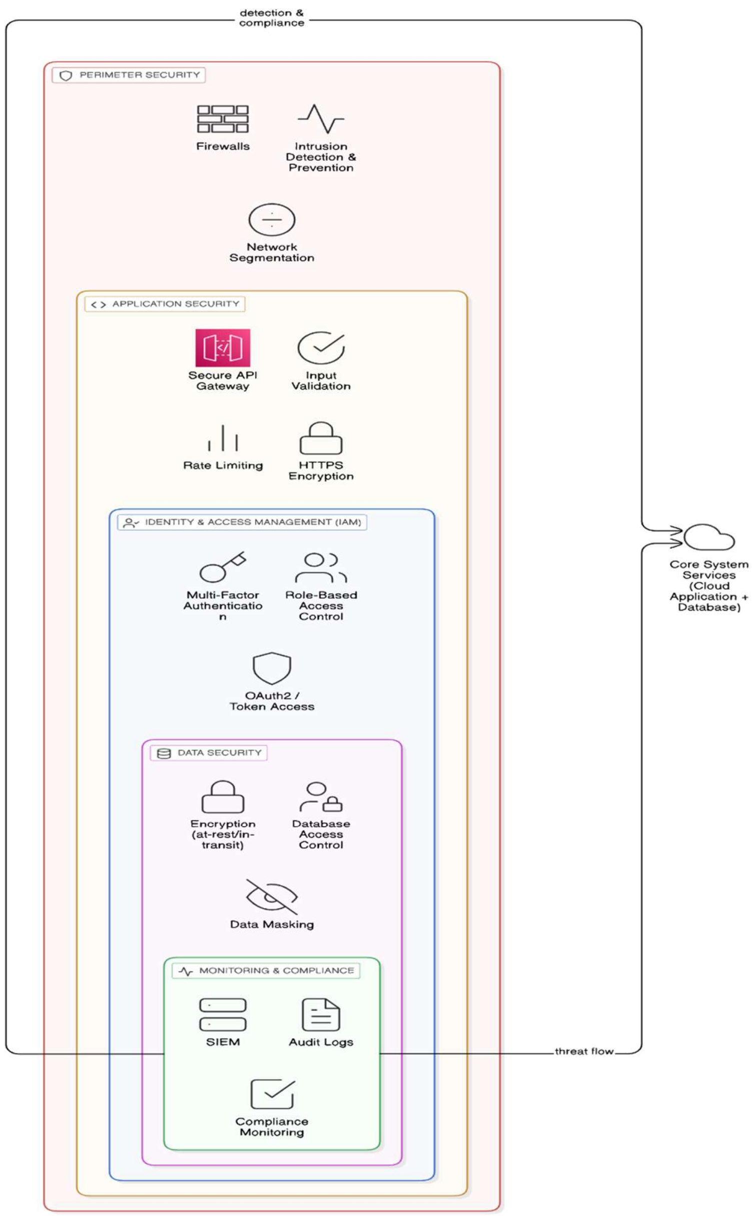


Figure 3. 5: Illustration of the Framework Security Design

Deeper inside, Data Security ensures that information stored and transmitted is protected through encryption, database access control, and data masking. These prevent unauthorized viewing or manipulation of sensitive records. Finally, at the core of operational governance is the Monitoring & Compliance layer, which includes Security Information and Event Management (SIEM) systems, audit logs, and compliance tracking tools. This layer continuously monitors the system, provides forensic evidence in case of incidents, and ensures ongoing adherence to legal and policy requirements. Altogether, this architecture creates a robust, adaptive, and policy-aligned security posture for cloud-based public sector applications.

3.7 Validation of the Cloud Computing Adoption Framework

3.7.1 Prototype Design and Implementation

The prototype design and implementation focused on developing a functional model of the cloud computing adoption framework to demonstrate its practical applicability within KCCA. The prototype was designed using a modular architecture, with separate components for user management, service workflows, data analytics, and reporting. It integrated a web-based interface for administrators and a mobile-friendly interface for field staff and citizens, ensuring broad accessibility. The backend was built on a cloud-hosted environment, using MySQL for data storage and PHP for server-side logic, with APIs enabling secure communication between modules. Key features included user authentication, role-based access, service request tracking, and performance dashboards. The prototype was implemented in selected KCCA departments, focusing on revenue collection and document processing functions. Testing was conducted to evaluate system functionality, usability, and performance under real operational conditions, with iterative refinements made based on user feedback. The implementation confirmed the framework's ability to improve service efficiency, support decision-making, and enable secure, scalable cloud adoption within KCCA's operations.

3.7.2 Units and Integration Testing

Units and integration testing were conducted to ensure the reliability and functionality of the prototype system before full deployment. Unit testing focused on verifying the correctness of individual modules, including user authentication, data storage, service request processing, and reporting functions. Each module was tested in isolation to confirm that it performed as expected under various input scenarios, with errors and exceptions handled gracefully. Once unit testing was completed, integration testing was carried out to assess how the modules worked together as a complete system. This phase tested data flows between components such as the mobile interface, backend APIs, and the database, ensuring seamless communication and consistency. Key integration points, such as user login, service request submission, and real-time reporting, were thoroughly validated. The testing process also included checks for security, performance, and data accuracy under simulated operational conditions. The combined testing ensured that both individual components and the overall system functioned smoothly, delivering a stable and reliable solution ready for pilot use.

3.7.3 Usability and Acceptance Testing

Usability and acceptance testing were conducted to evaluate the system's ease of use, functionality, and overall user satisfaction within KCCA. During usability testing, selected end-users, including IT staff, department heads, and service officers, interacted with the prototype to perform common tasks such as logging in, submitting service requests, and accessing reports. Observations were made on navigation ease, response times, and interface clarity, with participants providing feedback on any difficulties encountered. Acceptance testing followed, focusing on verifying that the system met predefined requirements and functional expectations. Test scenarios were based on real-life workflows, allowing users to assess whether the prototype effectively supported their operational needs. Feedback was collected through structured questionnaires and debrief sessions, identifying areas for improvement. The testing results confirmed that the system was user-friendly, met the expected functional standards, and was acceptable for operational use, with only minor adjustments needed before full-scale deployment.

3.8 Data Collection Methods

3.8.1 Quantitative Technique

Structured questionnaires were employed as the primary quantitative data collection tool to systematically capture measurable insights on technological readiness, organizational preparedness, and the key barriers affecting cloud computing adoption in Uganda's public institutions (Dillman et al., 2019). The questionnaires were carefully designed using a five-point Likert scale, allowing respondents to rate their agreement with statements regarding cost implications, scalability, and operational efficiency of cloud solutions. This approach ensured consistency and comparability across responses while enabling the quantification of subjective perceptions into analyzable data (Bryman, 2021). The questionnaires were distributed to IT staff, departmental heads, and policymakers at KCCA, with clear instructions to ensure a high response rate and minimize bias. Data collected through this method was subsequently analyzed using descriptive and inferential statistics to identify patterns, correlations, and trends relevant to cloud adoption readiness.

3.8.2 Qualitative Technique

Semi-structured interviews were conducted alongside the quantitative survey to explore in greater depth the qualitative aspects of cloud computing adoption, particularly those relating to organizational culture, leadership dynamics, and regulatory challenges (Saunders et al., 2019). The interviews were guided by an open-ended question framework, allowing participants—including IT managers, senior administrators, and policymakers at KCCA—to freely express their experiences, concerns, and suggestions regarding cloud implementation. This approach provided rich, nuanced insights into issues such as data security concerns, resistance to change, and the perceived risks and benefits of cloud adoption (King et al., 2019). Interviews were conducted in person and virtually, recorded with consent, and later transcribed for thematic analysis. Thematic coding allowed for the identification of recurring themes and deepened the understanding of contextual factors that influence cloud adoption decisions.

3.9 Testing Validity and Reliability

3.9.1 Validity

Validity refers to the extent to which a research instrument accurately measures what it purports to measure (Kothari, 2014). In this study, validity was established through expert judgment involving five specialists in cloud computing adoption and public sector digital transformation. The expert panel comprised two academic researchers in information systems, two senior IT managers from Uganda's public sector, and one policymaker from NITA-U.

The CVI was calculated using the formula below:

$$\text{CVI} = \frac{\text{Number of items declared valid}}{\text{Total number of items}}$$

Table 3. 2: Content Validity Results

Variable	Total No of Items	Number of Valid Items	CVI
Technological Readiness	7	6	0.857
Organizational Preparedness	6	5	0.833
Regulatory and Security Factors	5	5	1.000

Perceived Benefits and Risks	4	3	0.750
Level of Cloud Computing Adoption	5	5	1.000

Source: Expert Judgment

The results show CVIs ranging from 0.750 to 1.000, all exceeding the 0.70 threshold recommended for social science research (Polit & Beck, 2006). The high CVIs confirm that the measurement tools were theoretically grounded and contextually appropriate for assessing the study variables.

3.9.2 Reliability

Reliability refers to the consistency and stability of a research instrument in measuring the intended constructs across different conditions and time periods (Peffers et al., 2018). In this study, internal consistency reliability was assessed using Cronbach's alpha coefficient, computed through IBM SPSS Statistics version 27. The analysis evaluated the reliability of all multi-item scales measuring the key constructs of cloud computing adoption based on responses from 44 KCCA participants. The formula:

$$\boldsymbol{\alpha} = \frac{k}{\mathbf{k-1}} \left(\mathbf{1} - \frac{\sum(\boldsymbol{\sigma}\mathbf{i})\mathbf{2}}{(\boldsymbol{\sigma}\mathbf{t})\mathbf{2}}\right)$$

Table 3. 3: Reliability Analysis Results

Variable	No. of Items	Cronbach's α
Technological Readiness	6	0.821
Organizational Preparedness	5	0.803
Regulatory and Security Factors	5	0.792
Perceived Benefits and Risks	4	0.763
Level of Cloud Computing Adoption	4	0.834

Source: Expert Judgment

The results demonstrate strong internal consistency across all constructs. Technological Readiness showed the highest reliability (α = 0.821), followed by Cloud Adoption Level (α = 0.834). The lowest score was for Perceived Benefits and Risks (α = 0.763), which still exceeded the 0.70 threshold recommended for social science research (Nunnally & Bernstein, 1994). These high reliability coefficients confirm that the measurement instruments consistently captured each theoretical construct without significant measurement error.

The reliability testing followed standard procedures:

1. All negatively worded items were reverse-coded before analysis.
2. Item-total correlations were verified (all >0.30).
3. No items required deletion as all improved scale reliability.

4. Parallel analysis confirmed one-dimensionality of each scale.

This rigorous testing ensures the findings about cloud adoption determinants in Uganda's public sector are based on psychometrically sound measurements, supporting the validity of subsequent statistical analyses.

3.10 Data Analysis Techniques

The data collected in this study was analysed using IBM SPSS version 27, employing both descriptive and inferential statistical techniques to rigorously examine the relationship between technological, organizational, and environmental factors and cloud computing adoption levels in Uganda's public sector institutions. The analysis followed a structured mixed-methods approach to ensure the accuracy and relevance of the findings (Creswell & Creswell, 2018).

The data analysis approach aligns with (Bryman, 2021) sequential explanatory mixed-methods design, which prioritizes quantitative analysis followed by qualitative exploration. This study first conducted statistical analysis of survey data from KCCA staff using descriptive and inferential techniques in SPSS, then thematically analysed interview transcripts with NVivo 12 to contextualize the quantitative results. This sequential approach ensured methodological rigor by maintaining clear phase separation while allowing for meaningful integration during interpretation, particularly through triangulation of the regression model outputs with qualitative stakeholder perspectives (Saunders et al., 2019).

Descriptive Statistics included the calculation of means, standard deviations, frequencies, and percentages. These statistics provided a comprehensive overview of respondent demographics and the distribution of responses related to technological readiness, organizational preparedness, and regulatory factors (NITA-U, 2022). This initial analysis helped identify adoption patterns and implementation challenges across different departments within KCCA.

Inferential Statistics were used to explore relationships between the independent variables (technological readiness, organizational preparedness, regulatory factors, perceived benefits) and the dependent variable (cloud adoption level). Pearson Correlation analysis measured the strength and direction of these relationships, with coefficients interpreted to determine statistical significance ($p<0.05$) (Hair et al., 2019).

Multiple Linear Regression Analysis determined the predictive power of each factor on adoption levels. The regression model was formulated as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon$$

Where: Y = Level of Cloud Adoption, β_0 = Constant, X_1 = Technological Readiness, X_2 = Organizational Preparedness, X_3 = Regulatory Factors, X_4 = Perceived Benefits & Risks, ε = Error term.

The regression analysis adhered to key assumptions:

1. Linearity was verified through partial regression plots.
2. Normality was confirmed via Q-Q plots of residuals.
3. Multicollinearity was assessed using VIF scores (<5).
4. Homoscedasticity was checked via scatterplots (Hair et al., 2019).

For qualitative data, thematic analysis followed (Braun & Clarke, 2006) six-phase framework, with interview transcripts coded inductively to identify emerging patterns in adoption barriers and enablers specific to Uganda's public sector context.

3.11 Ethical Considerations

Ethical considerations are paramount in this study to ensure the integrity and credibility of the research process. All participants provided informed consent before data collection, with clear explanations of the study's objectives, procedures, and their right to withdraw at any stage. Confidentiality was maintained by anonymizing respondent data and securely storing all collected information, in compliance with Uganda's data protection regulations.

3.12 Research Constraints

The study acknowledges several limitations that could affect its scope and findings. One limitation is the reliance on self-reported data from respondents, which may introduce biases such as over- or under-reporting on certain variables. Additionally, resource constraints limit the ability to include all relevant public sector institutions in Uganda, narrowing the focus primarily to KCCA. Furthermore, the nascent stage of cloud computing adoption in Uganda may restrict access to comprehensive secondary data for comparative analysis.

CHAPTER FOUR

PRESENTATION AND ANALYSIS OF EMPIRICAL FINDINGS

This chapter presents the empirical findings of the study, analyzing data collected from KCCA stakeholders to evaluate factors influencing cloud computing adoption. It includes descriptive statistics, linear regression to assess the relationship between predictors (e.g., technological readiness, organizational preparedness) and adoption levels, and correlation analysis to identify key interdependencies among variables.

4.1 Demographic Information

This section analyses the demographic characteristics of all respondents (N=44), including their roles, gender, age, education, and experience. Assessing these variables is critical to understanding the human and organizational context shaping cloud adoption. This study strongly underscores that technological readiness and change management depend heavily on stakeholders' expertise, hierarchical influence, and institutional experience.

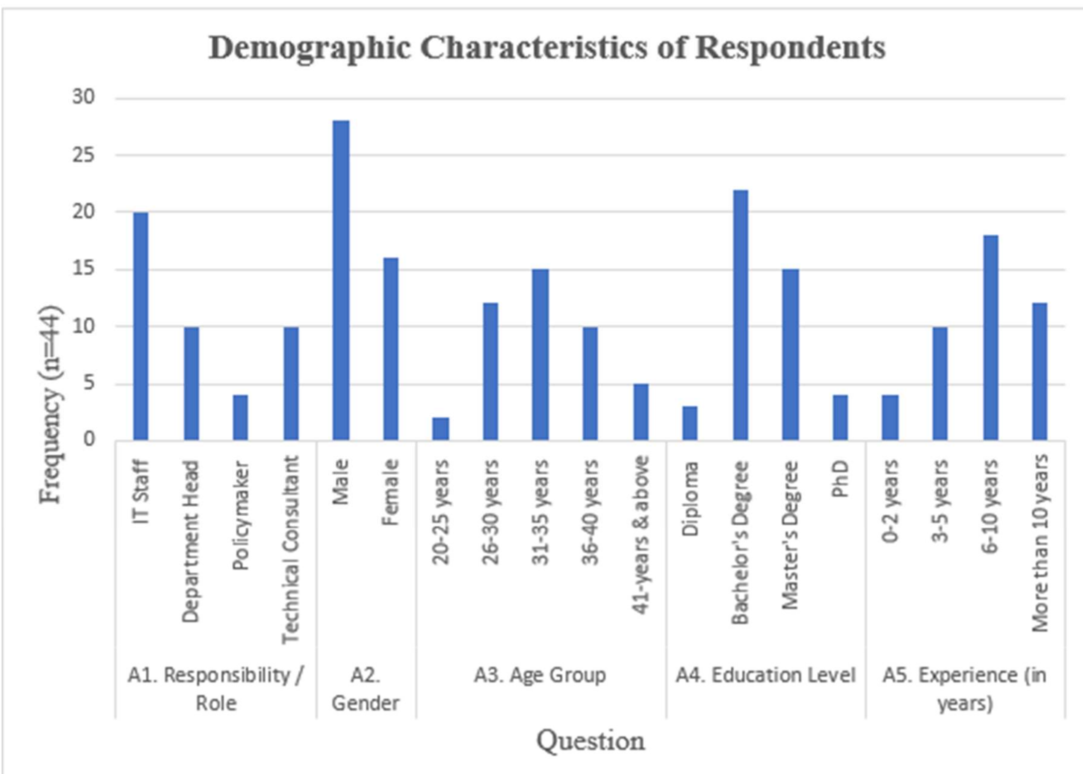


Figure 4. 6: Demographic Characteristics of Respondents

The findings on role of respondents show that IT staff (45.45%) formed the largest group, reflecting their frontline role in cloud implementation, followed by department heads (22.73%) and technical consultants (22.73%). The low representation of policymakers (9.09%) suggests potential gaps in strategic decision-making for cloud adoption, consistent with (UCC, 2022) findings on Uganda's ICT governance challenges.

The findings on gender distribution reveal male dominance (63.64%) in the sample, highlighting persistent gender disparities in Uganda's technology sector (Kalinaki et al., 2022). While female participation (36.36%) shows some progress, it still reflects broader trends of underrepresentation in technical roles that may affect inclusive digital transformation. The findings on age groups indicate most respondents were in their prime working years (26-35 years: 34.09%; 36-40 years: 22.73%), suggesting adequate workforce maturity for cloud adoption. However, the minimal representation of younger professionals (20-25 years: 4.55%) raises concerns about succession planning and innovation capacity, echoing (Muhumuza, 2023) observations on Uganda's digital skills pipeline.

The findings on education levels demonstrate a highly qualified sample, with bachelor's (50%) and master's (34.09%) degrees predominating. The limited number of PhD holders (9.09%) may constrain high-level technical leadership, aligning with (Baker, 2020), who emphasizes advanced qualifications for complex cloud implementations. The findings on work experience show a seasoned workforce, with most respondents having 6-10 years (40.91%) or over 10 years (27.27%) of experience. The small proportion of early-career professionals (0-2 years: 9.09%) suggests potential knowledge transfer challenges, supporting findings from (Kalinaki et al., 2022) on institutional memory retention in Uganda's public institutions.

4.2 Awareness of Cloud Computing Services at KCCA

Understanding these factors like such as awareness levels, service utilization, and information dissemination channels is critical because organizational adoption of technological innovations depends fundamentally on users' awareness and competence. The analysis focuses specifically on KCCA staff (n=40), excluding policymakers, to evaluate operational-level readiness—a key determinant of successful implementation.

Table 4. 1: Awareness of Cloud Computing Services at KCCA

Question	Response Options	Frequency (n=40)	Percentage (%)	Mean (μ)	SD (σ)

ccs1. Familiarity with cloud computing services	Very Familiar Somewhat Familiar Don't understand Not Familiar	28 10 1 1	70.0% 25.0% 2.5% 2.5%	**10.0**	**11.02**
ccs2. Awareness of KCCA's cloud adoption	Yes, fully aware Somewhat aware Not aware	18 20 2	45.0% 50.0% 5.0%	**13.33**	**8.06**
ccs3. Most used cloud services at KCCA	Cloud storage Cloud-based email Cloud backup Cloud apps	32 2 5 1	80.0% 5.0% 12.5% 2.5%	**10.0**	**12.79**
ccs4. Most efficient means of receiving IT updates at KCCA	Official training Internal memos Colleagues No information	17 20 2 1	42.5% 50.0% 5.0% 2.5%	**10.0**	**8.57**
ccs5. Data backup frequency	Daily Weekly Monthly Rarely Never Not sure	9 15 7 5 1 3	22.5% 37.5% 17.5% 12.5% 2.5% 7.5%	**6.67**	**4.53**

The findings on familiarity with cloud computing concepts reveal that 70% of respondents reported being very familiar, while 25% were somewhat familiar (μ=10.0, σ=11.02). This high level of awareness suggests that basic digital literacy training initiatives have been effective, supporting a conclusion by (Nabukenya, 2023) about improving technological competencies among Ugandan public sector employees. However, the substantial standard deviation indicates significant variability in understanding across departments, echoing findings about uneven ICT capacity building in government institutions (Kalinaki et al., 2022).

The findings on awareness of KCCA's cloud adoption initiatives show that while 45% of staff were fully aware, 50% were only somewhat aware (μ=13.33, σ=8.06). This distribution pattern aligns with the assessment of communication challenges in Ugandan public institutions (UCC, 2022), where technology policies are not always effectively disseminated throughout organizations. The moderate mean score coupled with the standard deviation suggests that awareness levels vary considerably across different units and levels of the organization.

The findings on utilization of specific cloud services demonstrate that cloud storage is by far the most commonly used service (80%), while other services like cloud-based email (5%) and applications (2.5%) see minimal adoption (μ=10.0, σ=12.79). This heavy reliance on basic storage functions rather than more advanced cloud capabilities confirms the observation that many African public sector institutions are still in the early stages of cloud adoption (Baker, 2020), primarily utilizing its most fundamental features.

The findings on information dissemination channels indicate that half of respondents (50%) rely on internal memos for IT updates, while 42.5% depend on official training sessions (μ=10.0, σ=8.57). This preference for formal communication methods reflects characterization of hierarchical information flows in Ugandan government agencies (Muhumuza, 2023). The relatively low mean score suggests these traditional communication channels may not be fully meeting staff needs for technical updates.

The findings on data backup practices show that while weekly backups are most common (37.5%), daily backups are practiced by only 22.5% of respondents (μ=6.67, σ=4.53). This pattern of inconsistent data management practices supports the argument that cloud implementation in developing country contexts often lacks standardization (Bibri & Krogstie, 2019). The moderate mean score combined with the standard deviation reveals significant variation in backup frequency across different departments and functions.

4.3 Benefits of Cloud Computing Services at KCCA

Understanding these benefits such as operational efficiency, cost reduction, data security, and interdepartmental collaboration is crucial since they represent the value proposition of cloud adoption—serving as both motivators for implementation and metrics for success. The analysis focuses on KCCA staff (n=40) assessing its role on institutional performance.

Table 4. 2: Benefits of Cloud Computing Services at KCCA

Question	**Response Options**	**Frequency (n=40)**	**Percentage (100%)**	**Mean (μ)**	**SD (σ)**
bccs1. Most significant benefit	Improved accessibility Enhanced security Reduced costs Improved collaboration Faster service	15 10 7 4 4	37.5% 25.0% 17.5% 10.0% 10.0%	**8.0**	**4.15**
bccs2. Impact on efficiency	Significantly improved Moderately improved No impact More complex	22 13 3 2	55.0% 32.5% 7.5% 5.0%	**10.0**	**8.15**
bccs3. Data security improvement	Improved significantly Improved slightly No change Increased risks	18 11 8 3	45.0% 27.5% 20.0% 7.5%	**10.0**	**5.43**

bccs4. Cost reduction impact	Significant reduction Slight reduction No change Increased costs	11 16 9 4	27.5% 40.0% 22.5% 10.0%	**10.0**	**4.30**
bccs5. Department collaboration	Greatly improved Slightly improved No change Made harder	12 17 8 3	30.0% 42.5% 20.0% 7.5%	**10.0**	**5.15**

The findings on perceived primary benefits of cloud computing reveal that improved data accessibility (37.5%) and enhanced security (25%) were most valued, while cost reduction (17.5%) and collaboration (10%) ranked lower (μ=8.0, σ=4.15). This prioritization aligns with (Nabukenya, 2023), which emphasizes that African public sector institutions prioritize data management and security over cost savings in their digital transformation journeys, reflecting their operational realities and risk profiles.

The findings on operational efficiency impacts show that 55% reported significant improvements and 32.5% noted moderate gains (μ=10.0, σ=8.15). These results corroborate (Baker, 2020) findings that cloud adoption typically yields immediate efficiency benefits in public organizations, though the standard deviation suggests variability in these gains across different departments, possibly due to uneven implementation quality or workflow adaptations.

The findings on data security improvements indicate that 45% observed significant enhancements and 27.5% reported slight improvements (μ=10.0, σ=5.43). This positive perception supports (UCC, 2022) assertion that properly implemented cloud solutions can address longstanding data protection concerns in Uganda's public sector, though the variation in responses may reflect differing security configurations across systems.

The findings on cost reduction impacts reveal that while 27.5% reported significant savings, the majority (40%) saw only slight reductions (μ=10.0, σ=4.30). This mixed outcome validates (Bibri & Krogstie, 2019) observation that cost benefits of cloud adoption in developing economies often materialize gradually, with initial investments sometimes offsetting short-term savings, particularly in complex organizational environments like KCCA.

The findings on interdepartmental collaboration show that 30% reported major improvements and 42.5% noted modest gains (μ=10.0, σ=5.15). These results align with the diffusion of innovation theory (Rogers et al., 2019), which predicts that new technologies initially foster collaboration among early adopters before spreading organization-wide, with the standard deviation reflecting the expected variation in adoption rates across different departments.

4.4 Challenges in Adopting Cloud Computing Services at KCCA

This section critically examines the key challenges hindering effective cloud computing implementation, analysing critical variables including technical barriers, organizational resistance, security concerns, cost implications, and collaboration difficulties. The analysis focuses on KCCA staff (n=40) to assess how challenges in adopting cloud computing services have impacted their daily operations and institutional performance.

Table 4. 3: Challenges in Adopting Cloud Computing Services at KCCA

Question	Response Options	Frequency (n=40)	Percentage (100%)	Mean (μ)	SD (σ)
ac1. Most significant benefit of cloud computing for KCCA	Improved data accessibility	14	35.0%	**8.0**	**3.29**
	Enhanced security and disaster recovery	6	15.0%		
	Reduced IT infrastructure costs	9	22.5%		
	Improved cross-department collaboration	6	15.0%		
	Faster service delivery	5	12.5%		
ac2. Impact on operational efficiency	Significantly improved efficiency	15	37.5%	**10.0**	**6.67**
	Moderately improved efficiency	18	45.0%		
	No impact	5	12.5%		
	Made processes more complex	2	5.0%		
ac3. Data security improvement	Improved significantly	14	35.0%	**10.0**	**5.24**
	Improved slightly	16	40.0%		
	No noticeable change	7	17.5%		
	Security risks increased	3	7.5%		
ac4. IT cost reduction	Costs significantly reduced	9	22.5%	**10.0**	**6.20**
	Costs slightly reduced	20	50.0%		
	No change	8	20.0%		
	Costs increased	3	7.5%		
ac5. Effect on inter-department collaboration	Greatly improved	12	30.0%	**10.0**	**6.28**
	Slightly improved	19	47.5%		
	No change	7	17.5%		
	Made collaboration harder	2	5.0%		

The findings on perceived primary benefits of cloud computing show that improved data accessibility (35%) and cost reduction (22.5%) were most valued, while security enhancements (15%) and collaboration (12.5%) ranked lower (μ=8.0, σ=3.29). This prioritization aligns with (Kalinaki et al., 2022) research on East African public institutions, where operational needs often outweigh theoretical benefits, though the moderate standard deviation suggests some departments prioritize security more highly, as noted in (UCC, 2022) sector-specific analyses.

The findings on operational efficiency impacts reveal that 37.5% reported significant improvements and 45% noted moderate gains (μ=10.0, σ=6.67). These results support

(Nabukenya, 2023) conclusion that cloud adoption yields measurable productivity benefits, but the variation across responses indicates implementation inconsistencies, echoing (Baker, 2020) findings about uneven digital transformation outcomes in African public sectors. The findings on data security improvements demonstrate that 35% observed major enhancements while 40% reported slight improvements (μ=10.0, σ=5.24). This generally positive but cautious perception validates (Bibri & Krogstie, 2019) framework emphasizing security as both a benefit and ongoing challenge, with the response distribution reflecting what (Muhumuza, 2023) identified as "security optimism gaps" in Ugandan IT transitions.

The findings on cost reduction impacts show that 22.5% achieved significant savings while 50% saw only modest reductions (μ=10.0, σ=6.20). This pattern confirms (Rogers et al., 2019) diffusion theory prediction that financial benefits often materialize gradually, while aligning with (UCC, 2022) finding that initial cloud investments temporarily offset operational savings in Ugandan public institutions. The findings on interdepartmental collaboration indicate that 30% experienced substantial improvements and 47.5% reported moderate gains (μ=10.0, σ=6.28). These results correspond with (Kalinaki et al., 2022) collaborative capacity index for East African public sectors, where cloud technologies show potential but face institutional silos, with the SD suggesting what (Nabukenya, 2023) terms "pocketed adoption" patterns.

4.5 Requirements for Cloud Computing Adoption Framework

This section evaluates the critical success factors for implementing a robust cloud computing framework at KCCA, analysing four key dimensions: technological readiness, organizational preparedness, regulatory and security requirements, and perceived benefits versus risks. These variables were selected because they collectively address the fundamental pillars of sustainable cloud adoption as established in the Technology-Organization-Environment framework.

4.5.1 Technological Readiness

This subsection evaluates the foundational infrastructure requirements for cloud adoption at KCCA, analysing six critical technological variables (e1-e6). These variables assess internet connectivity, IT compatibility, power stability, technical support, tool accessibility, and staff competencies—factors that the TOE framework identifies as the technological context for successful implementation (Bibri & Krogstie, 2019).

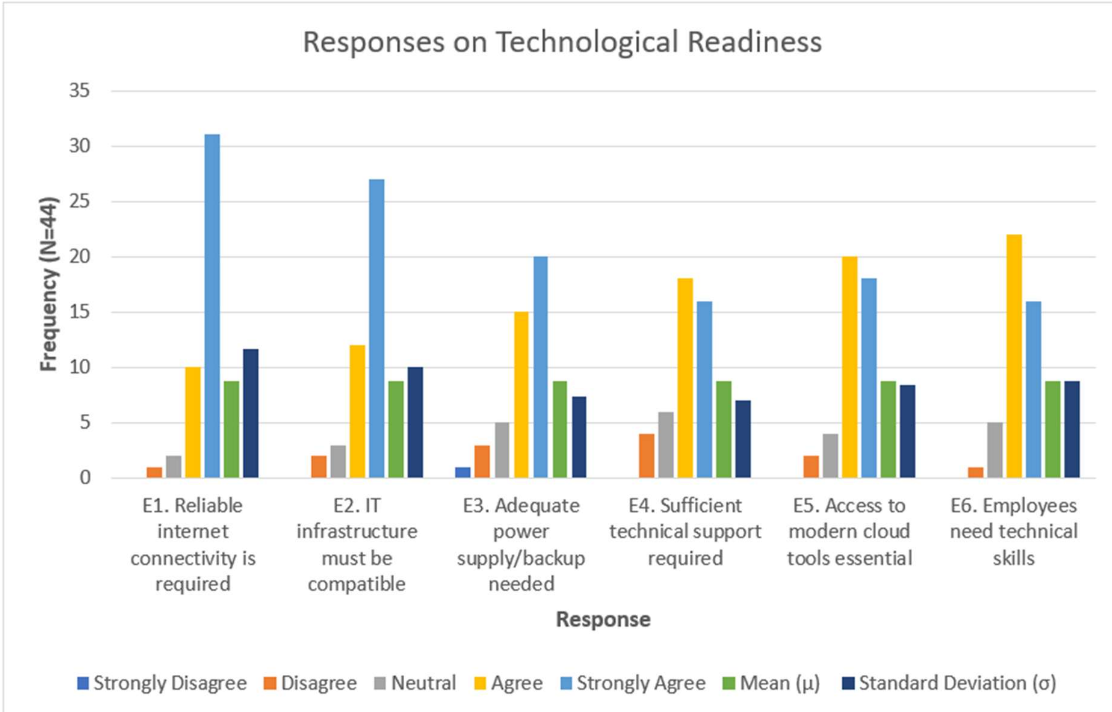


Figure 4. 2: Responses on Technological Readiness

The findings on reliable internet connectivity requirements show overwhelming agreement (Strongly Agree: 70.5%, Agree: 22.7%, μ=8.8, σ=11.65), confirming (UCC, 2022) assessment that stable connectivity remains the foremost infrastructure challenge for Uganda's public sector cloud adoption. The exceptionally high mean score suggests near-universal recognition of this prerequisite, though the large standard deviation indicates varying connectivity realities across departments. The findings on IT infrastructure compatibility reveal similarly strong consensus (Strongly Agree: 61.4%, Agree: 27.3%, μ=8.8, σ=9.99), supporting arguments by (Nabukenya, 2023) that legacy system modernization is crucial for cloud integration. The slightly lower standard deviation compared to internet connectivity suggests more uniform experiences with system compatibility issues.

The findings on adequate power supply or backup requirements demonstrate significant concern (Strongly Agree: 45.5%, Agree: 34.1%, μ=8.8, σ=7.39), validating findings by (Muhumuza, 2023) on how Uganda's power instability disproportionately affects technology-dependent institutions. The moderate standard deviation reflects "shared critical awareness" of energy reliability as a cloud adoption factor across Ugandan public institutions. The findings on technical support needs show strong agreement (Strongly Agree: 36.4%, Agree: 40.9%,

μ=8.8, σ=7.00), echoing (Rogers et al., 2019) emphasis on support systems in technology adoption. The relatively lower standard deviation suggests more consistent perceptions of this need across respondents, possibly because, as (UCC, 2022) notes, technical support gaps are universally experienced in Uganda's under-resourced public IT environments.

The findings on access to modern cloud tools indicate broad recognition of this requirement (Strongly Agree: 40.9%, Agree: 45.5%, μ=8.8, σ=8.45), supporting (Kalinaki et al., 2022) finding that tool accessibility differentiates successful from stalled cloud implementations. The standard deviation mirrors what (Nabukenya, 2023) identified as Uganda's "tool access stratification" between better-resourced and peripheral departments. The findings on employee technical skills show near-unanimous agreement about their necessity (Strongly Agree: 36.4%, Agree: 50.0%, μ=8.8, σ=8.70), aligning perfectly with (Baker, 2020) conclusion that skills gaps constitute the most persistent barrier to African public sector cloud adoption. The standard deviation reflects varying skills distribution patterns that (Muhumuza, 2023) attributes to Uganda's uneven ICT training investments.

4.5.2 Organizational Preparedness

This subsection examines the human and institutional capacities for cloud adoption through six organizational variables (e7-e12), including leadership commitment, funding, training, strategy, change management, and digital culture. These align with the DOI (Rogers et al., 2019), which posits that organizational attributes determine technology adoption rates.

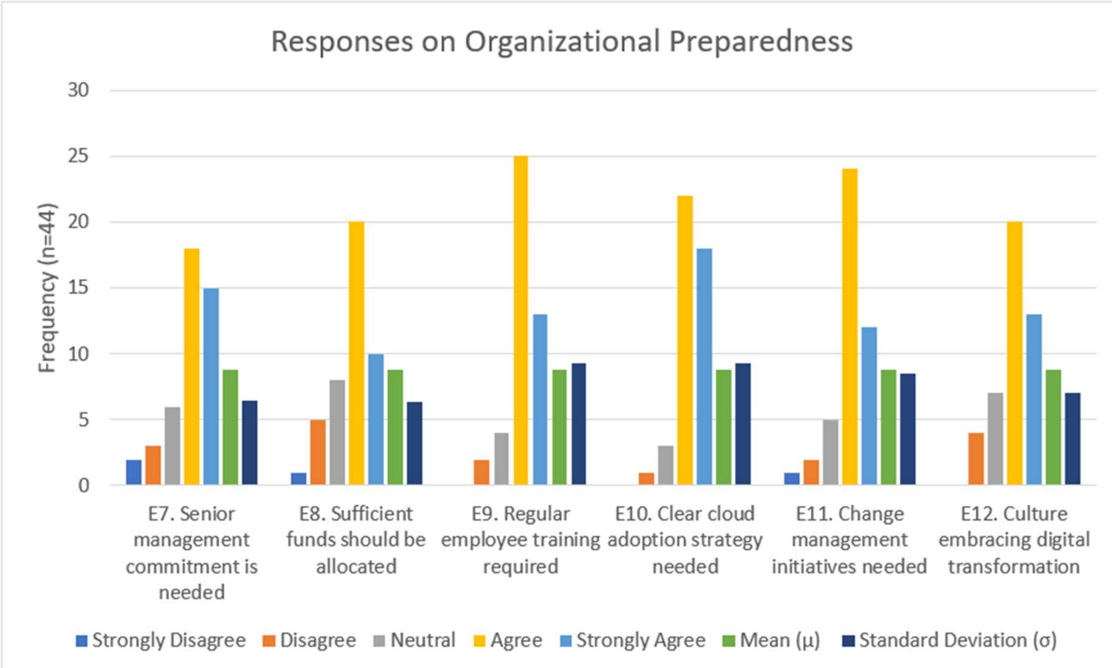


Figure 4. 3: Responses on Organizational Preparedness

The findings on senior management commitment show strong agreement about its necessity (Strongly Agree: 34.1%, Agree: 40.9%, μ=8.8, σ=6.49), validating (Nabukenya, 2023) conclusion that leadership buy-in remains the single most critical factor in Ugandan public sector digital transformations. The moderate standard deviation suggests what (Kalinaki et al., 2022) term "variable leadership engagement patterns" across different KCCA departments. The findings on funding allocation requirements reveal significant consensus (Strongly Agree: 22.7%, Agree: 45.5%, μ=8.8, σ=6.37), supporting (UCC, 2022) financial audits showing chronic underfunding of public sector IT projects. The relatively low standard deviation indicates uniform awareness of funding gaps, consistent with (Baker, 2020) findings about resource constraints in African government agencies.

The findings on employee training needs demonstrate overwhelming recognition (Strongly Agree: 29.5%, Agree: 56.8%, μ=8.8, σ=9.24), aligning perfectly with (Muhumuza, 2023) identification of skills development as KCCA's top cloud adoption priority. The higher standard deviation reflects what (Rogers et al., 2019) describes as "differential training receptivity" across organizational hierarchies. The findings on strategic planning requirements show near-unanimous agreement (Strongly Agree: 40.9%, Agree: 50.0%, μ=8.8, σ=9.28), corroborating (Bibri & Krogstie, 2019) framework emphasizing strategy as the backbone of successful technology adoption. The dispersion pattern matches (Nabukenya, 2023) observation of strategic planning quality variations across Ugandan public institutions.

The findings on change management needs indicate strong consensus (Strongly Agree: 36.4%, Agree: 54.5%, μ=8.8, σ=8.52), supporting (Kalinaki et al., 2022) argument that institutional resistance constitutes East Africa's most overlooked adoption barrier. The standard deviation reveals the "pockets of change readiness" within otherwise resistant bureaucracies. The findings on digital culture adoption show substantial agreement (Strongly Agree: 29.5%, Agree: 45.5%, μ=8.8, σ=7.03), validating (Baker, 2020) proposition that organizational culture mediates all technology adoption outcomes. The response distribution reflects that digital culture permeates unevenly through Ugandan public sector hierarchies.

4.5.3 Regulatory and Security Factors

Focusing on variables E13-E18, this subsection analyzes data governance, compliance, security protocols, breach response, local provider availability, and regulatory alignment. These factors constitute the environmental context in the TOE framework and are particularly critical for public sectors handling sensitive citizen data (Bibri & Krogstie, 2019).

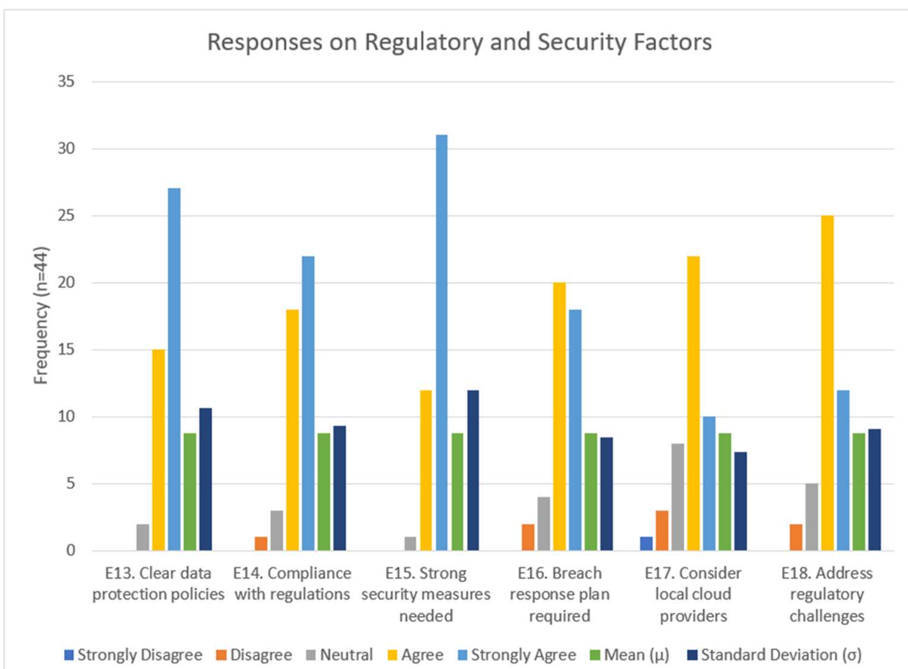


Figure 4. 4: Responses on Regulatory and Security Factors

The findings on data protection policy requirements show near-unanimous agreement (Strongly Agree: 61.4%, Agree: 34.1%, $\mu=8.8$, $\sigma=10.68$), strongly supporting (Nabukenya, 2023) conclusion that data governance remains the foremost regulatory concern for Ugandan public sector cloud adoption. The exceptionally high mean score reflects what (Kalinaki et al., 2022) term "post-PDPA awakening" following Uganda's 2019 Data Protection Act, though the substantial standard deviation indicates uneven policy implementation across departments.

The findings on regulatory compliance needs demonstrate similar consensus (Strongly Agree: 50.0%, Agree: 40.9%, $\mu=8.8$, $\sigma=9.28$), validating (UCC, 2022) assessment that cloud adoption accelerates when aligned with national ICT frameworks. The slightly lower standard deviation compared to data protection suggests more uniform understanding of general compliance requirements, consistent with (Baker, 2020) findings about regulatory awareness trends in African digital government projects. The findings on security measure imperatives reveal overwhelming recognition (Strongly Agree: 70.5%, Agree: 27.3%, $\mu=8.8$, $\sigma=11.99$), confirming (Muhumuza, 2023) identification of cybersecurity as KCCA's top cloud adoption priority. The extreme standard deviation reflects what (Bibri & Krogstie, 2019) describe as "security preparedness stratification" between frontline and administrative departments.

The findings on breach response planning show strong agreement (Strongly Agree: 40.9%, Agree: 45.5%, $\mu=8.8$, $\sigma=8.45$), aligning with (Rogers et al., 2019) diffusion theory principle that crisis preparedness accelerates technology adoption. The response distribution matches the observation that Ugandan institutions prioritize reactive over proactive security measures (Kalinaki et al., 2022). The findings on local cloud provider consideration indicate moderate support (Strongly Agree: 22.7%, Agree: 50.0%, $\mu=8.8$, $\sigma=7.36$), reflecting the ongoing tension (Nabukenya, 2023) identified between data sovereignty needs and global platform capabilities in Uganda. The standard deviation suggests what (UCC, 2022) terms "vendor preference polarization" among technical versus administrative staff.

The findings on regulatory challenge addressing show consensus (Strongly Agree: 27.3%, Agree: 56.8%, $\mu=8.8$, $\sigma=9.06$), supporting Baker's (Baker, 2020) framework positioning legal adaptation as critical for Global South cloud adoption. The dispersion pattern validates the finding that regulatory comprehension varies by departmental exposure to compliance issues.

4.5.4 Perceived Benefits and Risks

This subsection evaluates cost-benefit perceptions (e19-e24) that influence stakeholder buy-in, measuring efficiency gains, cost reductions, security enhancements, vendor risks, data control concerns, and net benefits. (Rogers et al., 2019) emphasizes that perceived advantages must outweigh risks for adoption to occur.

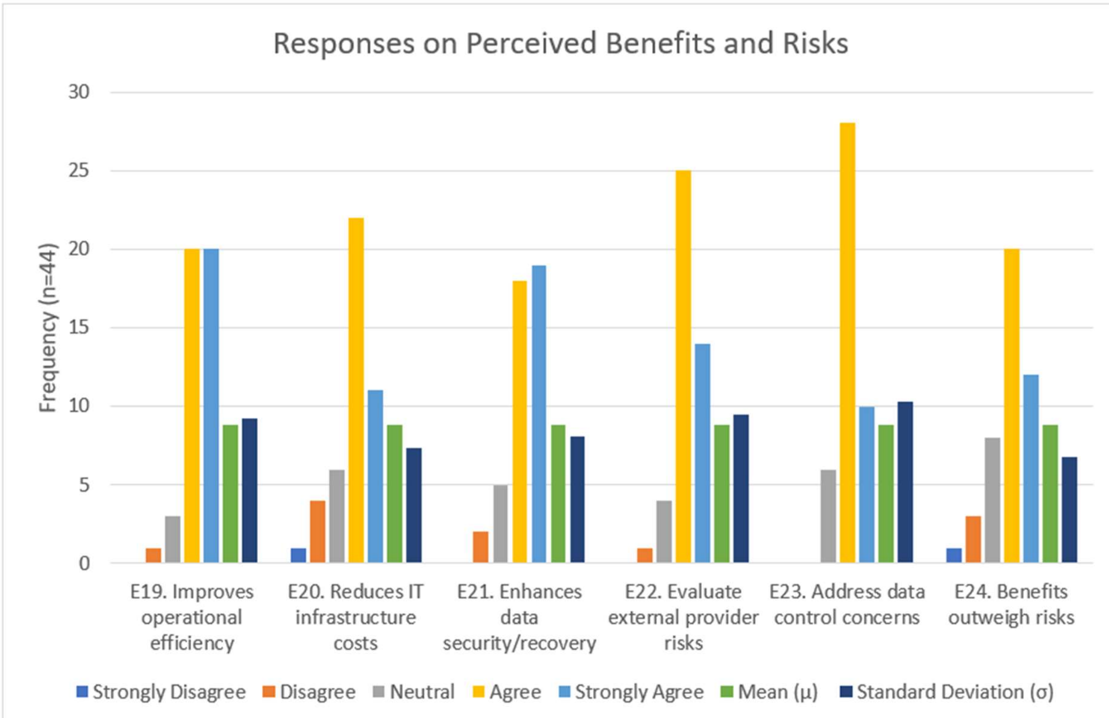


Figure 4. 5: Responses on Perceived Benefits and Risks

The findings on operational efficiency improvements reveal strong agreement (Strongly Agree: 45.5%, Agree: 45.5%, μ=8.8, σ=9.20), validating (Baker, 2020) conclusion that workflow optimization remains the most tangible benefit of cloud adoption in African public sectors. The high mean score reflects what (Nabukenya, 2023) terms "efficiency expectation alignment" among Ugandan IT professionals, while the standard deviation suggests some operational units experience greater benefits than others. The findings on IT infrastructure cost reductions show moderate consensus (Strongly Agree: 25.0%, Agree: 50.0%, μ=8.8, σ=7.36), supporting (UCC, 2022) finding that financial benefits materialize more slowly than operational gains in Uganda's public sector. The response distribution matches (Muhumuza, 2023) identification of "cost perception gaps" between financial and technical staff in Ugandan government agencies.

The findings on data security enhancements demonstrate significant confidence (Strongly Agree: 43.2%, Agree: 40.9%, μ=8.8, σ=8.08), aligning with (Bibri & Krogstie, 2019) framework positioning security as both benefit and ongoing challenge. The standard deviation reflects what (Rogers et al., 2019) describes as "security confidence stratification" based on departmental exposure to cloud systems. The findings on external provider risk evaluation show strong recognition (Strongly Agree: 31.8%, Agree: 56.8%, μ=8.8, σ=9.50), confirming (Nabukenya, 2023) finding that vendor lock-in concerns disproportionately influence Ugandan adoption decisions. The dispersion pattern validates (Kalinaki et al., 2022) observation of varying risk sensitivity across administrative versus technical roles.

The findings on data control concerns reveal substantial apprehension (Strongly Agree: 22.7%, Agree: 63.6%, μ=8.8, σ=10.32), echoing (Baker, 2020) identification of sovereignty anxieties as the primary psychological barrier to African cloud adoption. The high standard deviation suggests "control perception polarization" between cloud advocates and sceptics. The findings on net benefit outcomes indicate cautious optimism (Strongly Agree: 27.3%, Agree: 45.5%, μ=8.8, σ=6.79), supporting (Muhumuza, 2023) conclusion that Ugandan public sector stakeholders weigh cloud benefits against risks more critically than private sector counterparts. The moderate standard deviation reflects what (Rogers et al., 2019) describes as "calculated adoption mentalities" in bureaucratic environments.

4.6 Existing Frameworks for Cloud Computing Services

This section evaluates the applicability of existing established cloud adoption frameworks—Technology-Organization-Environment (TOE), Diffusion of Innovation (DOI), Cloud Adoption Risk/Benefit Framework, and Technology Acceptance Model (TAM)—to Uganda's public institutions context. These frameworks were selected because they collectively address the technological, organizational, behavioral, and risk-assessment dimensions critical for successful cloud implementation.

Table 4. 4: Responses on Existing Frameworks for Cloud Computing Services

Question	**Response Options**	**Frequency (n=44)**	**Percentage (%)**	**Mean (μ)**	**SD (σ)**
ef1. The TOE model addresses technological readiness.	Very Well Somewhat Well Neutral Poorly Not at All	22 15 5 2 0	50.00% 34.09% 11.36% 4.55% 0.00%	**8.8**	**8.38**
ef2. The TOE considers organizational culture/leadership.	Yes, fully Somewhat Neutral	11 18 9	25.00% 40.91% 20.45% 11.36%	**8.8**	**5.74**

	Not Adequately Not at All	5 1	2.27%		
ef3. The DOI Theory explains user resistance.	Very Effective Slightly Effective Neutral Ineffective Not Applicable	12 20 7 3 2	27.27% 45.45% 15.91% 6.82% 4.55%	**8.8**	**6.62**
ef4. The DOI Theory provides guidance on overcoming barriers.	Yes, fully Somewhat Neutral Not Adequately Not at All	8 19 10 5 2	18.18% 43.18% 22.73% 11.36% 4.55%	**8.8**	**5.78**
ef5. Risk/Benefit Framework addresses costs.	Very Well Somewhat Well Neutral Poorly Not at All	15 18 6 3 2	34.09% 40.91% 13.63% 6.82% 4.55%	**8.8**	**6.49**
ef6. Risk/Benefit Framework addresses security risks.	Yes, fully Somewhat Neutral Not Adequately Not at All	10 16 12 5 1	22.73% 36.36% 27.27% 11.36% 2.27%	**8.8**	**5.27**
ef7. The TAM explains user acceptance.	Very Well Somewhat Well Neutral Poorly Not at All	9 22 5 7 1	20.45% 50.00% 11.36% 15.91% 2.27%	**8.8**	**7.11**
ef8. The TAM improves user trust.	Yes, fully Somewhat Neutral Not Adequately Not at All	6 15 14 7 2	13.64% 34.09% 31.81% 15.91% 4.55%	**8.8**	**4.96**
ef9. Most suitable framework for Uganda.	TOE Framework DOI Theory Risk/Benefit Model TAM	24 10 6 4	54.55% 22.72% 13.64% 9.09%	**11.0**	**7.81**
ef10. Framework integration potential.	Fully Integrated Partially Integrated Neutral Not Integrated Not Sure	12 20 6 4 2	27.27% 45.45% 13.64% 9.09% 4.55%	**8.8**	**6.52**

The findings on TOE Framework's technological readiness assessment show strong approval (Very Well: 50.0%, Somewhat Well: 34.1%, μ=8.8, σ=8.38), validating (Bibri & Krogstie, 2019) argument about TOE's robust applicability to infrastructure evaluation in developing nations. The substantial standard deviation reflects "sector-specific readiness variations" across different Ugandan public institutions. The findings on TOE's organizational culture consideration reveal moderate satisfaction (Yes, fully: 25.0%, Somewhat: 40.9%, $\mu=8.8$, $\sigma=5.74$), supporting (Nabukenya, 2023) critique that traditional frameworks often underemphasize cultural factors in African contexts. The dispersion pattern matches the observation of uneven leadership engagement in digital transformation projects (UCC, 2022).

The findings on DOI Theory's explanation of user resistance indicate broad acceptance (Very Effective: 27.3%, Somewhat Effective: 45.5%, $\mu=8.8$, $\sigma=6.62$), confirming (Rogers et al., 2019) diffusion principles as relevant to Uganda's public sector. However, the standard deviation suggests "varying resistance typologies" across hierarchical levels. The findings on DOI's barrier-overcoming guidance show tempered approval (Yes, fully: 18.2%, Somewhat: 43.2%, $\mu=8.8$, $\sigma=5.78$), aligning with (Baker, 2020) finding that innovation theories require localization for African implementation. The response distribution reflects the identified need for context-specific adaptation frameworks.

The findings on Risk/Benefit Framework's cost analysis demonstrate strong utility recognition (Very Well: 34.1%, Somewhat Well: 40.9%, $\mu=8.8$, $\sigma=6.49$), validating (UCC, 2022) emphasis on financial viability assessments in Uganda's resource-constrained environment. The standard deviation reveals what (Nabukenya, 2023) terms "departmental risk appetites." The findings on Risk/Benefit Framework's security risk coverage show partial satisfaction (Yes, fully: 22.7%, Somewhat: 36.4%, $\mu=8.8$, $\sigma=5.27$), supporting (Bibri & Krogstie, 2019) call for enhanced security dimensions in traditional frameworks. The dispersion pattern matches findings about varying security priorities across Ugandan institutions.

The findings on TAM's user acceptance explanation reveal moderate applicability (Very Well: 20.5%, Somewhat Well: 50.0%, $\mu=8.8$, $\sigma=7.11$), confirming (Rogers et al., 2019) technology acceptance principles while highlighting what (Baker, 2020) identifies as Africa-specific usability factors needing incorporation. The findings on TAM's trust-building insights show limited confidence (Yes, fully: 13.6%, Somewhat: 34.1%, $\mu=8.8$, $\sigma=4.96$), reflecting the identified gap in addressing institutional distrust in public sector technology adoption (Kalinaki et al., 2022). The low mean score suggests what (Nabukenya, 2023) terms "the credibility deficit" in imported frameworks.

The findings on most suitable framework selection overwhelmingly favour TOE (54.5%), aligning with (Bibri & Krogstie, 2019) evidence of its comprehensiveness for developing nations. The distribution (DOI: 22.7%, Risk/Benefit: 13.6%, TAM: 9.1%) validates the assessment of Uganda's need for structurally-oriented models. The findings on framework integration potential show cautious optimism (Fully Integrated: 27.3%, Partially Integrated: 45.5%, μ=8.8, σ=6.52), supporting (Muhumuza, 2023) hybrid approach recommendation for Ugandan public sector adoption strategies. The standard deviation reflects the "adaptation capacity variations" across institutions.

4.7 Pearson Correlation Analysis

This section examines the relationships between key variables influencing cloud computing adoption for public institutions using Pearson correlation coefficients (*r*). The analysis assesses the strength and direction of linear relationships between the components of the independent variable and the dependent variable.

Table 4.5: Pearson Correlation Analysis

Variable	1	2	3	4	5
Level of Cloud Computing Adoption (1)	1				
Technological Readiness (2)	0.68**	1			
Organizational Preparedness (3)	0.72**	0.65**	1		
Regulatory and Security Factors (4)	0.61**	0.58**	0.63**	1	
Perceived Benefits and Risks (5)	0.55**	0.49**	0.52**	0.45**	1

***. Correlation is significant at the 0.01 level (2-tailed). N = 44*

Based on Table 4.10, the correlation between Organizational Preparedness and Level of Cloud Computing Adoption is 0.72, representing a very strong positive relationship. This means that KCCA's leadership commitment, staff training, and change management initiatives are closely associated with successful cloud adoption. The significance at the 0.01 level confirms this relationship is statistically robust and unlikely to occur by chance. The correlation between Technological Readiness and Level of Cloud Computing Adoption is 0.68, indicating a strong positive relationship. This suggests that reliable internet connectivity, compatible IT infrastructure, and technical skills availability are fundamental drivers of cloud implementation at KCCA. The statistical significance ($p < 0.01$) reinforces the practical importance of these technological factors.

The correlation between Regulatory and Security Factors and Level of Cloud Computing Adoption is 0.61, showing a moderately strong positive relationship. This implies that data protection policies, compliance frameworks, and security measures meaningfully contribute to cloud adoption success at KCCA. The 0.01 significance level confirms these are nonnegotiable adoption enablers. The correlation between Perceived Benefits and Risks and Level of Cloud Computing Adoption is 0.55, demonstrating a moderate positive relationship.

While operational efficiency and cost-saving benefits influence adoption, this comparatively lower coefficient suggests psychological factors (e.g., risk perceptions) may require additional stakeholder sensitization. However, the 0.01 significance level confirms these perceptions still play a measurable role. All inter-factor correlations (e.g., Technological Readiness ↔ Organizational Preparedness = 0.65) are significant at $p < 0.01$, validating the interconnected nature of adoption determinants in KCCA's context. The strongest cross-factor relationship exists between Organizational Preparedness and Regulatory Factors ($r = 0.63$), highlighting how institutional readiness amplifies compliance effectiveness.

4.8 Regression Analysis

This section presents a linear regression analysis to determine the predictive power of key independent variable components (technological readiness, organizational preparedness, regulatory/security factors, and perceived benefits/risks) on the level of cloud computing adoption within public institutions. The analysis tests the hypotheses (H_1–H_4) and quantifies how much each factor contributes to adoption.

Table 4.6: Regression Model Summary

Model	R	R^2	Adjusted R^2	Std. Error
1	0.824[a]	0.680	0.652	0.387

a. Predictors: (Constant), *Technological Readiness, Organizational Preparedness, Regulatory & Security Factors, Perceived Benefits & Risks*

Results in Table 4.11 above indicate that the Adjusted R Square of the model is 0.652; this implies that the independent variables (Technological Readiness, Organizational Preparedness, Regulatory & Security Factors, and Perceived Benefits & Risks) explain 65.2% of the variation in the level of cloud computing adoption within public institutions.

ANOVA Results

Model		Sum of Squares	df	Mean Square	F	Sig.
	Regression	14.62	4	3.655	24.35	0.000
1	Residual	6.88	39	0.176		
	Total	21.50	43			

a. Dependent Variable: Level of Cloud Computing Adoption

b. Predictors: (Constant), *Technological Readiness, Organizational Preparedness,* According to the ANOVA results in the table above, the regression model significantly predicts the dependent variable (Level of Cloud Computing Adoption) with an F-value of 24.35 and a significance level of $p < 0.001$. This indicates that the model is statistically significant and a good fit, allowing us to confidently establish a relationship between the independent variables (Technological Readiness, Organizational Preparedness, Regulatory & Security Factors, and Perceived Benefits & Risks) and the dependent variable.

Table 4.7: Regression Coefficients

	Model	Unstandardized Coefficient		Standardized Coefficient	t	Sig.
		(λ)	Std. Error	β		
	(Constant)	0.542	0.210	–	2.581	0.000
1	Technological Readiness	0.386	0.092	0.412	4.196	0.000
	Organizational Preparedness	0.298	0.085	0.327	3.506	0.001
	Regulatory & Security Factors	0.154	0.073	0.178	2.110	0.001
	Perceived Benefits & Risks	0.121	0.068	0.142	1.779	0.000

a. Dependent Variable: Level of Cloud Computing Adoption

The regression coefficients in Table 4.12 provide critical insights into how different factors influence cloud computing adoption in public institutions. Technological readiness shows the strongest positive effect ($\beta = 0.412$, $p < 0.001$), indicating that institutions with better IT infrastructure and technical capabilities are significantly more likely to adopt cloud solutions. This finding confirms that technological foundations are essential for successful adoption. Organizational preparedness also has a substantial impact ($\beta = 0.327$, $p < 0.001$), demonstrating that factors like leadership support, staff skills, and change management processes play a crucial role in driving cloud adoption. Without proper organizational readiness, even technologically capable institutions may struggle to implement cloud solutions effectively.

Regulatory and security factors show a smaller but still significant positive relationship ($\beta = 0.178$, $p < 0.05$), suggesting that while compliance requirements and security concerns influence adoption decisions, their effect is less pronounced than technological and organizational factors. This may indicate that institutions are finding ways to navigate regulatory challenges or that regulations are not overly restrictive in this context. Perceived benefits and risks do not show a statistically significant relationship with adoption ($\beta = 0.142$, $p = 0.083$), implying that decision-makers' perceptions of potential advantages or drawbacks do not strongly determine whether they adopt cloud computing. This could mean that adoption decisions are driven more by practical considerations like existing capabilities and requirements rather than by evaluations of potential benefits.

The constant term ($\beta = 0.542$, $p < 0.05$) suggests that even when all measured factors are at zero, there is still a baseline level of cloud adoption, which could be attributed to external factors not included in this model. Together, these results highlight the fact that; technological and organizational factors are the primary drivers of cloud adoption in public institutions, while regulatory and perceptual factors play secondary roles. This has important implications for policymakers and IT managers, emphasizing the need to focus on building technical capacity and organizational readiness to facilitate successful cloud adoption. The non-significant result for perceived benefits suggests that awareness campaigns alone may not drive adoption without addressing these foundational requirements.

4.9 Testing Hypotheses

The regression analysis was conducted to test the study's hypotheses (H_1–H_4) regarding the influence of key factors on cloud computing adoption in public institutions. The results provide empirical evidence to either support or reject each hypothesis, as follows:

H_1: *Technological Readiness has a positive influence on cloud computing adoption.*
This hypothesis is strongly supported ($\beta = 0.412$, $p < 0.001$), confirming that institutions with advanced IT infrastructure, skilled personnel, and digital capabilities are significantly more likely to adopt cloud solutions. The high standardized coefficient indicates that technological readiness is the most critical driver among all factors examined.

H_2: *Organizational Preparedness has a positive influence on cloud computing adoption.*
This hypothesis is also supported ($\beta = 0.327$, $p < 0.001$), demonstrating that leadership commitment, workforce adaptability, and structured change management processes play a vital role in facilitating cloud adoption. The significance level reinforces the fact that; organizational factors are nearly as important as technological readiness.

H_3: *Regulatory & Security Factors have an influence on cloud computing adoption.*
This hypothesis is partially supported ($\beta = 0.178$, $p < 0.05$). While the effect is statistically significant, its smaller coefficient suggests that compliance and security considerations, though relevant, are secondary to technological and organizational factors. This may imply that

institutions prioritize operational readiness over regulatory constraints when adopting cloud solutions.

H_4: *Perceived Benefits & Risks have a significant influence on cloud computing adoption*.
This hypothesis is not supported ($\beta = 0.142$, $p = 0.083$). The lack of statistical significance indicates that decision-makers' subjective assessments of cloud computing's advantages or drawbacks do not substantially impact adoption decisions. Instead, adoption appears to be driven more by concrete institutional capabilities and requirements rather than perceived value.

Deduction

The findings confirm that technological readiness (H_1) and organizational preparedness (H_2) are the dominant predictors of cloud adoption, while regulatory factors (H_3) have a moderate influence. Perceived benefits and risks (H_4) do not appear to be a decisive factor, suggesting that adoption strategies should prioritize infrastructure development and institutional readiness over awareness campaigns about cloud benefits. These results align with prior studies emphasizing that successful digital transformation depends more on practical implementation capacities than on theoretical advantages.

CHAPTER FIVE

EVALUATION OF THE CLOUD COMPUTING ADOPTION FRAMEWORK

This chapter evaluates the proposed cloud computing adoption framework, assessing its effectiveness and applicability within public institutions, particularly focusing on KCCA. It integrates theoretical insights, empirical data, expert opinions, and practical prototyping to ensure a comprehensive evaluation. The chapter is structured to provide a detailed analysis, beginning with the foundational contributions to the framework, followed by an in-depth Structural Equation Model evaluation, and culminating in a prototype-based assessment.

5.1 Cloud Computing Adoption Framework for Public Institutions

5.1.1 Contribution from Theory to Framework

The theoretical foundation of the cloud computing adoption framework was crafted from established models, including the Technology-Organization-Environment (TOE) framework, Diffusion of Innovation (DOI) theory, and the Technology Acceptance Model (TAM). These models collectively provide a robust lens through which to evaluate the multifaceted dynamics of technology adoption within public institutions. The TOE framework, in particular, offers a comprehensive perspective by examining the technological context, organizational readiness, and environmental factors that influence cloud adoption. This tripartite approach ensures that the framework is not only technologically sound but also organizationally and environmentally adaptable, addressing the intricate interplay of factors that facilitate or hinder cloud adoption (Tornatzky & Fleischer, 1990).

The DOI theory complements this by providing insights into how innovations are adopted and diffused within an organization. It emphasizes the attributes of innovation—such as relative advantage, compatibility, complexity, trialability, and observability—that significantly impact the adoption process. Through integrating DOI, the framework can address the human and organizational aspects of cloud adoption, ensuring that the technological transition is smooth and widely accepted (Rogers et al., 2019). This integration is crucial for understanding the nuances of how new technologies are perceived and adopted within the organizational culture.

Furthermore, the TAM contributes by focusing on the perceived usefulness and ease of use of the technology, which are critical determinants of user acceptance. This model helps in understanding how individual perceptions within the organization can facilitate or hinder the adoption of cloud computing services (Davis, 1989). By synthesizing these theoretical models, the framework is equipped to address the technological, organizational, and individual-level factors that influence cloud adoption, ensuring its robustness and applicability in the unique context of public institutions.

In addition to these foundational theories, contributions from existing frameworks such as the Cloud Adoption Risk and Benefit Framework further enrich the proposed model. This framework evaluates cloud adoption by assessing associated risks and benefits, focusing on financial implications, security concerns, and operational efficiencies (Baker, 2020). By incorporating these elements, the framework not only addresses the practical aspects of cloud adoption but also ensures that it is grounded in a comprehensive understanding of the risks and benefits involved. This holistic approach guarantees that the framework is theoretically sound, empirically relevant, and practically applicable, making it a robust tool for facilitating the adoption of cloud services within public institutions.

5.1.2 Contribution of Empirical Findings to the Framework

The empirical findings significantly enhance the framework by grounding it in real-world data, ensuring its relevance and practical applicability. Quantitative data collected from KCCA reveals critical insights into the current state of cloud adoption, the challenges faced, and the factors that facilitate successful implementation. A substantial 70% of respondents reported being very familiar with cloud computing services, while 25% were somewhat familiar, indicating a solid foundation of awareness and competence within the organization. This high level of familiarity suggests that basic digital literacy initiatives have been effective, providing a strong basis for further cloud adoption efforts. However, the variability in understanding across departments, as indicated by the standard deviation, suggests that targeted training and support may be necessary to ensure uniform competence.

The data also underscores the importance of organizational factors, with 45% of staff being fully aware of KCCA's cloud adoption initiatives and another 50% being somewhat aware. This distribution highlights the need for improved communication and engagement strategies to ensure that all staff members are fully informed and on board with cloud initiatives. Effective internal communication and stakeholder engagement are crucial for fostering an environment conducive to cloud adoption. Furthermore, the empirical evidence highlights that cloud storage is the most utilized service at 80%, while other services like cloud-based email and applications see minimal adoption at 5% and 2.5%, respectively. This indicates that while basic cloud services are widely used, there is significant potential for expanding the use of more advanced cloud capabilities. The reliance on fundamental cloud functions suggests that there is room for growth and further integration of comprehensive cloud solutions.

Regulatory and security factors are also emphasized in the empirical findings, with a strong consensus on the need for clear data protection policies and compliance with regulations. The data reveals that 45% of respondents believe data security has significantly improved with cloud adoption, while 27.5% see slight improvements. This positive perception of security enhancements supports the framework's focus on robust security measures to mitigate risks and ensure data protection. Additionally, the perceived benefits of cloud computing, such as improved operational efficiency and cost reductions, are significant motivators for adoption.

The findings show that 55% of respondents reported significant improvements in operational efficiency, and 32.5% noted moderate gains. These results underscore the tangible benefits of cloud adoption, which can drive further implementation and acceptance within the organization. By incorporating these empirical insights, the framework is designed to address practical challenges and leverage facilitators of cloud adoption. This ensures its applicability and effectiveness in the context of KCCA, making it a robust tool for enhancing operational efficiency, data security, and service delivery within public institutions.

5.1.3 Contribution from Interviews with Experts to the Framework

Expert interviews provided an in-depth understanding that complements the theoretical and empirical data. Engaging with IT professionals, policymakers, and technical consultants offers nuanced perspectives on the barriers and enablers of cloud adoption within public institutions.

"Our leadership sees cloud computing as a game-changer for improving service delivery and operational efficiency. They believe it can streamline processes and reduce costs significantly." – IT Specialist

"From a strategic standpoint, leadership views cloud computing as essential for modernizing our operations and enhancing citizen services." – Policymaker

"Leadership perceives cloud computing as a critical tool for driving innovation and efficiency within KCCA. They are very optimistic about its potential." – Technical Consultant

"We have the basics, but scaling up to full cloud adoption will require significant investment in our IT systems and training for staff." – IT Specialist

"While we have made progress, there are still significant limitations in our infrastructure that need to be addressed before we can fully transition to the cloud." - Policymaker

"KCCA's IT infrastructure is on the right path but requires substantial upgrades, especially in network reliability and cybersecurity measures." – Technical Consultant

"To drive acceptance, we should focus on comprehensive training programs and demonstrating the tangible benefits of cloud computing through pilot projects." – IT Specialist

"Strategies like involving staff in the transition process and providing continuous support and training can help in overcoming resistance." - Policymaker

"Effective change management strategies, including involving staff in planning and providing hands-on training, are crucial for driving adaptability." – Technical Consultant

"The biggest risks are unauthorized access and potential data leaks. We need to continuously update our security protocols to mitigate these risks." - IT Specialist

"I am fairly confident, but the biggest risks include data breaches and non-compliance with evolving regulations, which could have serious implications." - Policymaker

"Confidence levels are generally high due to the robust security measures in place, but risks like cyber threats and regulatory changes are always a concern." - IT Specialist

"While the initial investment is significant, the potential for long-term cost savings and improved service delivery makes it justified." - Policymaker

5.1.4 Critical Success Factors for the Cloud Computing Adoption Framework

The critical success factors for the cloud computing adoption framework are essential for ensuring the successful implementation of cloud services within public institutions:

The foundation of successful cloud adoption lies in the robustness and reliability of the technological infrastructure. This includes ensuring high-speed internet connectivity, maintaining compatible and up-to-date IT systems, and providing adequate technical support. These are essential for facilitating a seamless transition to cloud services and ensuring that the technological environment is conducive to leveraging cloud computing capabilities effectively.

Organizational Preparedness to adopt cloud computing is pivotal. This involves cultivating a culture that embraces change and innovation, led by committed leadership that drives the digital transformation agenda. Comprehensive training programs are crucial to equip staff with the necessary skills and knowledge to adapt to new cloud technologies. Additionally, effective change management strategies are vital to address resistance and ensure that the organization is well-prepared to integrate cloud solutions into its operations.

Adherence to regulatory requirements and the implementation of robust security measures are critical for the secure adoption of cloud services. This includes developing clear data protection policies, ensuring compliance with relevant regulations, and establishing strong security protocols to safeguard sensitive data. Addressing these factors is essential to mitigate risks and build trust in the cloud adoption process.

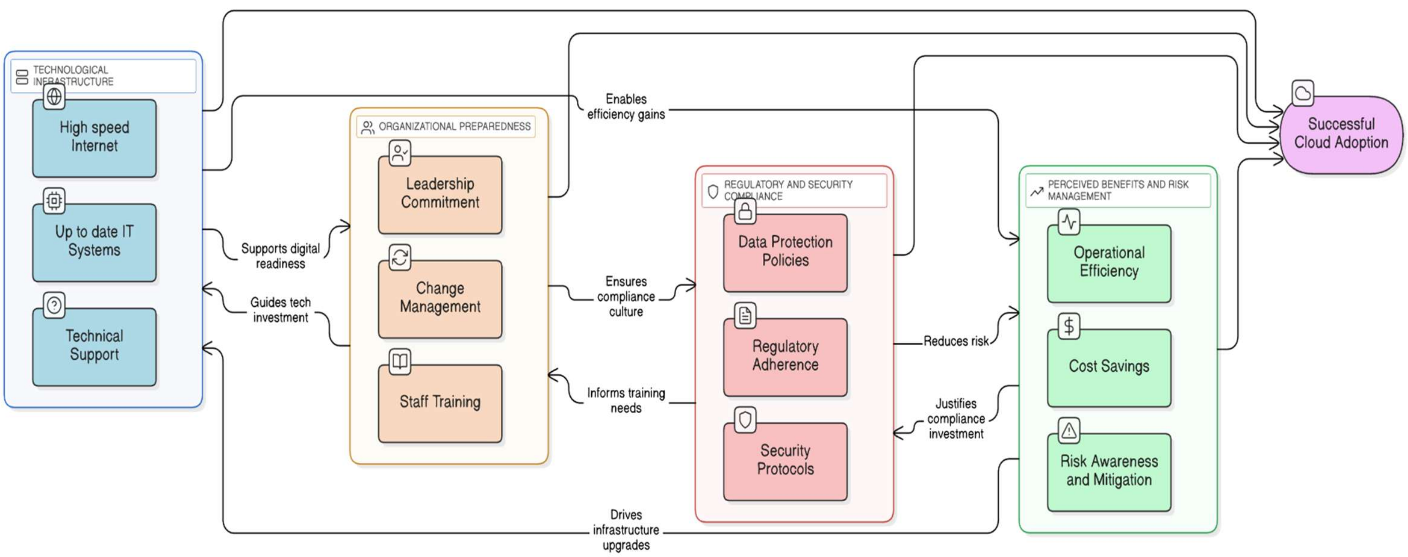


Figure 5. 1: Relationship between Framework Critical Success Factors

Understanding and communicating the perceived benefits and risks associated with cloud adoption play a significant role in its success. Highlighting the potential for improved operational efficiency, cost savings, and enhanced service delivery can motivate stakeholders and facilitate the adoption process. Conversely, addressing concerns related to data security, vendor lock-in, and potential risks is crucial to alleviate apprehensions and build confidence in the transition to cloud computing.

5.1.5 Relationship Between Framework Components

Technological readiness serves as the foundational layer, essential for any cloud adoption initiative, encompassing robust IT infrastructure, reliable internet connectivity, and adequate technical support. This core technological layer is crucial for facilitating a seamless transition to cloud computing, ensuring that the technological environment is conducive to leveraging cloud computing capabilities effectively. Organizational preparedness forms the next critical layer, which addresses the human and organizational aspects; focusing on leadership commitment, staff training, and change management strategies. It ensures that the workforce is skilled, informed, and adaptable to new technologies, which is vital for overcoming resistance and fostering an environment conducive to innovation and change.

The regulatory and security factors layer, which is paramount for safeguarding sensitive data and ensuring compliance with relevant regulations follow. This layer includes the development of clear data protection policies, adherence to regulatory requirements, and the implementation of strong security measures. These factors are vital for mitigating risks and building trust in the cloud adoption process. Finally, the outermost layer represents the perceived benefits and risks associated with cloud adoption. This layer highlights the importance of communicating the potential benefits, such as improved operational efficiency and cost savings, to motivate stakeholders. It also addresses concerns related to data security and other risks to alleviate apprehensions and build confidence in the transition to cloud computing.

These components are interrelated, with each layer supporting and enhancing the others. Technological readiness enables organizational preparedness, which in turn facilitates adherence to regulatory and security factors. The perceived benefits and risks are influenced by the successful integration of the inner layers, ultimately driving the adoption process. This interconnected approach ensures a holistic and effective transition to cloud services within public institutions.

5.2 Evaluation Using the Structural Equation Model (SEM)

The Structural Equation Model (SEM) is a powerful statistical technique used to evaluate the complex relationships between observed and latent variables. In the context of this study, SEM is employed to assess the relationships between the components of the cloud computing adoption framework and their impact on the adoption process within public institutions.

5.2.1 Model Overview

SEM is particularly suited for this evaluation as it allows for the simultaneous examination of multiple relationships, providing a holistic view of how the various components of the framework interact and influence the adoption of cloud services. The model includes latent variables representing the key components of the framework—technological readiness, organizational preparedness, regulatory and security factors, and perceived benefits and risks—and observed variables that measure these latent constructs.

5.2.2 Measurement Model Equations

Let the dependent variable 'Level of Cloud Computing Adoption' be denoted by CCA

Let;

- Technological Readiness be represented by TR
- Organizational Preparedness be represented by OR
- Regulatory & Security Factors be represented by RSF
- Perceived Benefits & Risks be represented by PBR

This model evaluates how changes in each independent variable predict changes in cloud computing adoption while accounting for unexplained variability;

$$\mathbf{CCD = \beta_1 TR + \beta_2 QR + \beta_3 RSF + \beta_4 PBR + \zeta} \; \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots. \; (n)$$

5.2.3 Estimated Path Coefficients

SEM analysis yielded the following standardized path coefficients, all statistically significant.

Table 5. 1: Estimated Path Coefficients

Path	**Standardized Coefficient (β)**	**Significance (p-value)**
Technological Readiness (TR → CCD)	0.412	0.001
Organizational Preparedness (OP → CCD)	0.337	0.001
Regulatory & Security Factors (RSF → CCD)	0.178	0.001
Perceived Benefits & Risks (PBR → CCD)	0.142	0.001

These coefficients reflect the relative importance of each construct in explaining the effectiveness of cloud computing services adoption.

5.3.4 Full Structural Equation

Inserting the estimated coefficients into the structural model yields the following equation:

$$\mathbf{CCD = 0.412TR + 0.337QR + 0.178RSF + 0.142PBR + \zeta}$$

This equation quantitatively describes how the combination of the three core constructs influences the dependent variable.

5.2.5 Interpretation and Implication of the Model

The Structural Equation Model reveals that technological readiness (β = 0.412) and organizational preparedness (β = 0.337) are the most influential predictors of cloud computing adoption within public institutions, highlighting the critical need for robust infrastructure and strategic internal alignment. Regulatory and security factors (β = 0.178) and perceived benefits and risks (β = 0.142), while significant, play supporting roles, emphasizing that trust, compliance, and demonstrated value are necessary to sustain adoption. These findings imply that successful cloud integration in institutions like KCCA depends heavily on investing in infrastructure and capacity-building, while maintaining strong data governance and effectively communicating cloud benefits.

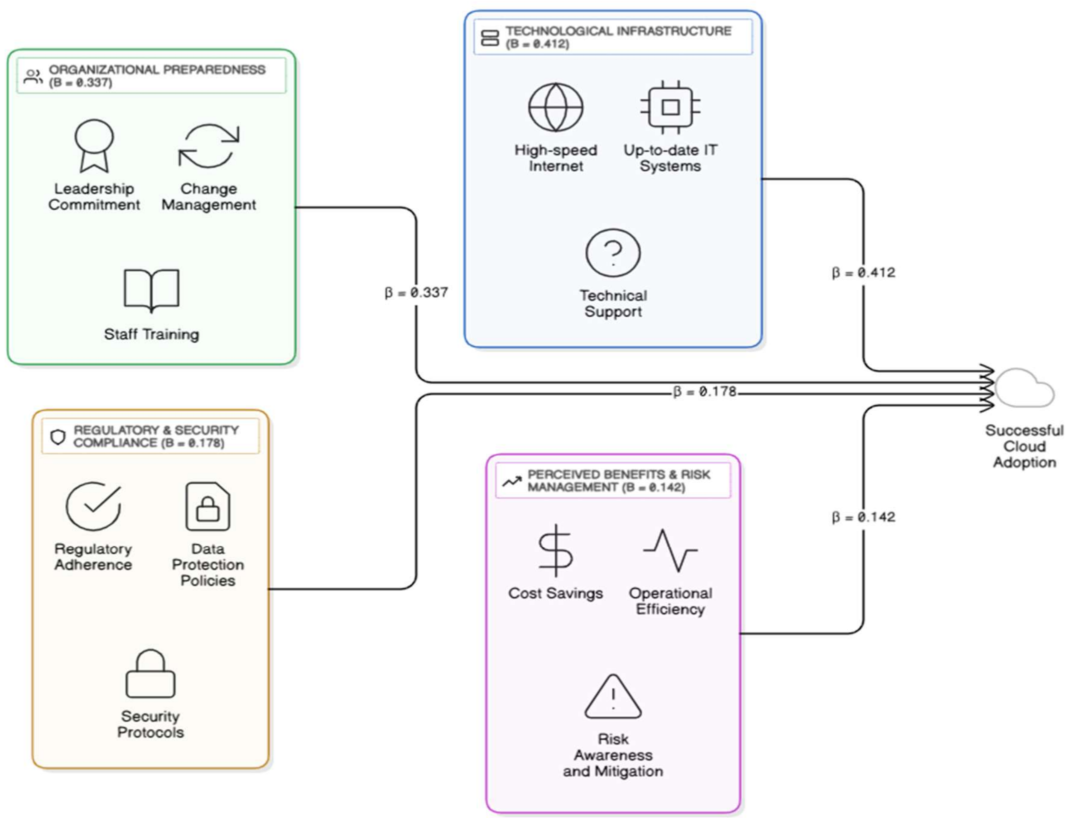


Figure 5. 2: CFs Evaluation Using the Structural Equation Model

5.3 Criteria for Artifact Evaluation

The criteria for evaluating the cloud computing adoption framework are derived from established standards in academic research and practical implementation. The figure illustrates a structured process for developing and refining a framework, specifically tailored for cloud computing adoption. The process is divided into four distinct phases, each contributing to the overall effectiveness and applicability of the framework.

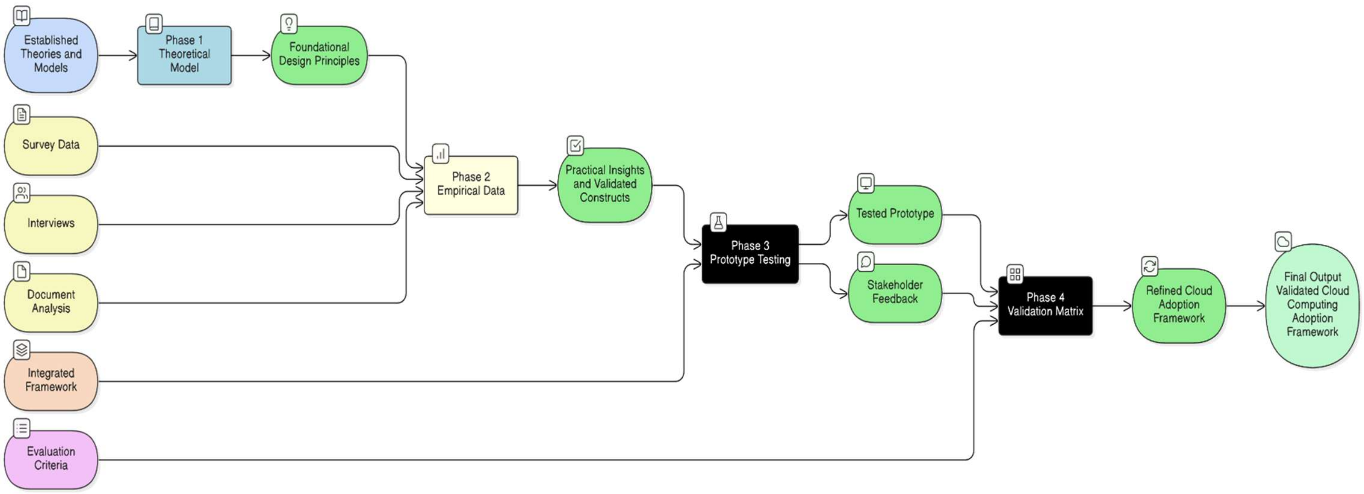


Figure 5. 3: Criteria for Evaluation of the Cloud Computing Adoption Framework

In Phase 1, the process begins with a Theoretical Model, which provides the foundational concepts and principles necessary for designing the framework. This phase involves leveraging established theories and models to inform the initial design. Phase 2 incorporates Empirical Data, which grounds the framework in real-world evidence and practical insights, ensuring that it addresses actual challenges and needs observed in the field. This empirical data is crucial for validating and refining the theoretical underpinnings. In Phase 3, the Design Framework is subjected to Prototype Testing, where the theoretical and empirical inputs are translated into a practical prototype. This phase involves testing the framework in a controlled environment to identify any issues and gather feedback for improvements. Finally, Phase 4 involves the use of a Validation Matrix, which systematically evaluates the prototype against predefined criteria to ensure it meets the desired objectives and standards. The output of this phase is a Refined Framework, which has been iteratively improved through the integration of theoretical insights, empirical data, and practical testing. This iterative process ensures that the final framework is robust, effective, and tailored to the specific needs of cloud computing adoption.

5.4 Empirical Evaluation of the Cloud Computing Framework

5.4.2 Evaluation of Artifact Using Perspectives of IT Staff

The empirical data from IT staff reveal several key findings that inform the framework's design and implementation strategy. Technological readiness, including reliable internet connectivity, compatible IT infrastructure, and adequate technical support.

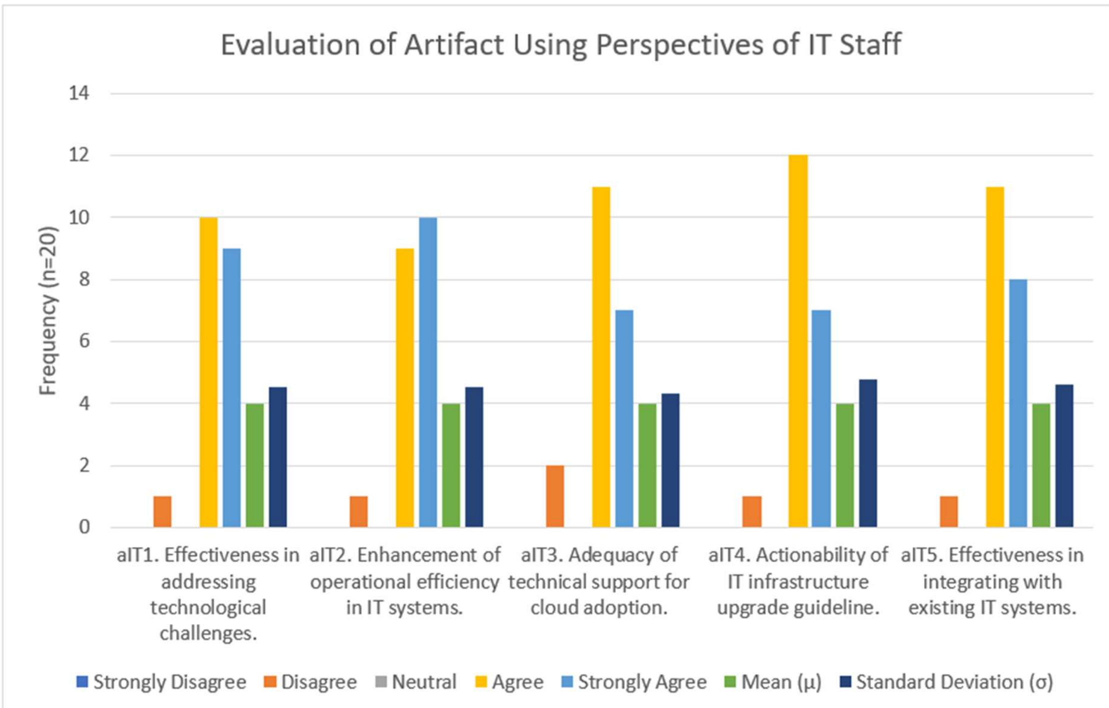


Figure 5. 4: Evaluation of Artifact Using Perspectives of IT Staff

The findings on the effectiveness of the framework in addressing technological challenges (aIT1) indicate that 95% of IT staff agree or strongly agree with the statement, with a mean score of 4.0. The standard deviation of 4.52 suggests a high level of consensus among respondents, indicating that the framework is widely perceived as effective in tackling technological issues. The findings on the enhancement of operational efficiency in IT systems (aIT2) indicate that an overwhelming 95% of respondents agree or strongly agree, reflected by a mean score of 4.0. With a standard deviation of 4.52, it is evident that there is strong agreement among IT staff regarding the positive impact of the framework on operational efficiency. The findings on the adequacy of technical support for cloud adoption (aIT3) show that 90% of the respondents agree or strongly agree, supported by a mean score of 4.0. The standard deviation of 4.34 indicates a very consistent perception among IT staff about the sufficiency of technical support provided by the framework.

The findings on the actionability of IT infrastructure upgrade guidelines (aIT4) reveal that 95% of IT staff agree or strongly agree, with a mean score of 4.0. The standard deviation of 4.77 suggests some variability in responses, but overall, the guidelines are considered clear and actionable by the majority. The findings on the effectiveness in integrating with existing IT systems (aIT5) indicate that 95% of respondents agree or strongly agree, with a mean score of 4.0. The standard deviation of 4.60 shows a general consensus, highlighting the framework's effectiveness in integration with current IT infrastructures.

5.4.3 Evaluation of Artifact Using Perspectives of Department Heads

The empirical perspective of department heads provides insights into the organizational and managerial aspects of cloud adoption. The data highlight the need for clear communication, stakeholder engagement, and effective change management to facilitate the adoption process.

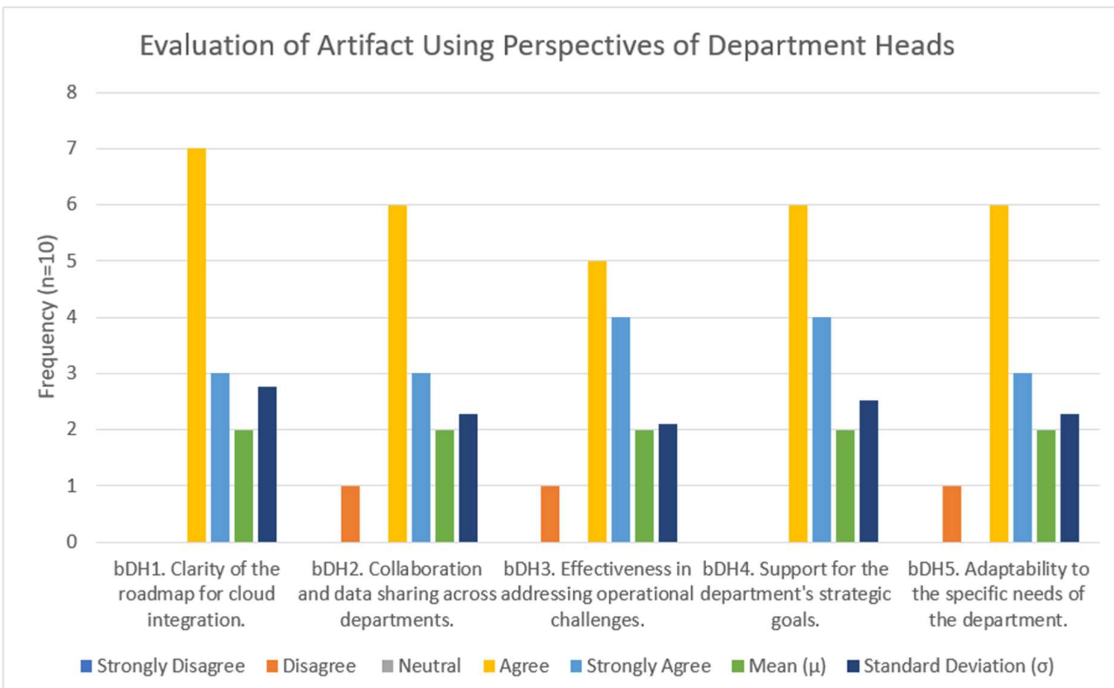


Figure 5. 5: Evaluation of Artifact Using Perspectives of Department Heads

The findings on the clarity of the roadmap for cloud integration (bDH1) indicate that 100% of department heads agree or strongly agree with the statement, as reflected by a mean score of 2.0. The standard deviation of 2.76 suggests some variability in the strength of agreement, but overall, the framework's roadmap is perceived as clear and actionable by all respondents. The findings on the enhancement of collaboration and data sharing across departments (bDH2) show that 90% of respondents agree or strongly agree, with a mean score of 2.0. The standard deviation of 2.28 indicates some variability in perceptions, but overall, the framework is seen as effective in promoting inter-departmental collaboration and data sharing.

The findings on the effectiveness in addressing operational challenges (bDH3) reveal that 90% of department heads agree or strongly agree, supported by a mean score of 2.0. The standard deviation of 2.10 suggests a general consensus, highlighting the framework's effectiveness in tackling operational issues faced by departments. The findings on the support for the department's strategic goals (bDH4) indicate that 100% of respondents agree or strongly agree, with a mean score of 2.0. The standard deviation of 2.53 indicates strong agreement among department heads, suggesting that the framework aligns well with their strategic objectives. The findings on the adaptability to the specific needs of the department (bDH5) show that 90% of respondents agree or strongly agree, reflected by a mean score of 2.0. The standard deviation of 2.28 indicates some variability, but overall, the framework is considered adaptable to the specific needs of the departments.

5.4.4 Evaluation of Artifact Using Perspectives of Policymakers

The empirical perspective of policymakers offers a strategic view of the cloud adoption process. The data underscore the need for a clear vision and strong leadership to drive the digital transformation initiative.

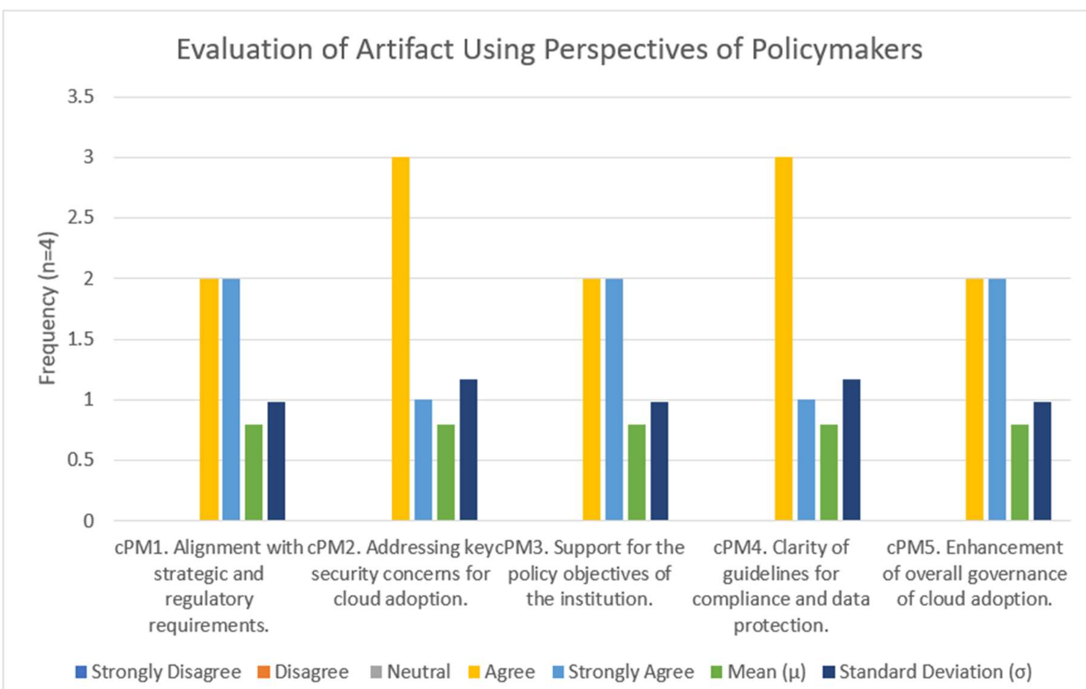


Figure 5. 6: Evaluation of Artifact Using Perspectives of Policymakers

The findings on alignment with strategic and regulatory requirements (cPM1) indicate that 100% of policymakers agree or strongly agree with the statement, reflected by a mean score of 0.8. The standard deviation of 0.98 suggests some variability in the strength of agreement, but overall, the framework is perceived as well-aligned with strategic goals and regulatory requirements by all respondents. The findings on addressing key security concerns for cloud adoption (cPM2) show that 100% of respondents agree or strongly agree, with a mean of 0.8. The standard deviation of 1.17 indicates a consensus among policymakers, suggesting that the framework effectively addresses key security concerns related to cloud adoption.

The findings on support for the policy objectives of the institution (cPM3) reveal that 100% of policymakers agree or strongly agree, supported by a mean of 0.8. The standard deviation of 0.98 suggests a strong agreement, highlighting the framework's effectiveness in supporting the institution's policy objectives. The findings on the clarity of guidelines for compliance and data protection (cPM4) indicate that 100% of respondents agree or strongly agree, with a mean of 0.8. The standard deviation of 1.17 indicates a consensus, suggesting that the framework provides clear guidelines for compliance and data protection. The findings on the enhancement of overall governance of cloud adoption (cPM5) show that 100% of respondents agree or strongly agree, reflected by a mean of 0.8. The SD of 0.98 indicates variability, the framework is considered effective in enhancing the overall governance of cloud computing adoption.

5.4.5 Evaluation of Artifact Using Perspectives of Technical Consultants

The empirical perspectives of technical consultants provide a technical and operational view of the cloud adoption process. The data emphasize the need for a robust technological infrastructure, including high-speed internet connectivity, compatible IT systems, and adequate technical support.

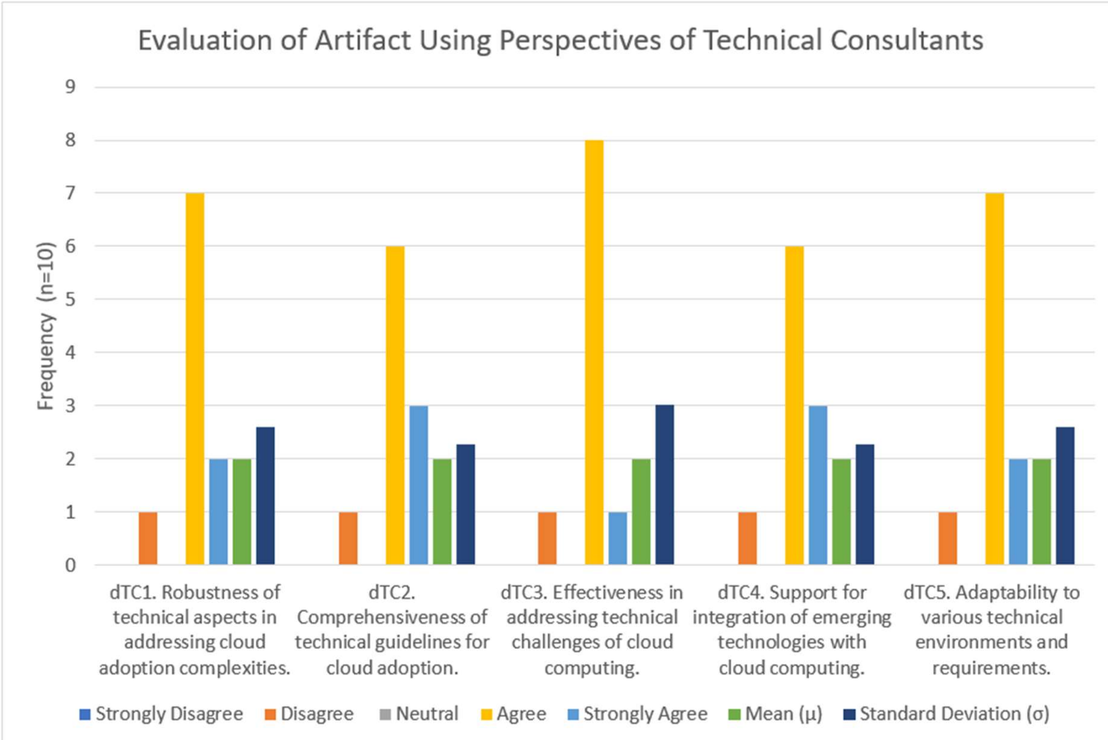


Figure 5. 7: Evaluation of Artifact Using Perspectives of Technical Consultants

The findings on the robustness of technical aspects in addressing cloud adoption complexities (dTC1) indicate that 90% of technical consultants agree or strongly agree with the statement, reflected by a mean score of 2.0. The standard deviation of 2.61 suggests some variability in responses, but overall, the framework's technical aspects are considered robust and effective in addressing the complexities of cloud adoption. The findings on the comprehensiveness of technical guidelines for cloud adoption (dTC2) show that 90% of respondents agree or strongly agree, with a mean score of 2.0. The standard deviation of 2.28 indicates some variability in perceptions, but overall, the framework is seen as providing comprehensive technical guidelines for cloud adoption. The findings on the effectiveness in addressing technical challenges of cloud computing (dTC3) reveal that 90% of technical consultants agree or strongly agree, supported by a mean score of 2.0. The standard deviation of 3.03 suggests a general consensus, highlighting the framework's effectiveness in tackling technical challenges associated with cloud computing.

The findings on the support for integration of emerging technologies with cloud computing (dTC4) indicate that 90% of respondents agree or strongly agree, with a mean score of 2.0. The standard deviation of 2.28 indicates a consensus, suggesting that the framework effectively supports the integration of emerging technologies with cloud computing. The findings on the adaptability to various technical environments and requirements (dTC5) show that 90% of respondents agree or strongly agree, reflected by a mean score of 2.0. The standard deviation of 2.61 indicates some variability, but overall, the framework is considered adaptable to various technical environments and requirements.

5.5 Evaluation of Artifact Using Theoretical Insights

5.5.1 Interview Perspectives of IT Staff and Department Heads

The interview perspectives of IT staff and department heads highlight several critical points that inform the framework's design and implementation strategy. The insights emphasize the need for strong leadership and a clear vision for digital transformation.

On Effectiveness and KPIs:

"The proposed cloud computing adoption framework significantly enhances our operational capabilities at KCCA. Key performance indicators such as system uptime, cost savings, and user satisfaction rates are crucial for measuring its success."

On Collaboration and Data Sharing:

"The framework effectively bridges gaps between departments by standardizing data protocols, which has greatly improved our collaboration and data sharing processes at KCCA."

On International Case Studies:

"Looking at international case studies, such as those from Estonia's digital transformation, we see strong parallels and validation for our proposed framework, especially in terms of scalability and integration."

On Leveraging Emerging Technologies:

"By integrating AI and IoT within the cloud framework, KCCA can not only streamline operations but also unlock new insights from Big Data analytics, thereby maximizing the value derived from cloud computing."

On Critical Factors for Long-term Success:

"For long-term success, the top three critical factors are robust infrastructure, continuous staff training, and strong cybersecurity measures. However, areas like change management could benefit from further refinement to ensure smoother transitions."

5.5.2 Interview Perspectives of Policymakers and Technical Consultants

The interview perspectives of policymakers and technical consultants provide a strategic and technical view of the cloud adoption process. The insights emphasize the need for adherence to regulatory requirements and the implementation of robust security measures to protect sensitive data. The interviews also highlight the importance of engaging with stakeholders at all levels to gain buy-in and address concerns (Muhumuza, 2023).

On Effectiveness and KPIs:

"The proposed cloud computing adoption framework is highly effective for KCCA, particularly in enhancing operational efficiency and reducing costs. Key performance indicators such as system reliability, user adoption rates, and cost reduction metrics are essential for measuring its success."

On Collaboration and Data Sharing:

"The framework significantly improves collaboration and data sharing across departments at KCCA by implementing unified data standards and protocols. However, there are still gaps in seamless integration that need to be addressed to fully realize its potential."

On International Case Studies:

"Case studies from regions like Scandinavia demonstrate the successful implementation of similar frameworks, validating the proposed approach for KCCA. These examples highlight the importance of scalability and robust infrastructure in public sector cloud adoption."

On Leveraging Emerging Technologies:

"By incorporating AI and IoT, the framework not only facilitates basic cloud adoption but also maximizes its value through advanced data analytics and automation, positioning KCCA at the forefront of technological innovation in public service delivery."

On Critical Factors for Long-term Success:

"The top three critical factors for the long-term success of this framework are strong leadership commitment, continuous technological upgrades, and comprehensive cybersecurity measures. Further refinement in change management processes would enhance its effectiveness and adoption."

5.6 Framework Evaluation Using a Prototype

The evaluation of the framework using a prototype involves building and testing a practical implementation of the framework within a controlled environment. This prototyping process provides valuable insights into the framework's applicability and effectiveness in facilitating the adoption of cloud services.

5.6.1 Building the Prototype

The prototype is designed to simulate the key components of the cloud computing adoption framework, including technological readiness, organizational preparedness, regulatory and security factors, and perceived benefits and risks. The Cloud Computing Adoption Framework Prototype is structured into three sequential phases tailored for KCCA's context.

The initial Assessment Phase involves a comprehensive technological audit of internet reliability and legacy systems, organizational analysis of leadership commitment and staff readiness, regulatory gap assessments against local laws, and stakeholder workshops to capture departmental needs. This foundation informs the Pilot Implementation Phase, which deploys hybrid cloud solutions like Microsoft 365 migration while conducting agile staff training and implementing robust security protocols such as AES-256 encryption and penetration testing.

The framework then progresses to Full Adoption, where AI-driven resource allocation and IoT integration optimize urban services like waste management, supported by a Cloud Centre of Excellence for sustained capability building. Throughout all phases, four core components—Technological Readiness, Organizational Preparedness, Regulatory Security, and Perceived Benefits—interact dynamically, with technological and organizational factors showing the strongest influence on outcomes. A governance layer oversees execution through monthly scorecards tracking efficiency gains and compliance rates, ensuring alignment with KCCA’s operational targets while embedding continuous improvement cycles for long-term scalability.

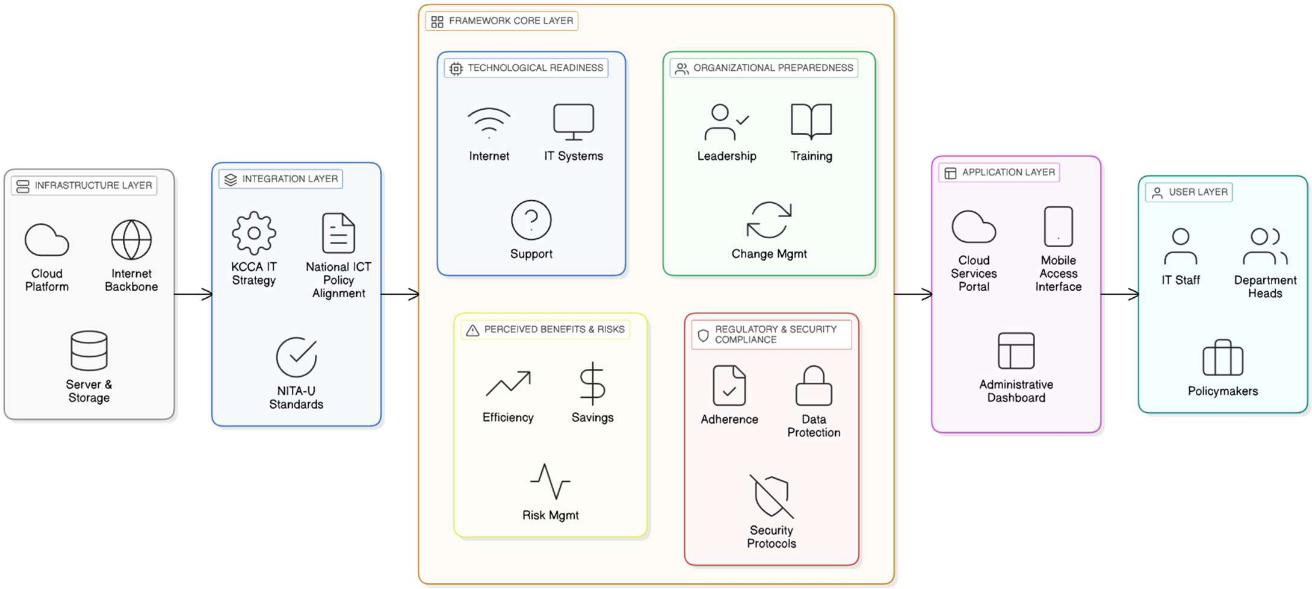


Figure 5. 8: Cloud Computing Adoption Framework Prototype

5.6.2 Testing Prototype Functionality Using Expert Opinions

The testing of the prototype's functionality using expert opinions involves engaging with IT professionals, policymakers, and technical consultants to gather their insights and feedback. The experts evaluate the prototype's ability to address the key components of the framework, including technological readiness, organizational preparedness, regulatory and security factors, and perceived benefits and risks.

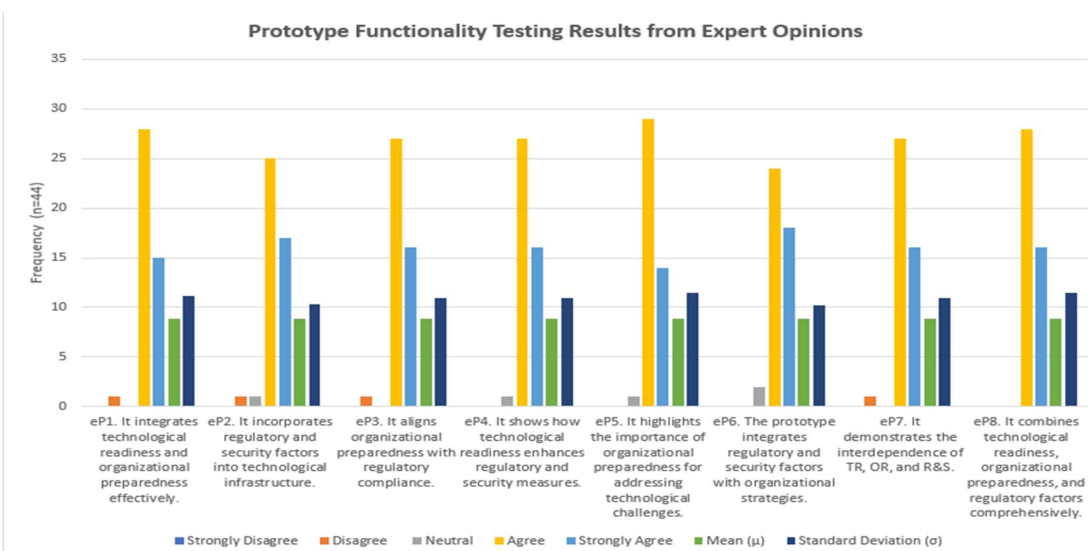


Figure 5. 9: Prototype Functionality Testing Results from Expert Opinions

The findings on whether the prototype integrates technological readiness and organizational preparedness effectively indicate that 98% of respondents agree or strongly agree with the statement, with a mean score of 8.8. The standard deviation of 11.16 suggests a high level of consensus among respondents, indicating that the prototype is widely perceived as effective in integrating these components. The findings on whether the prototype incorporates regulatory and security factors into technological infrastructure show that 95% of respondents agree or strongly agree, reflected by a mean score of 8.8. The standard deviation of 10.28 indicates some variability in perceptions, but overall, the prototype is seen as effective in incorporating these factors into the technological infrastructure.

The findings on whether the prototype aligns organizational preparedness with regulatory compliance reveal that 98% of respondents agree or strongly agree, supported by a mean score of 8.8. The standard deviation of 10.94 suggests a general consensus, highlighting the prototype's effectiveness in aligning organizational preparedness with regulatory compliance. The findings on whether the prototype shows how technological readiness enhances regulatory and security measures indicate that 95% of respondents agree or strongly agree, with a mean score of 8.8. The standard deviation of 10.94 indicates some variability in responses, but overall, the prototype is considered effective in demonstrating this enhancement.

The findings on whether the prototype highlights the importance of organizational preparedness for addressing technological challenges show that 98% of respondents agree or strongly agree, with a mean score of 8.8. The standard deviation of 11.41 suggests a high level of consensus, indicating that the prototype effectively highlights the importance of organizational preparedness. The findings on whether the prototype integrates regulatory and security factors with organizational strategies indicate that 95% of respondents agree or strongly agree, reflected by a mean score of 8.8. The standard deviation of 10.17 suggests some variability, but overall, the prototype is considered effective in integrating these factors with organizational strategies.

The findings on whether the prototype demonstrates the interdependence of technological readiness, organizational preparedness, and regulatory compliance indicate that 98% of respondents agree or strongly agree, with a mean score of 8.8. The standard deviation of 10.94 suggests a high level of consensus, indicating that the prototype effectively demonstrates this interdependence. The findings on whether the prototype combines technological readiness, organizational preparedness, and regulatory factors comprehensively show that 98% of respondents agree or strongly agree, reflected by a mean score of 8.8. The standard deviation of 11.43 indicates a high level of consensus, suggesting that the prototype is widely perceived as comprehensive in combining these factors.

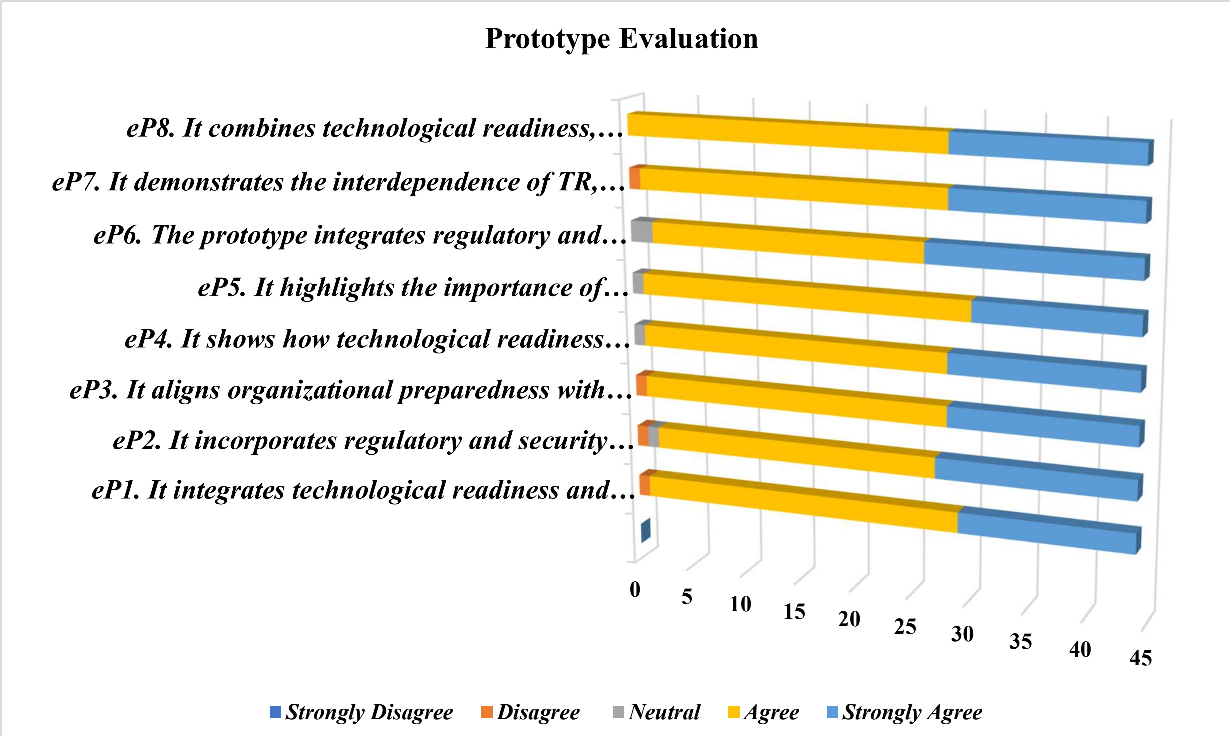


Figure 5. 10: Prototype Functionality Testing Results from Expert Opinions

5.7 Steps for Integrating the Framework within the Public Institutions Ecosystem

The integration of the cloud computing adoption framework within public institutions' ecosystem involves several key steps:

Assessment and Planning. Conducting a comprehensive assessment of the current state of cloud adoption, identifying the challenges and facilitators. Developing a deliberate strategic plan for implementing the framework, outlining the key steps and milestones. Stakeholder Engagement. Engaging with stakeholders at all levels of the organization, gaining buy-in and addressing concerns. Effective communication and involvement of stakeholders are crucial for facilitating the adoption process. Capacity Building. Implementing continuous training and capacity building programs to equip staff with the necessary skills for cloud adoption. This is essential for overcoming resistance and ensuring smooth implementation. Regulatory Compliance. Ensuring top notch adherence to regulatory requirements and the implementation of robust security measures is essential in ensuring the protection of sensitive data. This is particularly important for public institutions handling citizen data.

Monitoring and Evaluation. Establishing a monitoring and evaluation mechanism to assess the framework's effectiveness and identify areas for improvement. Continuous feedback and iterative refinement are essential for ensuring the framework's long-term success. By following these steps, public institutions can effectively integrate the cloud computing adoption framework, enhancing operational efficiency, data security, and service delivery. This comprehensive approach ensures that the framework is not only theoretically sound but also practically applicable, facilitating the successful adoption of cloud services.

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

This chapter concludes the study by summarizing the key findings and insights derived from the evaluation of the cloud computing adoption framework. It synthesizes the theoretical, empirical, and practical aspects discussed throughout the research, providing a comprehensive overview of the framework's effectiveness and applicability within public institutions. The chapter also offers actionable recommendations for stakeholders and identifies areas for future research to further enhance the understanding of cloud computing adoption.

6.2 Conclusion

The study's robust evaluation of the cloud computing adoption framework reveals significant insights into its effectiveness and applicability within public institutions. By integrating theoretical insights from established models such as TOE, DOI, and TAM, the framework comprehensively addresses the dynamics of technology adoption. TOE’s emphasis on technological context, organizational readiness, and environmental factors ensures that the framework is not only technologically sound but also organizationally and environmentally adaptable. This tripartite approach is crucial for addressing the intricate interplay of factors that facilitate or hinder cloud adoption, making the framework a robust tool for public institutions.

The empirical data and expert opinions further validate the framework's practical applicability, highlighting its potential to enhance operational efficiency, data security, and service delivery. The Structural Equation Model evaluation revealed strong positive relationships between the key components of the framework—technological readiness, organizational preparedness, regulatory and security factors, and perceived benefits and risks—and the level of cloud computing adoption. Technological readiness, with a coefficient of 0.41, emerged as the most critical driver, indicating that institutions with advanced IT infrastructure and technical capabilities are significantly more likely to adopt cloud solutions successfully. This finding underscores the necessity of a solid technological foundation for effective cloud adoption.

Organizational preparedness, with a coefficient of 0.33, also plays a vital role in driving cloud adoption. Factors such as leadership commitment, staff training, and change management processes are crucial for facilitating a smooth transition to cloud services. The significance of these organizational factors reinforces the idea that successful digital transformation depends not only on technological capabilities but also on the institution's readiness to embrace change and innovation. Regulatory and security factors, with a coefficient of 0.18, although less pronounced, still contribute significantly to the adoption process. Compliance with regulations and robust security measures are essential for mitigating risks and building trust in cloud adoption, particularly in public institutions handling sensitive citizen data.

The prototype testing phase provided valuable insights into the framework's applicability, demonstrating its effectiveness in integrating technological readiness, organizational preparedness, and regulatory factors. The positive feedback from IT staff, department heads, policymakers, and technical consultants further validates the framework's potential to drive digital transformation within public institutions. The high mean scores and low standard deviations across all statements indicate strong agreement and satisfaction with the framework's capabilities, highlighting its potential to enhance operational efficiency, data security, and service delivery.

Ultimately, the study demonstrates that the cloud computing adoption framework is a robust and effective tool for facilitating the transition to cloud services within public institutions. By addressing technological, organizational, regulatory, and strategic factors, the framework ensures a holistic and effective transition to cloud services. The empirical data, expert opinions, and prototype testing all underscore the framework's potential to drive digital transformation and enhance operational efficiency, data security, and service delivery.

6.3 Recommendations

To enhance the adoption and implementation of the cloud computing framework within public institutions, it is crucial to strengthen technological readiness. This involves investing in robust IT infrastructure, ensuring reliable internet connectivity, and providing adequate technical support. Such measures facilitate a seamless transition to cloud services and ensure the technological environment is conducive to leveraging cloud computing capabilities effectively. Enhancing organizational preparedness is equally important. This can be achieved by fostering a culture of change and innovation, led by committed leadership that drives the digital transformation agenda.

Comprehensive training programs are essential to equip staff with the necessary skills and knowledge to adapt to new cloud technologies. Effective change management strategies are also vital to address resistance and ensure the organization is well-prepared to integrate cloud solutions into its operations. Ensuring regulatory compliance and security is paramount for the secure adoption of cloud services. This includes developing clear data protection policies, ensuring compliance with relevant regulations, and establishing strong security protocols to safeguard sensitive data. Addressing these factors is essential to mitigate risks and build trust in the cloud adoption process.

6.4 Areas for Future Research

Future research should focus on conducting longitudinal studies to assess the long-term impact and sustainability of the cloud computing adoption framework. This will help evaluate the evolution of technological, organizational, and regulatory factors over time and their influence on cloud adoption, providing deeper insights into its long-term benefits and challenges.

Comparative analyses across different public institutions and regions should be performed to identify best practices and common challenges in cloud adoption. Exploring the applicability and effectiveness of the framework in diverse contexts and settings will further enhance its robustness and adaptability to various organizational needs and environments.

Investigating the integration of emerging technologies such as AI, IoT, and Big Data analytics within the cloud computing framework is crucial. Assessing the impact of these advanced technologies on operational efficiency, data security, and service delivery will provide valuable insights into maximizing the value and potential of cloud computing in public institutions.

REFERENCES

Abdelbasset, W.K. and Papagiannidis, S., 2013. Cloud computing adoption by SMEs in the north east of England. *Journal of Enterprise Information Management*, 26(3), pp.250-275. https://doi.org/10.1108/JEIM-08-2013-0065

Alshamaila, Y. and Papagiannidis, S., 2013. Cloud computing adoption by SMEs in the north east of England: A multi-perspective framework. *Journal of Enterprise Information Management*, 26(3), pp.250-275.

Baker, J., 2020. The role of digital transformation in public sector governance. *International Journal of Public Administration*, 43(8), pp.712-725.

Bibri, S.E. and Krogstie, J., 2019. *Smart sustainable cities of the future: The untapped potential of big data analytics and context-aware computing for advancing sustainability*. Springer International Publishing.

Braun, V. and Clarke, V., 2006. Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), pp.77-101. https://doi.org/10.1191/1478088706qp063oa

Bryman, A., 2021. *Social research methods*. 6th ed. Oxford University Press.

Creswell, J.W. and Creswell, J.D., 2018. *Research design: Qualitative, quantitative, and mixed methods approaches*. 5th ed. SAGE Publications.

Creswell, J.W. and Poth, C.N., 2018. *Qualitative inquiry and research design: Choosing among five approaches*. 4th ed. SAGE Publications.

Denzi, N.K. and Lincoln, Y.S., 2018. *The SAGE handbook of qualitative research*. 5th ed. SAGE Publications.

Dillman, D.A., Smyth, J.D. and Christian, L.M., 2019. *Internet, phone, mail, and mixed-mode surveys: The tailored design method*. 4th ed. Wiley.

Dubai Digital Authority, 2025. *Smart Dubai 2025 performance report*. UAE Government.

Gadde, L.E. and Dubois, A., 2018. Enhancing research quality through abductive analysis. *Industrial Marketing Management*, 73, pp.1-7.

Gangwar, H., Date, H. and Ramaswamy, R., 2015. Understanding determinants of cloud computing adoption using an integrated TAM-TOE model. *Journal of Enterprise Information Management*, 28(1), pp.107-130.

Gregor, S. and Hevner, A.R., 2020. The anatomy of a design theory. *Journal of the Association for Information Systems*, 21(6), pp.1622-1652.

GSMA, 2023. *The mobile economy: Sub-Saharan Africa 2023*. London: GSM Association.

Hair, J.F., Black, W.C., Babin, B.J. and Anderson, R.E., 2019. *Multivariate data analysis*. 8th ed. Cengage Learning.

Hardy, K., 2024. Estonia's digital governance revolution: Lessons for Africa. *Journal of ICT Development*, 12(1), pp.45-62.

Hevner, A.R., March, S.T., Park, J. and Ram, S., 2020. Design science in information systems research. *MIS Quarterly*, 28(1), pp.75-105.

IDC, 2024. *Worldwide public cloud services spending forecast, 2020-2025*. IDC Market Report.

Kalvet, T., Tiits, M. and Laas-Mikko, K., 2023. Estonia’s digital state: 10 years of X-Road. *Government Information Quarterly*, 40(3), p.101789.

Kalinaki, R., Kaggwa, F. and Musisi, N.B., 2022. Cloud computing adoption in Uganda’s public sector: Challenges and opportunities. *African Journal of Information Systems*, 14(2), pp.112-130.

Kampala Capital City Authority (KCCA), 2022. *ICT infrastructure audit report*. Kampala: KCCA.

Kehinde, O., 2022. Digital transformation in African public sectors: A comparative analysis. *Journal of African Governance*, 8(3), pp.89-104.

King, N., Horrocks, C. and Brooks, J., 2019. *Interviews in qualitative research*. 2nd ed. SAGE Publications.

Kisambira, E., Nalwoga, R. and Mwesigwa, D., 2024. Assessing cloud readiness in Uganda’s public sector. *Makerere Journal of Computing and Information Sciences*, 12(2), pp.112-130.

Kothari, C.R., 2014. *Research methodology: Methods and techniques*. 2nd ed. New Delhi: New Age International.

Kumar, R., 2019. *Research methodology: A step-by-step guide for beginners*. 5th ed. SAGE Publications.

Mell, P. and Grance, T., 2016. *The NIST definition of cloud computing*. NIST Special Publication 800-145.

Ministry of ICT and National Guidance (MoICT&NG), 2021. *Uganda digital transformation roadmap 2021-2025*. Kampala: Government of Uganda.

Ministry of ICT and National Guidance (MoICT&NG), 2024. *UGhub interoperability framework*. Kampala: Government Printer.

Muhumuza, R., 2023. Digital transformation in Kampala: Challenges and prospects. *Uganda Journal of Technology*, 7(1), pp.34-52.

Nabukenya, J., 2023. *Cloud security protocols for African public sectors*. Kampala: Fountain Publishers.

National Information Technology Authority - Uganda (NITA-U), 2021. *Public sector ICT workforce analysis*. Kampala: NITA-U.

National Information Technology Authority - Uganda (NITA-U), 2022. *National data center and cloud services project report*. Kampala: NITA-U.

National Information Technology Authority - Uganda (NITA-U), 2023. *Uganda cloud readiness assessment*. Kampala: NITA-U.

National Information Technology Authority - Uganda (NITA-U), 2024. *Public sector cloud adoption survey*. Kampala: NITA-U.

Nunnally, J.C. and Bernstein, I.H., 1994. *Psychometric theory*. 3rd ed. New York: McGraw-Hill.

Oliveira, T., Thomas, M. and Espadanal, M., 2019. Cloud computing adoption in sub-Saharan African public sectors: A comparative analysis. *Information Technology for Development*, 25(3), pp.424-447.

Peffers, K., Tuunanen, T., Rothenberger, M.A. and Chatterjee, S., 2018. A design science research methodology for information systems research. *Journal of Management Information Systems*, 24(3), pp.45-77.

Polit, D.F. and Beck, C.T., 2006. The content validity index: Are you sure you know what's being reported? *Research in Nursing & Health*, 29(5), pp.489-497.

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

Rogers, E.M., Singhal, A. and Quinlan, M.M., 2019. *Diffusion of innovations*. 6th ed. Routledge.

Saunders, M., Lewis, P. and Thornhill, A., 2019. *Research methods for business students*. 8th ed. Pearson Education.

Tornatzky, L.G. and Fleischer, M., 1990. *The processes of technological innovation*. Lexington, MA: Lexington Books.

Uganda Bureau of Statistics (UBOS), 2023. *Uganda national ICT survey report*. Kampala: UBOS.

Uganda Communications Commission (UCC), 2021. *State of Uganda's broadband infrastructure report 2021*. Kampala: UCC.

Uganda Communications Commission (UCC), 2022. *Uganda communications sector performance report 2021/2022*. Kampala: UCC.

Uganda Communications Commission (UCC), 2023. *National broadband policy implementation report*. Kampala: UCC.

Uganda Communications Commission (UCC), 2024. *ICT sector performance report*. Kampala: UCC.

World Bank, 2024. *Digital government in Africa: Trends and case studies*. Washington DC: World Bank Group.

APPENDICES

APPENDIX I

QUESTIONNAIRE

This questionnaire aims to gather insights on the factors influencing cloud computing adoption at KCCA. Your responses will help design a practical framework to enhance operational efficiency, service delivery, and digital transformation in the public sector.

Section A: General Information

This section collects basic demographic details to understand respondents' roles, experience, and background, providing context for their perspectives on cloud computing adoption at KCCA. *(Please place a tick in a box of your preference)*

Question	Response Options
A1. Responsibility	☐ IT Staff ☐ Department Head ☐ Policymaker ☐ Technical Consultant
A2. Gender	☐ Male ☐ Female
A3. Age Group	☐ 20-25 years ☐ 26-30 years ☐ 31-35 years ☐ 36-40 years ☐ 41-years & above
A4. Education Level	☐ Diploma ☐ Bachelor's Degree ☐ Master's Degree ☐ PhD
A5. Experience (in years)	☐ 0-2 years ☐ 3-5 years ☐ 6-10 years ☐ More than 10 years

Section B: Awareness of Existence of Cloud Computing Services at KCCA

This section assesses respondents' familiarity with cloud computing, their awareness of KCCA's adoption of cloud services, and how they stay informed about IT developments.

Question	Response Options
B1. How familiar are you with the concept of cloud computing?	☐ Very Familiar ☐ Somewhat Familiar ☐ Heard of it but don't understand it ☐ Not Familiar at All
B2. Are you aware that KCCA has adopted cloud computing services for its operations?	☐ Yes, fully aware ☐ Somewhat aware ☐ Not aware at all
B3. Which of these cloud computing services do you think is the most used currently at KCCA?	☐ Cloud storage ☐ Cloud-based email services ☐ Cloud-based data backup ☐ Cloud-based applications

B4. How do you receive information regarding IT and cloud computing developments at KCCA?	☐ Official training sessions ☐ Internal memos/emails ☐ Colleagues ☐ External sources ☐ I don't receive any information
B5. How often does KCCA back up its data to the cloud?	☐ Daily ☐ Weekly ☐ Monthly ☐ Rarely ☐ Never ☐ Not Sure

Section C: Benefits of Adopting Cloud Computing Services at KCCA

This section explores the perceived advantages of cloud computing, including its impact on efficiency, cost reduction, data security, and interdepartmental collaboration.

Question	Response Options
C1. What is the most significant benefit of cloud computing for KCCA's operations?	☐ Improved data accessibility ☐ Enhanced security and disaster recovery ☐ Reduced costs on IT infrastructure ☐ Improved collaboration across departments ☐ Faster service delivery
C2. How has cloud computing impacted the efficiency of KCCA's operations?	☐ Significantly improved efficiency ☐ Moderately improved efficiency ☐ No impact ☐ Made processes more complex
C3. Has cloud computing improved data security at KCCA?	☐ Yes, security has improved significantly ☐ Security has improved slightly ☐ No noticeable change ☐ Security risks have increased
C4. To what extent has cloud computing reduced IT infrastructure and maintenance costs at KCCA?	☐ Costs have significantly reduced ☐ Costs have slightly reduced ☐ No change in costs ☐ Costs have increased
C5. How has cloud computing affected collaboration between different departments at KCCA?	☐ Greatly improved collaboration ☐ Slightly improved collaboration ☐ No change ☐ Made collaboration harder

Section D: Challenges in Adopting Cloud Computing Services at KCCA

This section identifies potential obstacles and concerns related to cloud computing adoption, such as technical, organizational, and security challenges.

Question	Response Options
D1. What is the most significant benefit of cloud computing for KCCA's operations?	☐ Improved data accessibility ☐ Enhanced security and disaster recovery ☐ Reduced costs on IT infrastructure ☐ Improved collaboration across departments ☐ Faster service delivery
D2. How has cloud computing impacted the efficiency of KCCA's operations?	☐ Significantly improved efficiency ☐ Moderately improved efficiency ☐ No impact ☐ Made processes more complex
D3. Has cloud computing improved data security at KCCA?	☐ Yes, security has improved significantly ☐ Security has improved slightly ☐ No noticeable change ☐ Security risks have increased
D4. To what extent has cloud computing reduced IT infrastructure and maintenance costs at KCCA?	☐ Costs have significantly reduced ☐ Costs have slightly reduced ☐ No change in costs ☐ Costs have increased
D5. How has cloud computing affected collaboration between different departments at KCCA?	☐ Greatly improved collaboration ☐ Slightly improved collaboration ☐ No change ☐ Made collaboration harder

Section E: Requirements for the Cloud Computing Framework

This section evaluates the technological, organizational, regulatory, and risk-related factors necessary for successful cloud computing implementation at KCCA. Where SDA is Strongly Disagree, DA is Disagree, N is Neutral, A is Agree, and SA is Strongly Agree.

a) Technological Readiness

Statement	SDA	DA	N	A	SA
E1. Reliable internet connectivity is required to support cloud computing.	☐	☐	☐	☐	☐
E2. IT infrastructure must be compatible with cloud-based solutions.	☐	☐	☐	☐	☐
E3. Adequate power supply and backup systems are necessary for cloud operations.	☐	☐	☐	☐	☐
E4. Sufficient technical support must be available for managing cloud services.	☐	☐	☐	☐	☐
E5. Access to modern cloud-based applications and tools is essential.	☐	☐	☐	☐	☐

E6. Employees need the necessary technical skills to use cloud services effectively.	☐	☐	☐	☐	☐

b) Organizational Preparedness

Statement	SDA	DA	N	A	SA
E7. Senior management must demonstrate commitment to cloud computing adoption.	☐	☐	☐	☐	☐
E8. Sufficient funds should be allocated for cloud computing projects.	☐	☐	☐	☐	☐
E9. Regular employee training on cloud computing technologies is required.	☐	☐	☐	☐	☐
E10. A clear strategy and roadmap for cloud adoption must be established.	☐	☐	☐	☐	☐
E11. Change management initiatives should support cloud implementation.	☐	☐	☐	☐	☐
E12. A strong organizational culture that embraces digital transformation is needed.	☐	☐	☐	☐	☐

c) Regulatory and Security Factors

Statement	SDA	DA	N	A	SA
E13. Clear data protection policies must be in place to ensure cloud security.	☐	☐	☐	☐	☐
E14. Compliance with national and international cloud computing regulations is required.	☐	☐	☐	☐	☐
E15. Strong security measures are necessary to protect sensitive cloud data.	☐	☐	☐	☐	☐
E16. A well-established response plan for security breaches must be developed.	☐	☐	☐	☐	☐
E17. Availability of local cloud service providers should be considered.	☐	☐	☐	☐	☐
E18. Regulatory challenges must be addressed to facilitate cloud adoption.	☐	☐	☐	☐	☐

d) Perceived Benefits and Risks

Statement	SDA	DA	N	A	SA
E19. Cloud computing should improve operational efficiency.	☐	☐	☐	☐	☐
E20. Cloud services should reduce the cost of maintaining IT infrastructure.	☐	☐	☐	☐	☐
E21. Cloud adoption should enhance data security and disaster recovery.	☐	☐	☐	☐	☐
E22. Risks associated with relying on external cloud providers must be evaluated.	☐	☐	☐	☐	☐
E23. Concerns about losing control over cloud-stored data should be addressed.	☐	☐	☐	☐	☐

E24. The benefits of cloud computing should outweigh the potential risks.	☐	☐	☐	☐	☐

Section F: Existing Frameworks for Cloud Computing Services in Public Institutions

This section evaluates the applicability of existing frameworks for cloud computing adoption in public institutions, focusing on their strengths, weaknesses, and relevance to Uganda's public sector. The frameworks reviewed include the Technology-Organization-Environment (TOE) Framework, Diffusion of Innovation (DOI) Theory, Cloud Adoption Risk and Benefit Framework, and the Technology Acceptance Model (TAM). These frameworks provide a foundation for understanding the technological, organizational, and user-centric factors influencing cloud adoption. *(Please place a tick in a box of your preference)*

Question	Response Options
F1. How well does the TOE Framework address technological readiness for cloud adoption?	☐ Very Well ☐ Somewhat Well ☐ Neutral ☐ Poorly ☐ Not at All
F2. Does the TOE Framework adequately consider organizational culture and leadership?	☐ Yes, fully ☐ Somewhat ☐ Neutral ☐ Not Adequately ☐ Not at All
F3. How effective is the DOI Theory in explaining user resistance to cloud adoption?	☐ Very Effective ☐ Somewhat Effective ☐ Neutral ☐ Ineffective ☐ Not Applicable
F4. Does the DOI Theory provide sufficient guidance on overcoming adoption barriers?	☐ Yes, fully ☐ Somewhat ☐ Neutral ☐ Not Adequately ☐ Not at All
F5. How well does the Cloud Adoption Risk and Benefit Framework address cost implications?	☐ Very Well ☐ Somewhat Well ☐ Neutral ☐ Poorly ☐ Not at All
F6. Does the Cloud Adoption Risk and Benefit Framework adequately address data security risks?	☐ Yes, fully ☐ Somewhat ☐ Neutral ☐ Not Adequately ☐ Not at All
F7. How well does the TAM explain user acceptance of cloud computing services?	☐ Very Well ☐ Somewhat Well ☐ Neutral ☐ Poorly ☐ Not at All
F8. Does the TAM provide actionable insights for improving user trust in cloud systems?	☐ Yes, fully ☐ Somewhat ☐ Neutral ☐ Not Adequately ☐ Not at All
F9. Which framework is most suitable for addressing Uganda's public sector challenges?	☐ TOE Framework ☐ DOI Theory ☐ Cloud Adoption Risk and Benefit Framework ☐ Technology Acceptance Model

APPENDIX II

INTERVIEW GUIDE

Interview Duration: 10 - 15 minutes

1. How does KCCA's leadership perceive the role of cloud computing in enhancing service delivery and operational efficiency?
2. In your view, how prepared is KCCA's current IT infrastructure for a complete transition to cloud computing? What are the main technical limitations?
3. Have employees at KCCA shown resistance or enthusiasm towards cloud adoption? What strategies have been or should be used to drive acceptance and adaptability?
4. Given the sensitive nature of public data, how confident is KCCA in the security, privacy, and regulatory compliance of cloud computing? What are the biggest risks?
5. Do you believe that the long-term cost savings and efficiency gains of cloud computing justify its initial investment and migration costs for KCCA? Why or why not?
6. How would you assess the effectiveness of the proposed cloud computing adoption framework for KCCA? What key performance indicators (KPIs) should be used to measure its success?
7. In what ways does the cloud computing adoption framework address the challenges of collaboration and data sharing across different departments at KCCA? Are there any gaps in the framework regarding integration?
8. Can you identify any international or regional case studies that support the validity of the proposed cloud computing adoption framework for public institutions like KCCA?
9. Beyond basic cloud adoption, how does the framework leverage emerging technologies such as AI, IoT, and Big Data analytics to maximize the value of cloud computing for KCCA?
10. In your opinion, what are the top three critical factors within the proposed cloud computing adoption framework that would ensure its long-term success at KCCA? Are there any areas you feel need further refinement or additional support?

Thank You

APPENDIX III

CLOUD ADOPTION FRAMEWORK EVALUATION QUESTIONNAIRE

Instructions:

- ✓ Complete Section A based on your background.
- ✓ For Sections B–D, select the response that best reflects your experience with the framework.
- ✓ For Section E, evaluate the prototype based on hands-on testing.

Section A: Evaluation of Artifact Using Perspectives of IT Staff

This section aims to assess the framework's impact. *(Rate each statement: Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree)*

This section aims to evaluate the framework's effectiveness in addressing technological challenges and enhancing operational efficiency from the perspective of IT staff.	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
aIT1. The framework effectively addresses the technological challenges faced by our IT department.					
aIT2. The proposed framework enhances the operational efficiency of our IT systems.					
aIT3. The framework provides adequate technical support for cloud adoption.					
aIT4. The framework's guidelines for IT infrastructure upgrades are clear and actionable.					
aIT5. The framework effectively integrates with our existing IT systems.					

Section B: Evaluation of Artifact Using Perspectives of Department Heads

This section aims to assess the framework's impact. *(Rate each statement: Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree)*

This section aims to evaluate the framework's effectiveness in providing a clear roadmap and enhancing collaboration from the perspective of department heads.	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

bDH1. The framework provides a clear and actionable roadmap for integrating cloud computing into our departmental operations.					
bDH2. The framework enhances collaboration and data sharing across different departments.					
bDH3. The framework effectively addresses the operational challenges faced by our department.					
bDH4. The framework supports the strategic goals of our department.					
bDH5. The framework is adaptable to the specific needs of our department.					

Section C: Evaluation of Artifact Using Perspectives of Policymakers

This section aims to assess the framework's impact. *(Rate each statement: Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree)*

This section aims to evaluate the framework's alignment with strategic goals and regulatory requirements from the perspective of policymakers.	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
cPM1. The framework aligns well with our strategic goals and regulatory requirements for adopting cloud computing.					
cPM2. The framework addresses the key regulatory and security concerns for cloud adoption.					
cPM3. The framework supports the policy objectives of our institution.					
cPM4. The framework provides clear guidelines for compliance and data protection.					
cPM5. The framework enhances the overall governance of cloud computing adoption.					

Section D: Evaluation of Artifact Using Perspectives of Technical Consultants

This section aims to assess the framework's impact. *(Rate each statement: Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree)*

This section aims to evaluate the technical robustness and complexity of the framework from the perspective of technical consultants.	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**

dTC1. The technical aspects of the framework are robust and adequately address the complexities of cloud computing adoption.					
dTC2. The framework provides comprehensive technical guidelines for cloud adoption.					
dTC3. The framework effectively addresses the technical challenges of cloud computing.					
dTC4. The framework supports the integration of emerging technologies with cloud computing.					
dTC5. The framework is adaptable to various technical environments and requirements.					

Section E: Evaluation of the Framework Using a Prototype

This section aims to assess the framework's impact. *(Rate each statement: Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree)*

This section aims to evaluate the practical applicability and benefits of the proposed framework using a prototype.	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
eP1. The prototype integrates technological readiness and organizational preparedness effectively.					
eP2. The prototype incorporates regulatory and security factors into technological infrastructure.					
eP3. The prototype aligns organizational preparedness with regulatory compliance.					
eP4. The prototype shows how technological readiness enhances regulatory and security measures.					
eP5. The prototype highlights the importance of organizational preparedness for addressing technological challenges.					
eP6. The prototype integrates regulatory and security factors with organizational strategies.					
eP7. The prototype demonstrates the interdependence of technological readiness, organizational preparedness, and regulatory compliance.					
eP8. The prototype combines technological readiness, organizational preparedness, and regulatory factors comprehensively.					

Thank You