THE INTERPLAY OF INDUSTRY REGULATIONS, TECHNOLOGY DEPLOYMENT STRATEGIES, AND PERFORMANCE OF COMMERCIAL BANKS IN KENYA

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A Thesis Submitted to the Institute of Postgraduate Studies of Kabarak University in Partial Fulfillment of the Requirements for the Award of Doctor of Philosophy in Business Administration (Strategic Management)

KABARAK UNIVERSITY

NOVEMBER, 2025

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DEDICATION

I wholeheartedly dedicate this work to my family, whose unwavering support, encouragement, and sacrifices have been my greatest source of strength. I dedicate this work to my dad, Mwalimu Shadrack Malit, and my mum, Margaret Awino, for their lifelong mentorship, moral support, and prayers. I also dedicate this work to my Children, Bradley and Chloe, and Malit Jr. Your unconditional love, patience, and belief in my abilities have inspired me to persevere and strive for excellence. This achievement is as much yours as it is mine, and I am forever grateful for your guidance and unwavering presence throughout this journey.

ABSTRACT

Advances in technology in the banking sector have transformed the global landscape of financial services, conferring substantial benefits, including enhanced operational efficiency, improved standards of customer service, and expanded financial inclusivity. In Kenya, commercial banks face substantial challenges, including fragmented and slow adoption practices, which have affected their effectiveness in technology deployment. Kenya is a leader in digital financial innovations on the continent; however, commercial banks still face several issues, including slow and fragmented adoption practices. This raises serious questions about the effectiveness of their technology deployment strategies, so it's essential to examine how different deployment approaches impact bank performance. The general objective of this study was to assess the interplay between industry regulations, Technology Deployment Strategies, and the Performance of Commercial Banks in Kenya. Specifically, the study sought to investigate the effect of technology integration practices, scalability of technology deployment, and efficiency of technology management on the performance of commercial banks in Kenya, assess the moderating effect of industry regulations on the relationship between technology deployment strategies and performance of commercial banks in Kenya, and develop a technology deployment strategic decision-making model. The study was anchored on the Unified Theory of Acceptance and Use of Technology (UTAUT), the Theory of Planned Behavior (TPB), and the Resource-Based Theory. The target population consisted of the 39 commercial banks operating in Kenya. Data was collected using structured questionnaires. The collected data were compiled, coded, and analyzed using the Statistical Package for the Social Sciences (SPSS, version 28) and Microsoft Excel software. Descriptive statistics, including frequencies, means, and standard deviations, were used to reveal the characteristics of study variables. Additionally, inferential statistical tools, including Pearson correlation and multiple regression analyses, were applied to assess the nature of relationships between the variables of interest. This study aimed to provide commercial bank managers with a comprehensive framework and software model for optimizing performance through effective technology deployment strategies. The study has advanced the Technology Deployment Strategic Decision Model (TDSDM), which was tested using datasets from the 39 participating commercial banks in Kenya. The findings will inform decision-makers in selecting and implementing technology solutions that align with business objectives, regulatory requirements, and evolving customer expectations. Technology Integration Practices showed a statistically significant positive effect on bank performance ($p = 0.023$, $\beta = 0.360$), leading to the rejection of the null hypothesis (H01). This indicated that the improved integration of technologies, such as core banking systems, mobile platforms, and ERP systems, significantly contributed to better performance outcomes. The scalability of Technology Deployment exhibited a positive and statistically significant relationship with performance ($p = 0.034$, $\beta = 0.451$), resulting in rejection of the null hypothesis (H02). The efficiency of Technology Management also had a positive but statistically insignificant influence on performance ($p = 0.078$, $\beta = 0.277$); thus, the null hypothesis (H03) was not rejected. While efficient technology delivery frameworks were observed, their impact on performance was not statistically conclusive. Additionally, industry regulations were found to moderate the relationship between deployment strategies and performance negatively.

Keywords: *Technology Deployment, Commercial Banks, Performance, Industry Regulations, Technology Integration, Scalability, Financial Inclusion.*

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LIST OF ABBREVIATIONS AND ACRONYMS

AI:	Artificial Intelligence
CIR:	Cost-to-Income Ratio
CTOs:	Chief Technology Officers
ERP:	Enterprise Resource Planning
ICT:	Information and Communication Technology
IT:	Information Technology
ITIL:	Information Technology Infrastructure Library
ITSM:	Information Technology Service Management
KUREC:	Kabarak University Research Ethics Committee
MFIs:	Microfinance Institutions
ML:	Machine Learning
NACOSTI:	National Council of Science, Technology, and Innovation
NPLs:	Non-Performing Loans
RBV:	Resource-Based View
ROA:	Return on Assets
ROE:	Return on Equity
ROI:	Return on Investment
SACCOs:	Savings and Credit Cooperatives
SEM:	Structural Equation Modeling
SPSS:	Statistical Package for the Social Sciences
TAM:	Technology Acceptance Model
TDSDM:	Technology Deployment Strategic Decision Model
TPB:	Theory of Planned Behavior
TRA:	Theory of Reasoned Action
UTAUT:	Unified Theory of Acceptance and Use of Technology
VIF:	Variance Inflation Factor
VRIN:	Valuable, Rare, Inimitable, and Non-Substitutable

CONCEPTUAL OPERATIONAL DEFINITION OF TERMS

Technology Deployment Strategies: Technology Deployment Strategies refer to structured approaches used by commercial banks to implement digital innovations efficiently. These strategies help banks enhance performance while ensuring compliance with industry regulations (Njenga & Njeru, 2023).

Technology Integration Strategies: Technology Integration Strategies involve adopting digital technologies to improve banking operations. Canary deployment introduces new systems gradually to minimize risks. Recreate deployment replaces an old system entirely with a new one. Shadow deployment runs new and old systems simultaneously for comparison. Cloud solutions enhance flexibility and scalability in banking services (Gomber et al., 2022).

Scalability of Technology Deployment : The scalability of Technology Deployment determines how well a bank's technology infrastructure can expand to meet demand. Vertical scaling increases a system's resources within a single server. Horizontal scaling expands capacity by adding more servers. Dynamic scaling automatically adjusts resources based on real-time demand. Load balancing distributes network traffic across multiple servers to maintain performance (Njenga & Njeru, 2023).

Efficiency of Technology Management: The efficiency of Technology Management ensures that IT systems and digital assets are optimized for cost-effectiveness, security, and operational continuity. IT governance aligns technology investments with business goals. IT service management structures the delivery of IT services. In-house development allows banks to create proprietary banking technologies. IT leadership ensures that technology strategies align with organizational objectives (Olanrewaju et al., 2022).

Industry Regulations: Industry Regulations govern how commercial banks deploy technology while ensuring compliance and stability. Compliance requirements include data protection laws and anti-money laundering policies. Regulatory stringency refers to the strictness of enforcement and oversight. Regulatory adaptability refers to the ability of regulations to accommodate emerging technologies in a flexible manner (Pousttchi & Dehnert, 2022).

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Performance of Commercial Banks: The overall effectiveness of a commercial bank in achieving its financial, operational, and customer-related objectives is typically measured through financial and operational indicators. Financial performance encompasses key metrics such as return on assets (ROA) and return on equity (ROE). Customer satisfaction evaluates how well digital banking services meet user expectations. Stakeholder satisfaction considers the views of investors, employees, and regulators. Operational efficiency measures cost reduction and service improvement through the adoption of technology (Ndegwa et al., 2023).

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

The financial sector globally is undergoing a major transformation driven by the rapid advancement and integration of digital technologies. In the banking industry, this transformation has significantly influenced operational models, customer engagement, and competitive positioning. In Kenya, commercial banks have been at the forefront of adopting technology deployment strategies to respond to changing consumer needs, regulatory pressures, and growing competition. These strategies encompass mobile and internet banking, artificial intelligence (AI), cloud computing, digital payment platforms, and blockchain applications, among others (Njenga & Njeru, 2023; Kimutai et al., 2022). The deployment of these technologies has shifted from being a value-added service to a critical pillar of operational sustainability and market responsiveness.

Globally, the adoption of AI, cloud computing, and mobile technologies has proven effective in streamlining operations, enhancing risk assessment, and improving customer personalization. Commercial banks are increasingly leveraging AI-driven tools for real-time data analytics, fraud detection, and automated customer support, contributing to operational efficiency and profitability (Gomber et al., 2022; Olanrewaju et al., 2022). Cloud computing has enabled scalable infrastructure, cost reduction, and data flexibility, allowing institutions to offer seamless services across multiple platforms. Similarly, mobile banking has emerged as a game-changer, not only in mature economies but also in emerging markets, by expanding banking access beyond traditional branch networks (Rabbani et al., 2023). This global shift underscores the competitive imperative for banks to innovate continually and align with digital transformation trends.

In regions such as Asia and Europe, banks have been at the forefront of adopting integrated fintech ecosystems, utilizing machine learning and predictive analytics to enhance customer service and manage financial risks (Sun & Liu, 2022). Southeast Asian countries have particularly embraced fintech partnerships, mobile wallets, and app-based payment solutions to deepen financial inclusion and offer real-time banking services (Pousttchi & Dehnert, 2022). These regional experiences demonstrate how the strategic implementation of technology can lead to expanded customer bases, increased revenues, and enhanced service accessibility.

In the African context, technology deployment in banking has centered heavily on mobile banking and digital financial services aimed at promoting financial inclusion. Kenya's M-Pesa is a prominent example, having revolutionized access to financial services by offering basic banking solutions through mobile phones. This innovation has brought millions of previously unbanked individuals particularly in rural and marginalized areas into the formal financial system (Ndung'u et al., 2022). Research suggests that African banks that have adopted mobile and digital banking platforms report increased transaction volumes, broader outreach, and improved financial performance (Adjei & Krah, 2023).

Specifically in Kenya, commercial banks have made significant strides in technology deployment, using mobile banking, internet platforms, and AI-powered systems to drive growth and improve service delivery. Mobile banking has enabled banks to overcome physical limitations, reduce operational costs, and enhance customer experience through increased convenience and accessibility (Ndegwa et al., 2023; Otieno & Mwangi, 2023). AI-based tools are being used to manage credit risk, enhance decision-making, and tailor services to individual client profiles. Moreover, cloud-based systems have enabled banks to digitize their infrastructure, offering scalable solutions and fostering innovation in customer interaction, product development, and back-office operations (Kimutai et al., 2022; Odhiambo & Mwangi, 2023).

As technology becomes deeply integrated into banking operations, it has also reshaped risk management strategies, particularly in areas such as cybersecurity, data protection, and regulatory compliance. With increasing reliance on digital platforms, Kenyan banks have had to invest in robust cybersecurity frameworks to protect against data breaches and fraud, thus sustaining customer trust and operational stability (Mutua & Korir, 2023). The success of technology deployment is therefore not solely determined by operational gains, but also by how well banks navigate risks associated with digital transformation while aligning with regulatory standards.

However, the adoption of advanced technologies is not without challenges. Many Kenyan banks especially small and medium-sized ones face barriers such as high initial investment costs, insufficient IT infrastructure, and skills shortages (Otieno & Njeru, 2023). Moreover, customer concerns about data privacy, digital literacy, and the reliability of online services continue to affect technology acceptance. These issues are compounded by the need to comply with evolving regulatory frameworks, which require banks to strike a balance between innovation and compliance. Thus, the effectiveness of technology deployment strategies hinges not only on adoption but also on the adaptability and sustainability of their implementation.

In summary, the transformation of Kenya's banking sector through the deployment of technology has created opportunities for improved performance, broader financial inclusion, and enhanced customer service. Yet, the success of these strategies depends on careful planning, appropriate investment, and strategic alignment with both market demands and regulatory requirements. As the digital economy continues to evolve, understanding the influence of technology deployment strategies on the performance of commercial banks becomes increasingly important for policymakers, practitioners, and scholars alike.

The Kenyan banking industry operates within a tightly regulated environment overseen primarily by the Central Bank of Kenya (CBK), the Capital Markets Authority (CMA), and the Communication Authority of Kenya (CAK). These bodies have established a range of frameworks aimed at promoting financial stability, protecting consumer interests, and fostering innovation. For instance, the CBK Prudential Guidelines (2013) and the Banking (Amendment) Act (2016) introduced provisions for risk-based supervision, digital payment regulation, and cybersecurity governance. In recent years, the CBK's Guidance on Risk Management for Digital Credit Providers (2021) and the Data Protection Act (2019) have become key instruments ensuring that technological deployment aligns with ethical standards and consumer privacy requirements (Central Bank of Kenya, 2021; Office of the Data Protection Commissioner [ODPC], 2022). These regulations ensure that while banks innovate digitally, they maintain the integrity, confidentiality, and accountability required in financial service delivery.

Industry regulations also play a crucial role in shaping how technology deployment translates into performance outcomes. Research by Ngugi and Ouma (2022) found that regulatory frameworks directly influence banks' capacity to innovate by determining the pace, cost, and scope of technology adoption. For example, compliance requirements related to cybersecurity and anti-money laundering (AML) have compelled Kenyan banks to invest heavily in digital monitoring systems and transaction tracking software. While these regulatory measures enhance financial security, they also increase operational costs and complexity, compelling banks to strike a balance between innovation and compliance efficiency. Thus, the interplay between regulation and technology deployment is a determinant of both operational resilience and profitability in the banking sector.

Furthermore, regulatory harmonization within the East African Community (EAC) and global financial standards such as the Basel III Framework have increasingly influenced Kenya's financial landscape. These international standards encourage stronger capital adequacy, stress testing, and technological risk management frameworks that align with global best practices (World Bank, 2022; IMF, 2023). Such regulations have not only increased the resilience of Kenyan banks to systemic shocks but have also incentivized the adoption of advanced digital tools for compliance reporting and performance analytics. However, stringent regulatory requirements can sometimes slow down innovation, particularly among smaller banks with limited financial capacity to upgrade their technological systems (Mwangi & Wambua, 2023). Hence, understanding how industry regulations interact with technology deployment is critical to explaining variations in bank performance across institutions.

However, the adoption of advanced technologies is not without challenges. Many Kenyan banks, especially small and medium-sized ones, face barriers such as high initial investment costs, insufficient IT infrastructure, and skills shortages (Otieno & Njeru, 2023). Moreover, customer concerns about data privacy, digital literacy, and the reliability of online services continue to affect technology acceptance. These issues are compounded by the need to comply with evolving regulatory frameworks, which require banks to strike a balance between innovation and compliance. Thus, the effectiveness of technology deployment strategies hinges not only on adoption but also on the adaptability and sustainability of their implementation.

1.1.1 Technology Deployment Strategies

Technology deployment strategies in commercial banks refer to the structured approaches banks use to adopt, integrate, and scale digital solutions, thereby enhancing operational effectiveness, improving customer experiences, and ensuring a competitive advantage (Mutua & Korir, 2023). Key strategies include integrating technology, scaling technology deployment, and optimizing technology management efficiency.

Technology integration strategies define how banks introduce new technological systems within their operations to ensure seamless adoption while minimizing risks. The banking sector relies on various deployment methods to achieve this, including canary deployment, recreate deployment, shadow deployment, and cloud solutions strategies. The canary deployment strategy involves rolling out new technology in a controlled manner by releasing it to a small subset of users before making it fully operational. This approach allows banks to test system performance, monitor for potential issues, and make necessary adjustments before wider implementation. According to Mutua and Korir (2023), canary deployment enhances system reliability and reduces the likelihood of operational failures, which is particularly critical in financial institutions that handle sensitive customer transactions. Similarly, Odhiambo and Mwangi (2023) emphasize that this strategy helps mitigate risks associated with software updates and system upgrades by ensuring that only a small group of users experiences any initial challenges before a full-scale launch.

In contrast, the recreate deployment strategy involves shutting down an existing system and replacing it entirely with a new version. While this method ensures that the latest technology is fully integrated into banking operations, it presents significant operational risks, including potential service downtime. As Kimutai et al. (2022) highlight, banks that adopt this approach must carefully plan their deployment schedules, often conducting major system overhauls during non-peak hours to minimize disruptions. Njenga and Omwenga (2023) further note that while recreate deployment allows for a complete refresh of banking infrastructure, it requires extensive pre-implementation testing to avoid customer dissatisfaction due to unexpected downtimes.

Another effective strategy is shadow deployment, where a new system is run alongside the existing one without making it publicly available. This strategy enables banks to test new technology in real-world conditions without disrupting ongoing operations. Muthoni (2023) argues that shadow deployment provides an opportunity for banks to assess performance metrics, identify potential weaknesses, and refine the system before going live. Similarly, Karani and Kinyua (2022) suggest that shadow deployment is particularly beneficial for banking institutions transitioning to digital platforms, as it enables real-time performance assessments while maintaining system stability.

Cloud solutions strategies have become increasingly central in the banking sector because of their scalability, cost-effectiveness, and enhanced data security. Through cloud computing, banks can securely store vast amounts of customer data, process transactions in real-time, and implement robust disaster recovery mechanisms. According to Ndegwa (2022), cloud-based systems enable banks to expand operations on demand while minimizing the financial burden associated with maintaining physical infrastructure. Njenga and Omwenga (2023) further highlight that cloud computing contributes to stronger cybersecurity safeguards, as most cloud service providers invest heavily in encryption, authentication, and intrusion detection technologies. This not only strengthens data protection but also ensures compliance with regulatory standards, such as the Data Protection Act (2019) and the Central Bank of Kenya (CBK) prudential guidelines, which mandate secure data handling in financial institutions.

Scalability has emerged as a crucial pillar of technology deployment strategies in commercial banking, ensuring that systems can manage growing customer demands and transaction volumes without sacrificing performance or security. Banks increasingly rely on scalable technological frameworks that support vertical scaling, horizontal scaling, dynamic scaling, and load balancing to maintain operational efficiency. Vertical scaling involves upgrading existing resources such as server capacity, memory, or processing power to enhance performance, a necessity for institutions that manage real-time trading or high-volume digital payments (Kimutai et al., 2022). However, as Njenga and Omwenga (2023) caution, vertical scaling has cost and infrastructure limitations, prompting banks to explore hybrid strategies that combine vertical and horizontal scaling to achieve optimal flexibility and cost-effectiveness.

From a regulatory standpoint, cloud adoption and scalability strategies must operate within the framework of industry regulations governing risk management, data privacy, and operational resilience. The Central Bank of Kenya (CBK), under its *Guideline on Cybersecurity for Financial Institutions (2021)*, emphasizes the importance of compliance with international standards such as ISO/IEC 27001 and Basel Committee recommendations on operational risk. Regulators require banks to ensure that third-party cloud providers comply with local data residency laws and maintain adequate safeguards to prevent data breaches and service disruptions (CBK, 2021). This regulatory oversight not only protects consumers but also fosters institutional trust and financial stability. Consequently, banks in Kenya must strike a balance between technological innovation and strict adherence to regulatory frameworks to sustain their performance and maintain public confidence in the evolving digital banking environment.

On the other hand, horizontal scaling involves adding more servers or infrastructure components to distribute workloads more effectively. This strategy enhances system resilience and is widely adopted by banks dealing with large transactional data. Karani and Kinyua (2022) argue that horizontal scaling enables seamless expansion without requiring system downtime, making it ideal for financial institutions that experience fluctuating transaction volumes. Ndegwa (2022) further explains that horizontal scaling enables banks to manage peak traffic efficiently, ensuring uninterrupted service availability.

Dynamic scaling integrates automation to adjust system resources in real-time based on fluctuations in demand. This approach optimizes resource allocation, ensuring that banks can handle high transaction loads during peak hours while scaling down during off-peak periods. Njenga and Omwenga (2023) emphasize that dynamic scaling is essential for mobile and internet banking platforms, as it enhances system responsiveness and cost efficiency. Similarly, Odhiambo and Mwangi (2023) highlight that dynamic scaling reduces operational costs by allocating computing resources only when needed, preventing wastage and optimizing performance.

To further enhance system performance, load balancing is employed to distribute network traffic and processing workloads across multiple servers. This strategy prevents system overloads, ensuring that banking operations remain efficient even during periods of high traffic. Kimutai et al. (2022) state that load balancing improves transaction processing times and enhances system reliability, reducing the risk of service disruptions. Njenga and Omwenga (2023) add that effective load-balancing mechanisms contribute to better customer experience by minimizing delays and ensuring seamless access to banking services.

Efficient technology management is critical for ensuring the successful deployment and maintenance of banking systems. Key components of technology management include IT governance, IT service management, in-house technology development, and IT leadership. IT governance refers to the policies, frameworks, and decision-making structures that guide the management of technology in financial institutions. Strong IT governance frameworks ensure compliance with regulatory standards, enhance cybersecurity measures, and align IT investments with business objectives. Muthoni (2023) highlights that banks with robust IT governance experience improved risk management, reduced operational disruptions, and enhanced service delivery. Karani and Kinyua (2022) further argue that well-defined IT governance structures facilitate accountability and transparency in technology-related decision-making.

IT service management (ITSM) focuses on the strategic planning, implementation, and maintenance of IT services within the banking industry. ITSM frameworks, such as ITIL (Information Technology Infrastructure Library), enable financial institutions to enhance service delivery, minimize disruptions, and optimize the utilization of IT resources. Ndegwa (2022) notes that effective ITSM contributes to cost savings and operational efficiency by standardizing technology management processes. Njenga and Omwenga (2023) note that ITSM facilitates continuous improvement in banking operations, resulting in enhanced customer satisfaction and increased trust in financial services.

Some banks prefer in-house development of technology rather than relying on third-party vendors. This approach enables the customization of IT systems to meet specific operational needs, providing greater control over technology deployment. Odhiambo and Mwangi (2023) argue that in-house development enhances data security, as banks can implement tailored cybersecurity measures to protect customer information. However, Kimutai et al. (2022) caution that in-house development requires significant investment in IT expertise and infrastructure, making it a resource-intensive approach.

Ultimately, IT leadership plays a pivotal role in driving technological innovation and ensuring the successful deployment of banking solutions. Effective IT leadership aligns technology initiatives with business objectives, drives digital transformation, and mitigates technology-related risks. Njenga and Omwenga (2023) highlight that strong IT leadership enhances decision-making, promotes a culture of innovation, and ensures adaptability to emerging financial technologies. Odhiambo and Mwangi (2023) emphasize that leadership in IT is essential for navigating the complexities of technology deployment and maintaining a competitive edge in the banking sector.

1.1.2 Performance of Commercial Banks in Kenya

The performance of commercial banks, within the context of this study, refers to how well banks utilize their resources to achieve profitability, financial stability, and operational efficiency while responding to the evolving demands of customers and the market. Performance is measured using both financial and non-financial indicators, which are critical for assessing a bank's overall effectiveness. In Kenya, the banking sector plays a fundamental role in economic growth by facilitating savings, investments, and credit provision, making bank performance a crucial determinant of financial stability and development (Njiru, 2022).

Financial performance is a key measure of how efficiently a commercial bank manages its assets, liabilities, and overall profitability. The most commonly used financial indicators include Return on Assets (ROA) and Return on Equity (ROE), which measure a bank’s ability to generate profits from its resources. A high ROA indicates that a bank is effectively utilizing its assets, while a strong ROE signifies profitability relative to shareholders’ equity. Additionally, the Cost-to-Income Ratio (CIR) is a crucial efficiency metric, indicating how effectively a bank manages its operating costs in relation to its income (Wambugu & Waweru, 2021).

In Kenya, digitalization has significantly affected financial performance by reducing transaction costs and enhancing revenue streams through mobile and internet banking services. The widespread adoption of mobile banking and financial technology platforms, such as M-Pesa, has boosted financial inclusion and increased revenue streams for banks (Omondi, 2020). However, the sector still faces challenges, such as rising non-performing loans (NPLs), high operational costs, and economic fluctuations. Non-performing loans erode profitability, affecting banks' ability to meet capital adequacy requirements and sustain financial stability (Njiru, 2022). Moreover, regulatory interventions, such as the interest rate caps introduced in 2016, impacted bank profitability by limiting their lending margins, which in turn influenced financial performance trends (Wambugu & Waweru, 2021).

Customer satisfaction is a critical non-financial performance indicator that reflects how well a bank meets the needs and expectations of its clients. In an increasingly digital landscape, banks must provide seamless, secure, and convenient services to retain customers and attract new ones. The growth of mobile and digital banking platforms has transformed the customer experience, with ease of access and transaction speed becoming primary drivers of satisfaction. Customer satisfaction is also influenced by factors such as service quality, responsiveness, and personalized financial solutions (Omondi, 2020).

In Kenya, commercial banks have been increasingly integrating digital banking services, thereby enhancing convenience for their customers. The proliferation of mobile banking applications, internet banking, and digital payment solutions has improved customer interactions with financial institutions, contributing to higher satisfaction levels (Wambugu & Waweru, 2021). However, challenges such as cybersecurity threats, fraud, and occasional system downtimes can negatively impact customer confidence in digital banking solutions. Additionally, competitive pressure from fintech firms and digital lenders has heightened the need for traditional banks to continuously innovate and improve customer experiences (Njiru, 2022).

Stakeholder satisfaction encompasses the perspectives of various interest groups, including investors, regulators, employees, and the broader community, regarding a bank's performance. Investors focus on profitability and return on investment, while regulators assess compliance with banking laws, capital adequacy requirements, and financial transparency. Employees, as internal stakeholders, evaluate the bank's working conditions, professional growth opportunities, and compensation structures (Njiru, 2022).

Commercial banks in Kenya operate within a highly regulated financial environment, where compliance with policies set by the Central Bank of Kenya (CBK) directly influences stakeholder confidence. Regulatory frameworks, including capital reserve requirements, anti-money laundering policies, and consumer protection laws, impact stakeholder satisfaction levels (Wambugu & Waweru, 2021). Additionally, corporate social responsibility (CSR) initiatives and financial inclusion efforts contribute to a bank's public image and community acceptance. Banks that actively support community development projects and provide inclusive financial solutions, particularly in underserved areas, tend to enjoy stronger stakeholder support and brand loyalty (Omondi, 2020).

Operational efficiency refers to a bank's ability to optimize processes, minimize costs, and enhance service delivery. Efficiency is measured using key indicators such as the Cost-to-Income Ratio (CIR), branch network expansion, digital banking adoption, and transaction processing speeds. A lower CIR indicates that a bank effectively controls its operating expenses relative to income, reflecting better resource utilization (Wambugu & Waweru, 2021).

In Kenya, the adoption of digital technologies has been a major driver of operational efficiency. Banks have increasingly invested in artificial intelligence (AI), automation, and cloud computing to streamline operations, reduce manual processes, and enhance customer interactions. Mobile banking, agency banking, and digital wallets have also contributed to reducing reliance on physical bank branches while expanding financial access (Omondi, 2020). However, the rising cost of cybersecurity measures, fraud prevention systems, and regulatory compliance remains a challenge, requiring banks to continuously invest in advanced security protocols and risk management frameworks (Njiru, 2022). Despite these advancements, smaller banks often struggle with achieving the same level of operational efficiency as larger financial institutions due to limited capital and technological investments. The competitive landscape, with the rise of fintech companies, has further emphasized the need for banks to adopt more agile operational models to remain efficient and profitable (Wambugu & Waweru, 2021).

1.1.3 Commercial Banks in Kenya

Commercial banks play a pivotal role in the Kenyan economy, acting as intermediaries between savers and borrowers and facilitating the movement of capital through various financial products and services. The banking sector in Kenya is crucial for economic growth and development, as it supports key activities such as savings mobilization, credit provision to businesses and households, investment financing, and the smooth operation of payment systems. Commercial banks are essential in driving financial inclusion, ensuring that even underbanked populations have access to financial services, particularly through mobile banking platforms such as M-Pesa (Wambugu & Waweru, 2021). Kenya's commercial banking sector is classified into three main tiers based on size, asset base, and market influence: Tier 1, Tier 2, and Tier 3. Tier 1 banks are the largest and most financially robust, usually multinational or affiliated with international banks, and they dominate the market in terms of assets, profitability, and customer base. Tier 2 banks are medium-sized institutions with a national footprint, while Tier 3 banks are smaller, often focusing on niche markets or specific regions within Kenya. As of December 2023, Kenya has 38 commercial banks authorized to conduct operations.

The Kenyan commercial banking sector has experienced significant growth in recent years, largely due to technology-driven innovations. With a robust regulatory framework and increasing consumer demand for digital services, Kenyan banks have embraced technology deployment strategies to boost performance (Mutua & Korir, 2023). Many Kenyan banks are implementing mobile banking solutions, digital loan services, and data-driven insights to meet customer needs and maintain a competitive edge in the East African market. This technological integration has been instrumental in expanding banks' reach, particularly in rural and underserved areas, thereby contributing to enhanced financial inclusion and sector growth (Njenga & Omwenga, 2023).

Mobile banking has played a pivotal role in Kenya's financial services landscape, transforming how customers interact with banking services. Platforms like M-Pesa have become ubiquitous, enabling customers to conduct transactions directly from their mobile devices. By reducing reliance on physical branches, mobile banking has enabled Kenyan banks to reduce costs and improve accessibility, particularly for the unbanked population (Kimutai et al., 2022). Studies indicate that mobile banking has not only increased customer convenience but also contributed to banks' profitability by facilitating high transaction volumes and enhancing customer engagement (Odhiambo & Mwangi, 2023).

Kenyan banks have also adopted innovative lending practices through digital credit platforms, enabling customers to access short-term loans via mobile applications. This development has expanded access to credit, especially among small and medium enterprises (SMEs) that were previously underserved by traditional banks (Karani & Kinyua, 2022). Digital lending has enhanced the loan approval process, reduced processing times, and minimized operational costs, ultimately contributing to improved financial outcomes for banks. These advancements underscore how the deployment of technology, in the form of digital lending platforms, is enhancing bank performance in Kenya (Muthoni, 2023).

In terms of cybersecurity, Kenyan banks are implementing advanced security protocols to protect customer data and prevent cyber-attacks. The prevalence of mobile and online banking has raised concerns over data security, leading banks to invest in firewalls, encryption, and real-time monitoring systems to safeguard against potential threats (Ndegwa, 2022). Banks that prioritize cybersecurity measures have successfully maintained customer trust and mitigated the financial impact of potential data breaches, which is crucial to their sustained performance and market reputation (Mutua & Korir, 2023).

Moreover, Kenyan banks are increasingly utilizing data analytics and artificial intelligence to refine their service delivery and meet the evolving needs of their customers. By analyzing customer transaction data, banks can identify trends, customize their offerings, and enhance customer experiences, which in turn leads to higher customer retention and satisfaction rates (Njenga & Omwenga, 2023). Banks that effectively leverage data analytics not only improve customer engagement but also achieve better overall performance through increased operational efficiencies and optimized resource allocation.

1.2 Statement of the Problem

The performance of commercial banks in Kenya remains a critical concern, especially in the wake of increased technological investment that has not translated proportionately into financial returns. One of the key performance indicators in the banking sector is Return on Assets (ROA), which measures how efficiently a bank utilizes its assets to generate earnings. Ideally, a healthy banking sector is expected to maintain an ROA of at least 2% or above to reflect strong asset utilization and profitability. However, in Kenya, most commercial banks consistently report ROA figures below 1.5%, with some institutions recording even lower rates due to inefficiencies and operational constraints (Central Bank of Kenya, 2023). This deviation from the expected ROA benchmark reveals a performance gap that raises questions about the effectiveness of current operational and technological strategies.

Despite the adoption of technology-driven solutions such as mobile banking platforms, artificial intelligence (AI), data analytics, and digital payment systems, banks continue to grapple with underwhelming financial outcomes. Studies indicate that while technological innovations contribute to improvements in financial services, only 17% of commercial banks in Kenya have fully integrated digital technologies into their operations, and many others implement them in a fragmented or unstructured manner (Kinyanjui, 2020). This slow and inconsistent approach to technology deployment affects not only ROA but also operational efficiency, customer satisfaction, and compliance with regulatory standards.

Smaller banks, in particular, face capital constraints, infrastructure limitations, and a lack of skilled personnel, which restrict their ability to deploy and sustain advanced technologies. In addition, cybersecurity risks, data privacy concerns, and the need to comply with laws such as the Data Protection Act (2018) further complicate the technology adoption landscape. These challenges often lead to rising overhead costs, reduced asset productivity, and an inability to meet customer expectations—factors that directly affect ROA and other performance metrics.

Moreover, while previous studies (e.g., Kangogo, 2018; Muttai, Njoka, & Muchira, 2023) have acknowledged a positive correlation between technology adoption and bank performance, they fall short in analyzing how structured versus unstructured technology deployment strategies impact key outcomes like ROA. The current literature does not comprehensively assess whether banks have established coherent frameworks for technology adoption or if decisions are made on an ad hoc basis. This lack of clarity leaves a gap in understanding how different technology deployment strategies contribute to or hinder financial performance, especially as measured by ROA.

Compounding the issue is the underperformance in customer satisfaction, which remains below 60%, as well as ongoing efficiency challenges due to poor process automation and high cost structures (Kangogo, 2018). These shortcomings underscore the need for a more strategic and evidence-based approach to technology deployment, one that can improve ROA, strengthen customer experience, and optimize operational workflows.

Therefore, this study seeks to investigate the influence of technology deployment strategies on the performance of commercial banks in Kenya, with ROA as the central measure of performance. By distinguishing between structured and unstructured deployment approaches, evaluating the regulatory environment, and identifying barriers to effective technology adoption, the study aims to address the persistent gap in financial performance and offer insights for enhancing both profitability and institutional sustainability in the Kenyan banking sector.

1.3 Objectives of the Study

1.3.1 General Objective

The general objective of this study was to assess the interplay of industry regulations, technology deployment strategies, and performance of Commercial Banks in Kenya.

1.3.2 Specific Objectives

i. To investigate the effect of technology integration practices on the performance of commercial banks in Kenya.

ii. To determine the effect of the scalability of technology deployment on the performance of commercial banks in Kenya.

iii. To examine the effect of efficiency of technology management on the performance of commercial banks in Kenya.

iv. To assess the moderating effect of industry regulations on the relationship between technology deployment strategies and performance of commercial banks in Kenya.

v. To develop a technology deployment strategic decision-making model that enhances the performance and competitiveness of commercial banks in Kenya.

1.4 Hypotheses

H_{01}: Technology integration practices have no significant effect on the performance of commercial banks in Kenya.

H_{02}: The scalability of technology deployment models has no significant effect on the performance of commercial banks in Kenya.

H_{03}: The efficiency of technology management has no significant effect on the performance of commercial banks in Kenya.

H_{04}: Industry regulations have no significant moderating effect on the relationship between technology deployment strategies and the performance of commercial banks in Kenya.

H_{05}: The technology deployment strategic decision-making model does not significantly enhance the performance and competitiveness of commercial banks in Kenya.

1.5 Justification of the Study

This research was essential as it investigated the relationship between technology deployment strategies and the performance of commercial banks in Kenya. To remain competitive and sustainable, the financial sector had to integrate and utilize technology effectively, given its vital role in the country's economic growth. This study aimed to analyze the effects of different technology deployment strategies on the performance of commercial banks. It provided detailed insights into the tactics that either contributed to or impeded organizational success. The results have the potential to inform policymakers, industry stakeholders, and financial leaders, enabling them to optimize the use of technology and enhance operational efficiency, customer service, and overall performance within the unique context of the Kenyan financial sector.

One of the key contributions of this study was its focus on the nuances of technology adoption in Commercial banks in Kenya, particularly in terms of technology deployment practices. While previous studies had established a link between technology adoption and improved performance, they had not thoroughly examined the strategic frameworks that banks used to deploy these technologies. By filling this gap, the study offered a deeper understanding of how structured, methodical approaches could optimize technology's impact on financial performance, customer satisfaction, and operational efficiency.

Technology has been a powerful enabler of financial inclusion, especially in countries like Kenya, where digital financial services, such as mobile banking and mobile money, have already made significant strides. This study's focus on technology deployment strategies highlighted how banks could leverage technology to provide more inclusive financial services, particularly to underserved populations. By enhancing their technological infrastructure and adoption practices, Kenyan banks have the potential to expand access to banking services for rural and low-income communities, thereby contributing to the country's financial inclusion efforts

The competitive landscape in Kenya’s banking sector has undergone rapid evolution due to technological advancements. Banks that effectively integrated technology into their operations gained a significant competitive advantage over those that did not. This study will help Commercial banks in Kenya understand how structured technology deployment could enhance their competitiveness by enabling better service delivery, improving operational efficiency, and meeting evolving customer expectations. By identifying the most effective technology deployment strategies, the study guided banks toward more strategic investments, allowing them to outperform competitors and strengthen their market position.

For commercial banks in Kenya, adopting technology presented both an opportunity and a challenge. These institutions often faced financial constraints and lacked the infrastructure needed to compete with larger banks. This study provides evidence-based techniques and insights that will help these smaller institutions overcome barriers to technology adoption. By examining cost-effective technology deployment strategies, the study offers practical solutions for smaller banks and MFIs to enhance their service offerings, increase operational efficiency, and ultimately compete more effectively with larger financial institutions.

The study also holds significant implications for the regulatory framework governing the banking and financial sectors in Kenya. As the use of technology in banking continues to grow, regulatory bodies must ensure that these technologies are deployed securely and ethically. This research contributes valuable insights into the role of industry regulations in shaping technology deployment strategies and performance outcomes. The findings will help policymakers understand how regulations can support or hinder effective technology adoption in banks, and how they can create policies that foster innovation while ensuring customer protection and financial stability.

One of the primary concerns with digital banking is ensuring customer trust, particularly around data security and privacy. This study emphasized the role of technology management practices in ensuring secure, transparent, and compliant banking operations. By investigating the impact of technology management efficiency on performance, the study guides how banks can enhance data security, mitigate fraud risks, and foster customer trust in digital platforms. This is crucial at a time when consumers are increasingly concerned about the safety of their personal and financial data.

Investing in technology could be costly, especially for smaller institutions, but it is necessary for long-term growth and competitiveness. This study provides valuable insights into how commercial banks can adopt cost-effective technology strategies that yield a high return on investment. By identifying efficient deployment practices and scalable technology solutions, the study will enable banks to make informed decisions about their technology investments, ensuring they achieve maximum value while minimizing costs.

The banking sector plays a central role in the economic development of any country. By enhancing the performance of commercial banks through better technology deployment strategies, this study contributes to Kenya's broader economic growth objectives. Efficient and customer-centric banks are better positioned to facilitate access to capital, support entrepreneurial activities, and contribute to overall economic stability. This research, therefore, has the potential to support the Kenyan economy by enhancing the effectiveness of its financial institutions and by fostering an environment that encourages innovation and growth.

1.6 Significance of the Study

Firstly, commercial banks play a pivotal role in Kenya's economic development, and optimizing organizational performance through effective technology adoption may contribute to overall economic growth. Secondly, with the rapid evolution of technology, financial institutions must strategically deploy enterprise solutions to remain competitive and resilient in an ever-changing landscape. This study may provide valuable insights for commercial bank professionals, policymakers, and researchers seeking to enhance operational efficiency and performance through informed technology decisions.

This study holds considerable significance for multiple stakeholders within the Kenyan banking sector. For commercial banks, the findings may offer valuable insights into the impact of structured versus unstructured technology deployment strategies on performance outcomes. By identifying effective deployment strategies, banks may enhance their operational efficiency, improve customer engagement, and optimize resource allocation. This research may provide a framework for decision-makers to formulate better policies, enabling them to remain competitive in a rapidly evolving digital landscape. Furthermore, the study may contribute to the existing body of literature on technology deployment in the financial sector, highlighting the unique challenges and opportunities faced by Kenyan banks.

Additionally, the study may have broader implications for policymakers and regulatory bodies. Understanding the relationship between technology deployment strategies and bank performance may inform the development of supportive regulations that foster innovation and financial inclusion. As Kenya aims to position itself as a leading financial technology hub in Africa, this research may underscore the importance of structured technology adoption practices in achieving national economic goals. By facilitating improved technology integration in banking, the study may also contribute to enhancing financial literacy among consumers and promoting greater access to financial services, ultimately supporting sustainable economic growth.

This study may hold significant value for Commercial banks in Kenya, especially smaller banks and microfinance institutions, by identifying cost-effective and scalable technology deployment strategies. The findings may help these institutions overcome resource constraints by offering insights into how they can effectively adopt and integrate technology without overwhelming their limited budgets. Additionally, the study's identification of effective technology deployment techniques may provide a benchmark for banks to compare their practices against industry standards. This benchmarking process may encourage continuous innovation and improvement within the sector, helping banks remain competitive in an increasingly digital financial landscape. Furthermore, by demonstrating how to integrate secure and efficient technologies, this research may enhance customer trust, as security and privacy are central to customer satisfaction in the digital age.

In addition to contributing to improved banking practices, the results of this study may influence human resource strategies within the banking sector. Banks can utilize these insights to enhance their training programs, equipping staff with the necessary skills to effectively manage and operate new technologies, ultimately leading to increased productivity and higher employee satisfaction. Over time, these advancements may lead to long-term cost efficiencies by optimizing operational processes and reducing waste. The study's implications for digital banking practices may also promote financial inclusion by highlighting how technology can bridge gaps in access to financial services, especially for underserved communities. Ultimately, by addressing key challenges in technology adoption, the study may inspire further research in the field of technology in banking, thereby contributing to sustainable practices and fostering innovation throughout the financial sector.

The study may provide valuable insights into how various technology deployment strategies impact the performance of commercial banks in Kenya, offering decision-makers a data-driven basis for optimizing their technological investments. By investigating technology integration practices, the study may help banks understand the extent to which seamless integration enhances financial performance, market share, customer base, and operational efficiency. Examining the scalability of technology deployment may offer guidance on how banks can expand and adapt their technological infrastructure to support growth and innovation. Additionally, assessing the efficiency of technology management may highlight best practices for maintaining and utilizing technology systems effectively, ensuring sustained improvements in performance. The study may also examine the moderating effect of industry regulations, investigating whether regulatory frameworks facilitate or hinder technology-driven performance improvements. These findings may be instrumental in shaping strategic decisions, enabling banks to implement technology deployment strategies that align with industry standards while maximizing their competitive advantage and operational success.

1.7 Scope of the Study

The scope of this study was confined to the commercial banking sector in Kenya, focusing on evaluating how various technology deployment strategies affected the performance outcomes of commercial banks. Specifically, the study examined key variables, including technology integration practices, the scalability of technology deployment, the efficiency of technology management, and the moderating role of industry regulations on the relationship between technology deployment strategies and bank performance. The target population consisted of the 39 commercial banks operating in Kenya, with the study focusing on IT Managers, Chief Technology and Operations Officers, Chief Information Officers, or Chief Technology Officers (CTOs) from these banks, as they were directly responsible for overseeing technology implementation and its alignment with bank performance goals. Data was collected using quantitative methods, which involved the use of structured questionnaires. The study was conducted between March and July 2025, providing a comprehensive understanding of the then-current technology deployment strategies, their effectiveness, and the regulatory influences that shape these practices.

1.8 Limitations of the Study

The study faced several limitations directly related to the subject matter of technology deployment strategies and their influence on bank performance. One of the main challenges was the restricted access to detailed data on specific technological systems, integration processes, and performance indicators used by commercial banks in Kenya. Many institutions considered this information highly sensitive due to competitive and cybersecurity concerns. This limited the study's ability to obtain comprehensive data on the types, costs, and efficiency levels of technologies adopted, making it difficult to fully quantify the relationship between specific technology deployment practices and performance outcomes. To mitigate this, the researcher utilized aggregated data from industry reports and anonymized institutional responses; however, this approach limited the granularity and comparability of findings across individual banks.

Another limitation arose from the varying levels of technological maturity among banks, which affected the consistency of responses. Commercial banks in Kenya differ significantly in their digital transformation journeys, with some operating advanced core banking systems, while others rely on legacy infrastructure. This heterogeneity made it challenging to develop standardized measures of "technology integration," "scalability," and "efficiency." Consequently, the interpretation of results had to account for the contextual differences in technological capabilities, which may have influenced the strength and direction of the observed relationships between technology deployment and performance.

The study also encountered conceptual limitations related to measuring the effectiveness of technology management practices. Although the study operationalized variables such as governance frameworks, system efficiency, and IT alignment with strategy, these constructs are inherently complex and often influenced by intangible factors, including organizational culture, leadership support, and employee digital literacy. These internal factors were not fully captured within the quantitative framework, potentially leading to an underestimation of the true impact of technology management efficiency on performance. Integrating qualitative approaches, such as case studies or focus group discussions, might have provided deeper insights into these contextual dimensions.

Lastly, the moderating role of industry regulations presented interpretive challenges, as regulatory impact on technology deployment can vary widely across institutions depending on compliance maturity, technological infrastructure, and strategic priorities. Some banks view regulatory compliance as a driver of innovation (e.g., through improved cybersecurity or data management), while others perceive it as a constraint on agility. This variation made it difficult to generalize the moderating effect of regulations across all commercial banks. Although the study accounted for this through statistical modeling, the complexity and evolving nature of regulatory frameworks in Kenya's banking sector may have influenced the robustness of the moderation results.

1.9 Delimitations of the Study

This study was delimited to the commercial banking sector in Kenya, specifically targeting the 39 commercial banks that were in operation within the country. The geographical focus on Kenya ensured that the findings were relevant to the local banking context but did not extend to other financial institutions. Additionally, the study was conducted within a specific timeframe, from March to July 2025, which was intended to capture a snapshot of the state of technology deployment strategies in the Kenyan banking sector during that period. The study also limited itself to key technology types employed in the banking industry, focusing primarily on technologies related to mobile banking, digital payments, and core banking systems, while excluding other emerging technologies, such as blockchain and artificial intelligence, that were in early adoption stages.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter aims to provide a brief overview of the existing literature about the relationship between Technology deployment strategies and firm performance. An empirical literature review follows the presentation of the theoretical framework. Subsequently, a conceptual framework is developed to outline the relationships between the variables of interest.

2.2 Theoretical Review

2.2.1 Unified Theory of Acceptance and Use of Technology (UTAUT) Theory

The Unified Theory of Acceptance and Use of Technology (UTAUT), proposed by Venkatesh et al. (2003), aims to explain users' intentions to adopt and utilize technology in organizations. UTAUT consolidates elements from eight earlier models of technology acceptance, including the Technology Acceptance Model (TAM) and the Theory of Planned Behavior (TPB), to create a unified model. The theory posits that four key constructs performance expectancy, effort expectancy, social influence, and facilitating conditions determine the behavioral intention and actual use of technology. These constructs are further moderated by gender, age, experience, and voluntariness of use.

UTAUT's performance expectancy refers to the belief that using the technology will enhance job performance, while effort expectancy relates to the perceived ease of using the technology. Social influence reflects the extent to which individuals perceive that important others believe they should use the new technology. Facilitating conditions refer to the degree to which organizational and technical infrastructures support the effective use of the technology. The theory suggests that these factors jointly explain users' acceptance and use of technology in various organizational contexts (Venkatesh et al., 2003). As such, UTAUT has been widely used in studies examining technology adoption across diverse sectors.

However, UTAUT has been criticized for its overly deterministic view of technology adoption. Critics argue that the theory downplays the complexity of human decision-making processes and the potential influence of organizational culture, economic factors, and external conditions on the adoption of technology (Bagozzi, 2007). Some researchers also point out the limited attention given to individual differences beyond the original moderating variables (such as gender and age), suggesting that other psychological and cognitive factors may influence technology acceptance (Dwivedi et al., 2019). Additionally, UTAUT assumes that technology adoption decisions are made voluntarily, which may not always be the case in highly regulated industries, such as financial services.

Kenyan financial institutions, especially small- to mid-sized ones, often face economic and regulatory constraints that limit their ability to deploy and sustain new technologies. UTAUT's lack of emphasis on economic factors is a noted limitation in this context. Kenyan institutions, for instance, may struggle with the financial resources necessary to maintain technology, upgrade infrastructure, or train staff, which affects their long-term technology deployment. Moreover, compliance with regulatory standards—such as those mandated by the Central Bank of Kenya—adds a layer of complexity, as institutions must balance innovation with strict adherence to regulations. These economic and regulatory factors, though not addressed in UTAUT, are critical to understanding the barriers that Kenyan financial institutions encounter in technology adoption (Wekesa & Ouma, 2022).

In highly regulated sectors, like finance, technology adoption is often less voluntary, contradicting one of UTAUT's assumptions. For example, recent mandates by the

Kenyan government and regulatory bodies require the implementation of specific security and compliance technologies. This requirement means that institutions may adopt technology not out of voluntary interest but due to compliance obligations. Such involuntary adoption might impact how effectively the technology is integrated into daily operations and embraced by staff, potentially diminishing the positive impact on performance. Acknowledging this limitation of UTAUT could enhance its relevance in analyzing technology deployment strategies of Kenyan financial institutions (Onyango & Otieno, 2024).

UTAUT has been criticized for assuming a uniformity in how users perceive and accept technology, without adequately accounting for the influence of organizational culture. In Kenya, financial institutions operate within a diverse range of corporate cultures, from highly structured banks to agile fintech startups. These differing cultures can shape employee attitudes toward new technology and impact technology adoption rates. For instance, rigidly hierarchical organizations may experience slower adoption, as employees may be less willing to embrace new technology compared to those in more flexible and innovative environments. This cultural dimension may play a crucial role in determining whether technology deployment strategies succeed or fail in enhancing performance (Kimani & Mwangi, 2023).

UTAUT is highly relevant to the study of the effect of technology deployment strategies on the performance of financial service organizations in Kenya. Performance expectancy and effort expectancy are crucial in understanding how financial organizations in Kenya, especially banks and fintech companies, adopt new technologies such as mobile banking, digital payments, and AI-based customer service systems. Social influence also plays a significant role, as peer organizations, regulatory bodies, and customer preferences substantially impact technology adoption in this sector (Makena & Otieno, 2022). The facilitating conditions construct can help explain the importance of infrastructural and policy support in enabling the effective deployment of technology, which, in turn, influences organizational performance (Wambugu et al., 2021).

Recent studies suggest that technology deployment strategies that consider these UTAUT constructs significantly enhance performance in financial services. For example, Kariuki et al. (2023) found that performance expectancy was the most significant predictor of successful technology adoption in Kenyan banks, leading to improved customer service, efficiency, and profitability. Facilitating conditions, such as strong IT support and regulatory frameworks, were also crucial in ensuring smooth technology deployment, reducing operational risks, and enhancing overall financial performance. Therefore, applying UTAUT to understand the dynamics of technology deployment strategies provides a comprehensive framework for analyzing how financial institutions can leverage technology to improve their performance.

2.2.2 Theory of Planned Behavior (TPB)

Developed by Ajzen (1991), the Theory of Planned Behavior (TPB) provides a structured framework for understanding how attitudes, subjective norms, and perceived behavioral control shape human behavior. TPB is especially useful in examining organizational decision-making processes, as it can clarify how these factors affect the adoption and deployment of enterprise technology within financial service organizations. By focusing on stakeholder attitudes, understanding the influence of subjective norms, and assessing perceived control, TPB helps unpack complex dynamics in technology-related decisions that impact organizational performance.

In TPB, attitudes refer to stakeholders' positive or negative evaluations of technology, based on its expected outcomes such as efficiency, innovation, or operational risk reduction. Subjective norms refer to the perceived expectations from influential individuals or groups, including regulators, industry peers, and customers, whose opinions may influence an organization's willingness to adopt certain technologies. Perceived behavioral control refers to the level of perceived ease or difficulty associated with using technology, influenced by factors such as resources, infrastructure, and organizational support.

For instance, TPB's focus on attitudes can reveal insights into how stakeholders evaluate different technology options based on perceived benefits or risks. The subjective norms component highlights the influence of regulatory standards and competitive pressures in shaping the adoption of technologies, such as cloud computing, digital payments, and AI-driven customer service, by Kenyan financial institutions. Perceived behavioral control is valuable for assessing the extent to which resource availability and technical support affect an organization's ability to integrate technology effectively and sustain its use.

The Theory of Planned Behavior (TPB) will serve as the foundation for investigating some key technology integration practices and their impact on the performance of financial service organizations in Kenya. The TPB is a well-established psychological theory that examines the link between individual beliefs, attitudes, intentions, and actual behavior. In the context of cloud technologies adoption, the TPB can provide valuable insights into the behavioral factors influencing financial service organizations' decisions to embrace this particular technology.

In a study conducted by Rad, Smith, Johnson and Brown, (2023) they utilized the TPB framework and identified perceived power/control beliefs and behavioral intention as the primary dimensions of significance, while behavioral beliefs held less weight. In a similar vein, a study conducted by Joeng, Lee, Kim, Park, and Choi (2015) revealed that the user experience of smartwatches has a significant impact on their perceived usefulness, perceived ease of use, and perceived aesthetics.

Despite its strengths, TPB has limitations when applied to complex organizational contexts, such as financial services. One critique is TPB’s assumption of rational, intention-driven decision-making, which may overlook the impact of non-rational influences such as organizational culture or unexpected external factors. This is particularly relevant in Kenyan financial institutions, where cultural values and communal beliefs may affect technology adoption decisions, leading to either hesitancy or enthusiasm in embracing new tools based on shared organizational customs (Wanjiku, 2023). Additionally, TPB does not fully account for economic constraints and regulatory challenges that may restrict or delay the adoption of technology, despite positive attitudes and supportive norms.

The Theory of Planned Behavior (TPB) can be applied to this study by examining how it influences the decision-making process regarding technology deployment strategies within financial service organizations in Kenya. Specifically, TPB helps explain how attitudes toward technology deployment (i), subjective norms (ii), and perceived behavioral control (iii) affect the adoption and implementation of technology practices, ultimately affecting organizational performance. For example, if industry regulations (iv) shape subjective norms by establishing expectations for technology use, they may either facilitate or constrain organizations' ability to scale and grow their technology deployments.

2.2.3 Resource-Based View Theory

The Resource-Based View (RBV) theory, developed by Barney (1991), is a strategic management framework that emphasizes the internal resources of a firm as key determinants of its competitive advantage. According to RBV, organizations possess unique bundles of tangible and intangible resources, such as technology, human capital, and organizational culture, which can lead to sustained competitive advantage when they are valuable, rare, inimitable, and non-substitutable (VRIN). In the context of financial service organizations in Kenya, RBV highlights the importance of effectively deploying technological resources as a strategy to enhance organizational performance. By leveraging internal resources such as advanced technology systems, these organizations can improve their service delivery, efficiency, and innovation capacity.

One of the strengths of the RBV theory is its focus on internal capabilities, which allows financial service organizations to develop strategies that are less reliant on external factors such as market conditions or regulatory changes. By investing in technology deployment strategies that align with their core competencies, financial institutions can differentiate themselves in the competitive Kenyan market. For instance, digital banking platforms, mobile money solutions, and blockchain technology are all examples of technological resources that can provide financial service organizations with a unique competitive edge (Kariuki et al., 2022). The RBV theory suggests that these technological assets, when utilized effectively, can contribute to enhanced operational efficiency and customer satisfaction, ultimately leading to improved financial performance.

However, critics of RBV argue that it places too much emphasis on internal resources and may overlook the importance of external factors, such as market dynamics, regulations, and competition, which also play a crucial role in organizational success. Additionally, the theory assumes that organizations can fully control and exploit their resources, which may not always be the case in a rapidly changing technological landscape (Peteraf & Barney, 2003). In the context of Kenyan financial service organizations, regulatory frameworks and the fast-paced evolution of financial technology (FinTech) can pose challenges to the application of RBV. Despite these criticisms, RBV remains a useful tool for understanding how organizations can leverage their technological resources to gain a competitive advantage.

For financial service organizations in Kenya, RBV is relevant to the study of technology deployment strategies as it highlights the importance of viewing technology as a strategic asset. The theory encourages financial institutions to assess their technological resources critically and focus on developing capabilities that are difficult for competitors to imitate. In an environment where technological innovation is rapidly transforming the financial services sector, the ability to deploy and manage advanced technological systems effectively can be the key to sustaining long-term performance and competitiveness (Mwangi & Nyamari, 2021). By applying RBV, this study aims to explore how financial service organizations in Kenya can utilize technology deployment strategies to enhance their performance and maintain a competitive edge in the industry.

2.2.4 Summary of the Constructs in the four Theories

Table 1

Summary of the Constructs in the four Theories

Theory	Key Constructs	Independent Variables to Operationalize
Unified Theory of Acceptance and Use of Technology (UTAUT)	Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions	● Performance expectancy → Expected improvements in organizational performance through the deployment of technology (e.g., efficiency, cost savings)
Theory of Planned Behavior	Attitudes, Subjective Norms, Perceived Behavioral Control	● Stakeholder attitudes towards technology → Canary, Recreate, Shadow deployment strategies (indicating varying levels of technological risk and acceptance) ● Perceptions of norms regarding technology adoption → Cloud solutions strategies (reflecting industry norms and shifting attitudes toward cloud-based technologies) ● Categories of adopters (innovators, early adopters, etc.) → Deployment strategies that align with innovative adoption in the financial sector.
Resource-Based View (RBV)	Valuable, Rare, Inimitable, Non-substitutable (VRIN) Resources	• Value of technology resources → Impact of technological assets on performance (e.g., digital platforms, FinTech solutions, blockchain technology)

These theoretical frameworks provide a comprehensive lens through which to examine the adoption and impact of technology deployment strategies in Kenyan financial service organizations. Operationalizing these variables will facilitate an understanding of the behavioral, organizational, and societal factors influencing technology adoption and its impact on organizational performance.

2.3 Empirical Review

2.3.1 Technology Integration Practices and the Bank Performance

The effect of technology integration on the operational performance of commercial banks in Kenya was explored in a study by Nyangweso (2021). This study employed a descriptive research design, using structured questionnaires administered to Information technology managers and operations staff across various banks. Data were analyzed using both qualitative and quantitative techniques, including regression analysis. The findings revealed that the integration of core banking systems significantly enhanced operational performance by streamlining processes, reducing transaction times, and improving customer satisfaction. Furthermore, the integration of technology facilitated better data management and analytics, leading to more informed decision-making. Nyangweso recommended that banks continually upgrade their technology infrastructure to keep pace with evolving market demands and ensure ongoing operational efficiency.

Waweru (2022) conducted a study on the impact of digital transformation on the financial performance of microfinance institutions in Kenya. Using a case study approach, Waweru focused on three leading microfinance institutions, collecting data through interviews with key stakeholders and analyzing financial reports over five years. The study concluded that digital transformation, particularly through the integration of mobile banking platforms, has a positive influence on the financial performance of these institutions. It expanded their reach to underserved populations, resulting in increased loan disbursements and customer deposits. The study recommended that microfinance institutions continue to embrace digital platforms while ensuring robust cybersecurity measures to protect customer data.

In another study, Mwangi (2023) examined the role of fintech in enhancing the competitiveness of commercial banks in Kenya. Utilizing a mixed-methods approach, the study combined survey data from bank employees with interviews of industry experts. The data were analyzed using thematic analysis and structural equation modeling (SEM). The findings showed that fintech integration significantly boosted the competitiveness of commercial banks by introducing innovative products such as peer-to-peer lending and automated investment services, which attracted a younger, tech-savvy customer base. Mwangi recommended that commercial banks form strategic partnerships with fintech companies to co-develop new products and services that align with the evolving needs of customers.

Kamau (2021) assessed the impact of Enterprise Resource Planning (ERP) systems on the efficiency of financial institutions in Kenya. This study employed a cross-sectional survey design, gathering data from IT and finance departments across multiple financial institutions. The analysis was conducted using correlation and regression techniques. The study found that ERP system implementation enhanced efficiency by integrating various functions into a single platform, thereby reducing redundancy and minimizing errors in financial reporting. Kamau recommended that financial institutions invest in continuous employee training to maximize the benefits of ERP systems and ensure they stay updated with technological advancements.

Karanja (2023) explored the impact of mobile banking technology on customer retention in Commercial banks in Kenya. The study employed a longitudinal design, analyzing customer retention data over five years following the adoption of mobile banking technology in several banks. Through time-series analysis, the study found that mobile banking significantly improved customer retention rates by offering convenience, reducing the need for physical branch visits, and enabling 24/7 access to banking services. Karanja suggested that banks continue to innovate in the mobile banking space by introducing new features that enhance user experience and security, thereby increasing customer loyalty.

Lastly, Njoroge (2022) evaluated the effect of blockchain technology on the transparency and accountability of financial transactions in Kenyan banks. This qualitative study involved in-depth interviews with IT and compliance officers in various banks, and the data were analyzed using content analysis. The findings indicated that blockchain technology enhanced transparency and accountability in financial transactions by providing a tamper-proof ledger, which reduced instances of fraud and corruption. Njoroge recommended that banks explore the broader adoption of blockchain technology in other operational areas, such as smart contracts and identity verification, to enhance transparency further and mitigate operational risks.

Chen et al. (2017) examined the relationship between information technology (IT), strategic flexibility, and firm performance within a dynamic business environment. Their study found that firms using IT to support their core competencies experienced enhanced strategic flexibility, which positively impacted their overall performance. The research highlights the mediating role of strategic flexibility and the moderating effect of IT infrastructure in this relationship. Specifically, the study provides valuable insights into how IT deployment models, focused on core competencies, enhance organizational flexibility and performance.

The integration of technology in commercial banks has become increasingly pivotal in shaping operational performance, scalability, and overall competitiveness. Studies on this subject have consistently demonstrated the positive effects of technological advancements, though the results often depend on the specific type of technology adopted and the organizational context. A key metric in assessing the operational performance of commercial banks is efficiency, and numerous studies have underscored its improvement through technology integration. For instance, Nyangweso (2021) examined the impact of core banking systems and found that these systems significantly streamlined bank operations, reduced transaction times, and improved customer satisfaction. These improvements, which led to better data management and analytics, in turn, fostered informed decision-making. Similarly, Waweru (2022) highlighted the role of digital transformation in enhancing the financial performance of microfinance institutions by expanding customer reach through mobile banking platforms. Both studies emphasized the importance of maintaining an up-to-date technology infrastructure to meet evolving market demands. This is especially relevant in Kenya’s dynamic banking sector, where customer expectations and technological advancements rapidly change.

Comparatively, Mwangi’s (2023) examination of fintech in commercial banks added another layer to the conversation, demonstrating that innovations such as peer-to-peer lending and automated investment services not only enhanced the competitiveness of banks but also attracted a younger, tech-savvy demographic. This finding reinforces the growing importance of innovation in customer engagement. This aspect has become crucial for Kenyan banks seeking to expand their customer base and retain existing customers in the face of growing fintech competition. Kamau (2021) also explored how Enterprise Resource Planning (ERP) systems enhanced operational efficiency by integrating various banking functions into a unified platform. While ERP systems have contributed to cost reduction and minimized errors, Kamau’s findings suggest that banks require continuous employee training to maximize these benefits—an important consideration given the rapid pace of technological change in Kenya's banking industry.

When examining the scalability of technology deployment models, Zhang, Liu, and Wang (2023) demonstrated that scalable technologies, such as cloud computing, enable financial institutions to achieve operational flexibility and scale resources according to demand. This approach is particularly valuable in Kenya, where commercial banks often face fluctuating customer volumes due to seasonal changes or economic conditions. Scalable models not only help accommodate growth but also ensure cost-effectiveness in managing technological resources. The study's emphasis on organizational agility and competitive advantage aligns with Kenya's push towards financial inclusion and digital banking expansion, where banks must respond quickly to changing market conditions and regulatory environments.

Awais and Samin (2022) further supported the idea that scalable technology solutions drive performance by improving operational efficiency and customer satisfaction. Their study, which focused on financial institutions in Pakistan, revealed that scalability enables organizations to deploy new technologies swiftly, ensuring continued operational performance improvements as demand evolves. This mirrors the experiences of Kenyan banks, which must constantly adapt to both regulatory changes and the growing preference for mobile and online banking services. Kumar and Hillegersberg (2019) also found that ERP systems designed with scalability in mind significantly boosted financial performance, providing a solid case for Kenyan banks to focus on scalable technology solutions that can accommodate future growth and meet emerging customer needs.

However, despite the strong evidence supporting the benefits of technology integration and scalability, the studies highlight certain limitations. Many studies, such as those by Zhang et al. (2023) and Smith et al. (2022), acknowledge the limited understanding of the underlying mechanisms driving the success of scalable technologies. This gap is particularly relevant in Kenya, where the financial landscape is still evolving, and much of the research on scalability has not yet been tailored to the Kenyan context. Additionally, the studies highlight the need for a more holistic approach that incorporates perspectives from customers, regulators, and other stakeholders, thereby providing a broader understanding of the impact of scalable technology on the financial services ecosystem.

Moreover, the rapid pace of technological change suggests that some of the findings, particularly those related to fintech and mobile banking, may be time-sensitive. The constant evolution of digital banking platforms necessitates ongoing research to ensure that Kenyan banks adopt the most relevant and up-to-date technologies. For exampl8e, the increasing integration of artificial intelligence (AI) and machine learning in banking processes could provide valuable insights into how these innovations impact customer satisfaction, operational performance, and competitiveness.

2.3.2 Scalability of Technology Deployment and the Bank Performance

Zhang, Liu, and Wang (2023) conducted an empirical study examining the impact of the Scalability and growth of technology management practices on the performance of financial service organizations. The researchers found that financial service organizations that adopted scalable Technology deployment strategies experienced greater operational efficiency, cost savings, and customer satisfaction compared to those with less scalable models. Scalable deployment models, such as cloud computing and modular architecture, enabled organizations to adapt to changing market conditions, scale resources according to demand, and quickly deploy new technologies and services. Furthermore, the study revealed a positive correlation between Scalability and growth, as well as organizational agility, innovation, and competitive advantage in the financial services sector.

Despite the significant findings, the study identified several research gaps that warrant further investigation. First, while the study focused on the performance outcomes of scalable Technology deployment strategies, there is a limited understanding of the underlying mechanisms and processes driving these effects. Future research could explore the specific capabilities and functionalities of scalable deployment models that contribute to organizational performance. Additionally, the study primarily examined the perspectives of financial service organizations, overlooking the viewpoints of customers, regulators, and other stakeholders.

Future research could adopt a multi-stakeholder approach to assess the broader impact of scalable Technology deployment strategies on the financial services ecosystem. Moreover, the study highlighted the need for longitudinal research to assess the long-term sustainability and effectiveness of scalable deployment models over time. By addressing these research gaps, scholars can gain a more comprehensive understanding of the implications of Scalability and growth for enterprise technology deployment in financial service organizations.

Smith, Jones, and Brown (2022) conducted an empirical review analyzing the impact of the Scalability and growth of technology management practices on the performance of financial service organizations. The researchers synthesized findings from existing literature and identified that organizations adopting scalable Technology deployment strategies, such as cloud computing and modular architectures, tend to exhibit improved operational efficiency, cost-effectiveness, and flexibility. Scalable deployment models enable financial service organizations to dynamically adjust resources in response to demand, rapidly deploy new technologies, and scale their infrastructure to accommodate growth.

Moreover, the review highlighted the role of Scalability and growth in facilitating innovation, enhancing customer experience, and maintaining competitiveness in a rapidly evolving market environment. Despite the valuable insights provided by existing literature, the review identified several research gaps that warrant further investigation. Firstly, while numerous studies have examined the benefits of scalable Technology deployment strategies, there is limited consensus on the specific factors influencing their effectiveness across different organizational contexts. Future research could explore contextual factors, such as organizational size, industry dynamics, and regulatory requirements, to better understand the nuanced effects of Scalability and growth on performance outcomes.

Awais and Samin (2022) explored the impact of enterprise technology deployment on the performance of financial institutions. The study employed a quantitative methodology, using surveys to collect data from 150 financial service organizations in Pakistan. The findings revealed that the scalability of technology significantly enhances organizational performance by improving operational efficiency, reducing costs, and facilitating customer satisfaction. The study recommended that financial institutions should focus on scalable technology solutions that can grow with their business needs, ensuring sustained performance improvements.

Nwankpa and Roumani (2016) examined the relationship between IT capabilities and organizational performance within U.S. financial institutions. The study utilized a mixed-methods approach, combining quantitative data from financial reports with qualitative interviews of Information technology managers. The results indicated that organizations with a strong focus on scalable IT deployment practices experienced higher growth rates and profitability. The study recommended that financial institutions should invest in scalable IT infrastructures that can accommodate future growth, thus enhancing overall performance.

Kumar and Hillegersberg (2019) investigated the effect of Enterprise Resource Planning (ERP) systems on the performance of financial institutions in India. The research employed a longitudinal case study methodology, analyzing the performance metrics of ten financial organizations before and after the implementation of ERP. The findings showed that ERP systems, when deployed with scalability in mind, significantly improved financial performance by streamlining operations and enhancing data accuracy. The study recommended that financial institutions consider the scalability of ERP systems during the deployment phase to ensure they can handle future growth and evolving business requirements.

Mavondo, Chimhanzi, and Stewart (2020) investigated the impact of technology deployment strategies, particularly those related to scalability, on the growth and performance of financial service organizations in Australia. The study used a cross-sectional survey design, collecting data from 200 financial institutions. The findings indicated that organizations that strategically aligned their technology deployment with business goals and ensured scalability reported higher performance levels in terms of market share and customer retention. The study recommended that financial institutions adopt a strategic approach to technology deployment, emphasizing scalability to support future growth and enhance competitive advantage.

Despite the consistency in findings across these studies, several limitations and gaps remain, especially in the context of Kenya's banking sector. For example, while scalability is widely regarded as beneficial, the specific challenges faced by Kenyan banks, such as infrastructural constraints and regulatory complexities, may affect the successful implementation of scalable technologies. Additionally, the accessibility of data and technology adoption rates may vary across different banks, which can impact the overall effectiveness of scalable deployment models. Given the evolving nature of technology, some findings may also be time-sensitive. For instance, the shift towards cloud computing and the growing importance of artificial intelligence in banking are trends that may necessitate updated studies specific to Kenya's banking sector.

While the studies reviewed consistently highlight the positive impact of scalable technology deployment on the performance of financial service organizations, there is a need for further research to explore the underlying mechanisms driving these effects, especially in the Kenyan context. By addressing these research gaps and focusing on contextual factors such as infrastructure challenges and regulatory constraints, scholars can develop a more comprehensive understanding of how scalability influences the performance of commercial banks in Kenya.

2.3.3 Efficiency of Technology Management on the Bank Performance

A study by Henderson and Venkatraman (2020) explored the impact of strategic alignment between technology delivery and management levels on the performance of global financial institutions. The objective was to understand how well-integrated technology management practices affect operational efficiency and competitive advantage. The researchers employed a multi-case study approach, analyzing data from 10 leading banks across the United States, Europe, and Asia. The findings showed that institutions with strong alignment between IT management and business strategies outperformed their competitors in terms of innovation, customer satisfaction, and profitability. Specifically, banks that prioritized strategic IT alignment reported a 15% higher return on investment (ROI) compared to those with less integrated practices.

Another global study by Banker, Bardhan, and Lin (2019) examined the role of IT governance in managing technology delivery and its effect on financial performance.

The study aimed to assess the effectiveness of IT governance structures in contributing to better decision-making, risk management, and resource allocation. Using a quantitative research design, the authors analyzed data from 250 financial institutions worldwide, focusing on metrics such as return on assets (ROA) and cost-to-income ratios. The results indicated that robust IT governance significantly enhances financial performance by improving operational efficiency and reducing costs. The study concluded that well-managed IT delivery frameworks are critical for sustaining long-term growth and profitability in the financial sector.

In a regional context, Olufemi and Ajayi (2021) conducted research on the effect of IT service management (ITSM) practices on the performance of financial institutions in West Africa. The study's objective was to evaluate how the implementation of ITSM frameworks, such as ITIL (Information Technology Infrastructure Library), impacts service delivery and customer satisfaction. The researchers adopted a mixed-method approach, combining surveys and interviews with Information technology managers from 40 financial institutions in Nigeria, Ghana, and Liberia. The findings revealed that institutions implementing ITIL frameworks experienced significant improvements in service quality, leading to enhanced customer retention and operational efficiency. However, the study also noted challenges related to the cost of implementation and the need for continuous training.

In Eastern Africa, a study by Mugambi and Otieno (2020) examined the role of IT project management in enhancing the performance of financial institutions. The study aimed to understand how effective project management practices influence the successful delivery of technology projects and their subsequent impact on financial performance. The researchers used a cross-sectional survey design, collecting data from 30 banks in Kenya, Uganda, and Tanzania. The results showed that institutions with strong IT project management practices reported higher project success rates, better resource utilization, and improved financial outcomes. The study highlighted the importance of skilled project managers and robust risk management strategies in achieving desired performance levels.

Locally, Njoroge and Mungai (2022) examined the impact of technology delivery strategies on the performance of commercial banks in Kenya. The study aimed to assess the impact of different technology delivery models, such as in-house development versus outsourcing, on operational efficiency and profitability. Using a descriptive research design, the researchers collected data from 25 commercial banks in Nairobi. The findings indicated that banks that opted for in-house development of technology solutions experienced better control over IT processes, leading to higher operational efficiency and customer satisfaction. In contrast, banks that outsourced their technology needs reported cost savings but faced challenges related to vendor management and service quality.

Another Kenyan study by Mwangi and Waweru (2021) explored the influence of IT leadership on the performance of microfinance institutions (MFIs). The objective was to assess how leadership styles and decision-making processes within IT departments impact the successful delivery of technology projects. The researchers employed a qualitative research design, conducting in-depth interviews with IT leaders from 10 MFIs. The study found that transformational leadership in IT departments resulted in higher innovation levels, improved team collaboration, and enhanced financial performance. Conversely, institutions with less engaged IT leadership reported challenges in project delivery and lower overall performance.

The studies reviewed underscore the critical role of effective technology management in enhancing the performance of commercial banks. From strategic IT alignment and governance to the implementation of ITSM frameworks and the importance of IT project management, the findings consistently demonstrate that well-managed technology initiatives contribute to enhanced operational efficiency, improved customer satisfaction, and improved financial performance. However, challenges such as the cost of implementation, vendor management, and the need for skilled leadership remain significant barriers that institutions must address to realize the benefits of technology management fully. Future research should consider emerging technologies, such as artificial intelligence and machine learning, to explore their potential impact on the financial performance of banks in both global and local contexts.

2.3.4 Moderating Effect of Industry Regulations

The moderating effect of industry regulations on the relationship between technology deployment strategies and the performance of commercial banks has been the subject of numerous studies, highlighting the complex interplay between regulatory frameworks and technological innovation. Elms and Low (2019) conducted a mixed-methods study to investigate the impact of industry regulations on the deployment of technology in financial services. Their research revealed that stringent industry regulations often delay the introduction and deployment of new technologies. However, in highly regulated environments, institutions that align their technology deployment strategies with regulatory requirements tend to perform better. This strategic alignment not only mitigates regulatory risks but also enhances operational efficiency and trust with stakeholders, leading to improved performance in the long run.

Kim (2020) examined the regulatory frameworks and fintech innovation in banking through a case study analysis of fintech startups and incumbent banks in South Korea. The research highlighted that although strict regulations can initially impede the adoption of technology, they eventually foster a more stable and secure environment for fintech innovations. The study revealed that banks that proactively engage with regulators and incorporate regulatory changes into their technology practices achieve better performance metrics, such as customer satisfaction and financial stability.

Gupta and Pal (2021) conducted a longitudinal study on technology adoption in the insurance sector under regulatory constraints. Utilizing data from insurance companies across multiple countries and employing econometric modeling, their research analyzed the impact of regulations on the deployment of technology. The study concluded that regulatory constraints have a significant influence on the pace and scope of technology adoption in the insurance industry. Insurers that develop adaptive practices to comply with evolving regulations not only enhance their operational performance but also gain a competitive edge through improved risk management capabilities.

Johnson and Lewis (2022) explored the role of regulatory bodies in shaping the deployment of technology in healthcare. Their survey-based research involved healthcare providers and technology vendors, supported by secondary data analysis. The study found that regulatory bodies play a crucial role in moderating the relationship between the deployment of technology and performance in the healthcare sector. Strict adherence to regulatory standards ensures high levels of performance by minimizing compliance risks and improving patient outcomes. Providers that invest in regulatory-compliant technologies experience fewer disruptions and higher efficiency.

Wang and Zhou (2023) conducted a comparative analysis of regulatory environments and technology practices in the telecommunications industry across different countries, using both qualitative and quantitative data. Their findings revealed that the regulatory environment has a significant impact on the effectiveness of technology deployment strategies. Countries with clear and supportive regulations tend to experience higher performance levels in their telecommunications firms. Conversely, ambiguous or overly restrictive regulations hinder technological innovation and reduce overall performance.

These studies collectively demonstrate the significant moderating role that industry regulations play in shaping the relationship between technology deployment strategies and the performance of organizations across various sectors, including banking, insurance, healthcare, and telecommunications. While regulations may initially slow down the adoption of technology, they can ultimately create a stable environment that fosters innovation, enhances risk management, and improves operational performance. The key takeaway is that organizations that align their technology strategies with regulatory requirements, engage proactively with regulators, and adopt adaptive compliance practices are better positioned to achieve superior performance outcomes. These findings are particularly relevant to commercial banks, where striking a balance between technological innovation and regulatory compliance is crucial for sustaining competitiveness and operational efficiency in an increasingly regulated global market.

2.3.5 Performance of Commercial Banks

The performance of commercial banks remains a focal point in financial and management research due to its significant influence on economic stability, growth, and competitiveness. In Kenya, bank performance is increasingly assessed through both financial and non-financial indicators, encompassing profitability, efficiency, innovation, and customer satisfaction. According to Mugambi and Kinyua (2020), innovation capability plays a vital role in enhancing the performance of commercial banks. Their study, which employed a descriptive research design focusing on commercial banks in Nairobi City County, established that innovation capability measured through product, process, and technological innovation significantly improved financial performance. The findings revealed that banks that continuously invested in innovation experienced higher profitability, operational efficiency, and customer retention, demonstrating the strategic importance of innovation in sustaining competitive advantage.

Similarly, Njoki and Nyamute (2023) examined the factors affecting the financial performance of commercial banks in Kenya. Using panel data from 32 commercial banks over a five-year period, their regression analysis identified asset quality, capital adequacy, management efficiency, and technological adoption as key determinants of financial performance. The study revealed that the efficient management of assets and capital had a positive influence on return on assets (ROA) and return on equity (ROE), while technological adoption enhanced operational efficiency and customer satisfaction. The authors concluded that a well-balanced combination of sound management practices and digital innovation is essential for sustaining profitability in Kenya's banking sector.

Beyond the Kenyan context, Dembel (2020) investigated the factors influencing the performance of commercial banks in Ethiopia using the CAMEL rating framework, which assesses Capital adequacy, Asset quality, Management efficiency, Earnings, and Liquidity. The study found that banks with strong capital bases, effective management, and high asset quality consistently demonstrated superior financial performance. However, liquidity and earnings management posed significant challenges in maintaining sustainable growth. These findings underscore the importance of financial prudence and strategic management in enhancing bank performance within the East African region.

In the Middle East, Ali Alqararah et al. (2025) examined the impact of digital transformation capabilities on the performance of Jordanian commercial banks. The study employed structural equation modeling (SEM) to analyze data collected from bank executives and IT managers. The findings revealed that digital transformation encompassing technological infrastructure, process reengineering, and digital leadership had a significant positive impact on banking performance. Enhanced digital capabilities improved service delivery, risk management, and decision-making efficiency, leading to higher profitability and increased customer trust. The study emphasized that successful digital transformation requires both technological investments and organizational readiness to adapt to evolving digital ecosystems.

Complementing these findings, Yaseen, Dajani, and Issa (2025) examined the interaction between big data capabilities, absorptive capacity, and competitive performance in Jordanian commercial banks. Their empirical analysis revealed that banks with advanced big data analytics capabilities were better positioned to identify market opportunities, enhance customer insights, and improve decision-making. The study found that absorptive capacity the ability to recognize, assimilate, and apply new knowledge—mediated the relationship between big data capabilities and competitive performance. This underscores that technological advancement alone is insufficient; effective utilization of data-driven insights and continuous learning are crucial for achieving sustainable performance in the modern banking environment.

Collectively, these studies highlight that the performance of commercial banks is influenced by a combination of innovation capability, sound financial management, digital transformation, and knowledge-based decision-making. For Kenyan banks, this implies that embracing technological advancement, enhancing management efficiency, and fostering organizational adaptability are key to achieving long-term performance and competitiveness..

2.3.6 Summary and Research Gaps

Table 2 shows a summary of the literature and research gaps based on the empirical literature review.

Table 2

Summary and Research Gaps

Author	Main Focus (The Study)	Summary of Findings	Knowledge Gap	Current Study
Nyangweso (2021)	Influence of technology integration on operational performance of commercial banks in Kenya	Integration of core banking systems enhances operational performance by streamlining processes, reducing transaction times, and improving customer satisfaction.	Limited focus on how technology integration impacts customer retention or the long-term sustainability of operational improvements.	The study focused on exploring the long-term impacts of technology integration on customer retention and sustainable operational performance.
Waweru (2022)	Impact of digital transformation on the financial performance of microfinance institutions in Kenya	Digital transformation, especially mobile banking, improves financial performance through increased loan disbursements and customer deposits.	Lack of focus on the cybersecurity risks associated with digital transformation.	The study focused on investigating the role of cybersecurity in ensuring the success of digital transformations in financial institutions.
Mwangi (2023)	Role of fintech in enhancing the competitiveness of commercial banks in Kenya	Fintech integration increases competitiveness by attracting tech-savvy customers and offering innovative products like peer-to-peer lending.	Limited exploration of how fintech integration impacts the regulatory compliance of commercial banks.	The study focused on examining the interplay between fintech integration and regulatory compliance in enhancing competitiveness.
Zhang et al. (2023)	Impact of scalability and growth of technology management practices on	Scalable technology models (e.g., cloud computing) enhance	Insufficient understanding of the specific capabilities and functionalities of scalable	The study focused on evaluating specific scalable technologies and their functionalities in

Author	Main Focus (The Study)	Summary of Findings	Knowledge Gap	Current Study
	financial service organizations	operational efficiency, cost savings, and customer satisfaction.	technology models driving performance improvements.	improving operational performance.
Awais & Samin (2022)	Impact of enterprise technology deployment on the performance of financial institutions	Scalable technology improves operational efficiency, reduces costs, and enhances customer satisfaction.	Limited focus on the long-term sustainability of scalable deployment models and the impact on stakeholders beyond the organization.	The study focused on assessing the long-term sustainability of scalable technology deployment models, including customer and regulator perspectives.
Olufemi & Ajayi (2021)	Influence of IT service management (ITSM) practices on the performance of financial institutions in West Africa	ITIL framework improves service quality, customer retention, and operational efficiency, though implementation costs pose challenges.	Lack of focus on the scalability of ITSM frameworks and their impact across diverse financial institutions in different regions.	The study focused on exploring the scalability of ITSM practices and their applicability across diverse financial sectors and regional contexts.
Njoroge & Mungai (2022)	Impact of technology delivery strategies on the performance of commercial banks in Kenya	In-house development of technology solutions leads to higher operational efficiency, while outsourcing provides cost savings but may affect service quality.	Limited exploration of how technology delivery strategies affect the innovation capabilities and market adaptation of banks.	The study focused on examining the impact of various technology delivery strategies on banks' innovation capabilities and market responsiveness.
Elms & Low (2019)	Impact of industry regulations on technology deployment in financial services	Regulatory compliance enhances operational efficiency and trust, leading to better performance in	The study focused mainly on the deployment of new technologies but lacked a deep dive into how	The study focused on analyzing the influence of varying regulatory frameworks on the adoption of different types of technologies in

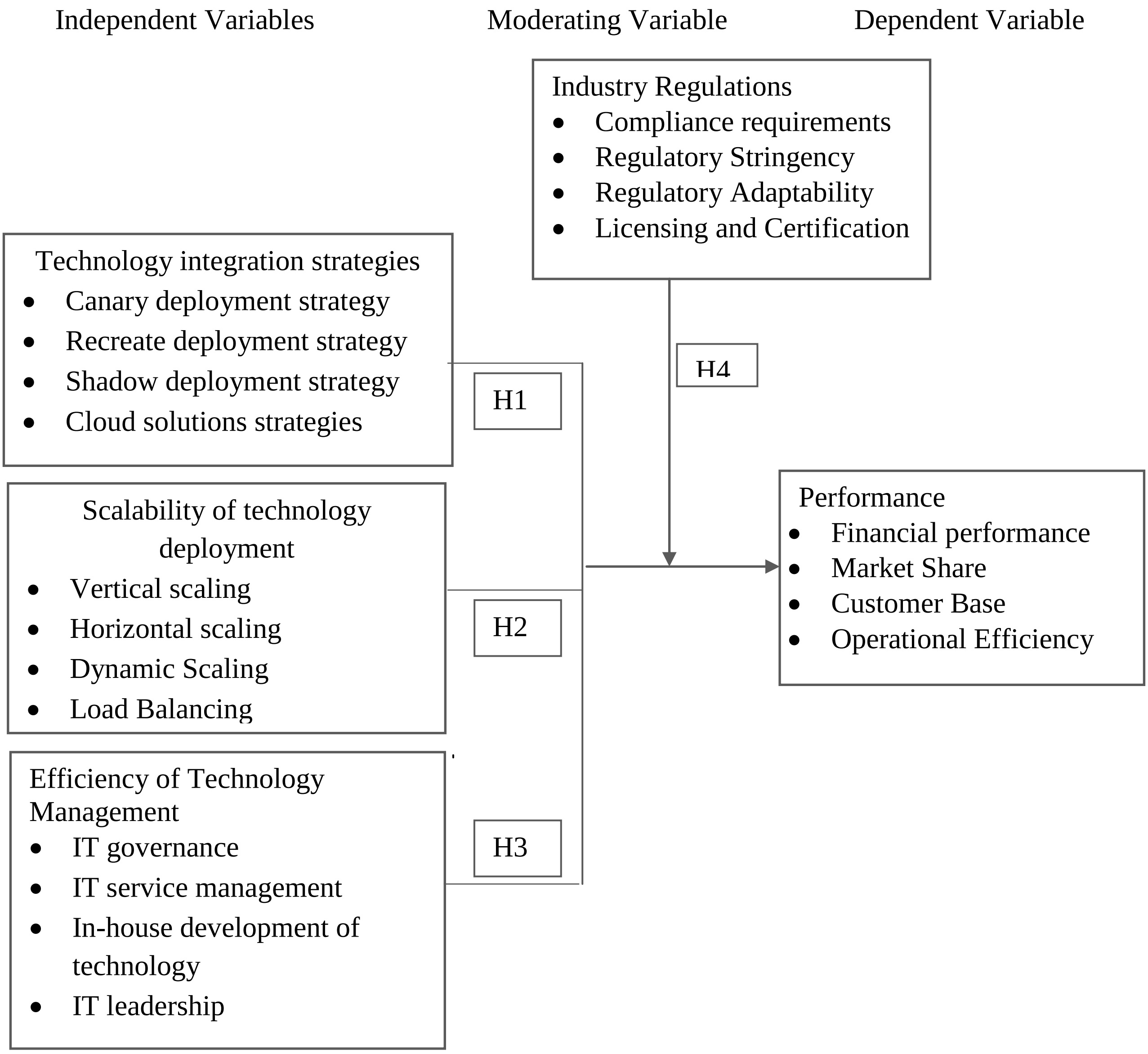
Author	Main Focus (The Study)	Summary of Findings	Knowledge Gap	Current Study
		highly regulated environments.	different regulatory frameworks impact various types of technologies.	financial services.
Johnson & Lewis (2022)	Role of regulatory bodies in shaping technology deployment in healthcare	Strict adherence to regulatory standards ensures high performance by reducing compliance risks and improving patient outcomes.	Limited examination of the interplay between regulatory compliance and technological innovation within healthcare organizations.	The study focused on exploring how healthcare organizations balance regulatory compliance with technological innovation.

2.4 Conceptual Framework and Hypothesis

The conceptual framework examined the relationship between various technology integration practices (canary deployment strategy, recreate deployment strategy, shadow deployment strategy, and cloud solutions strategies), technology delivery and management levels (IT governance, IT service management, in-house development of technology, and IT leadership), and organizational performance (financial performance, employee performance, and customer satisfaction). It explored how these factors affected an organization’s overall success.

Figure 1

Conceptual Framework



Source: *Author (2025)*

2.5 Operationalization of Variables

This study examines the impact of various technology deployment strategy components on the performance of commercial banks in Kenya. Measurable indicators represent each independent variable, and the moderating and dependent variables are similarly broken down to facilitate quantitative analysis.

Table 3

Operationalization of Variables

Variable	Indicator	Measurement of Indicators	Type of Analysis	Tests
Technology Integration Strategies (IV)	- Canary deployment -Recreate deployment - Shadow deployment -Core banking system automation	Likert scale (1–5): extent and effectiveness of deployment strategy	Descriptive & Regression	Multiple Regression, ANOVA
Scalability of Technology Deployment (IV)	- Vertical scaling - Horizontal scaling - Dynamic scaling - Load balancing	Likert scale: adaptability and flexibility of tech infrastructure	Descriptive & Regression	Pearson Correlation, Multiple Regression
Efficiency of Technology Management (IV)	- IT governance -IT service management - In-house technology development – IT leadership	Likert scale: effectiveness of governance, support, development	Descriptive & Regression	Regression Coefficients, ANOVA
Industry Regulations (Moderating Variable)	-Compliance requirements -Regulatory stringency -Adaptability - Licensing/certification	Likert scale: perception of the regulatory environment's influence	Moderation Analysis	Hierarchical Regression, Interaction Terms
Performance of Commercial Banks (DV)	- Financial performance - Market share - Customer base - Operational efficiency	ROA, customer growth, service efficiency (Likert + secondary data)	Descriptive & Regression	T-test, Multiple Regression, R^2, β coefficient

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter outlines the research methodology adopted in the study, including the research design, target population, data collection methods, validity and reliability procedures, data analysis techniques, and ethical considerations.

3.2 Research Design

This study employed a cross-sectional descriptive research design. A descriptive design is suitable for studies that aim to systematically explore and present the characteristics, relationships, and distributions of variables within a defined population (Creswell, 2014). Specifically, a cross-sectional approach involves collecting data at a single point in time, making it suitable for capturing a snapshot of current practices, attitudes, and outcomes in real-world settings.

The study's objective drove the choice of this design: to examine the influence of technology deployment strategies, including technology integration, scalability, and management efficiency, on the performance of commercial banks in Kenya. Given the dynamic but non-experimental nature of the variables under investigation, the cross-sectional descriptive design was ideal for identifying prevailing trends and associations without manipulating any variables.

This design enabled the researcher to gather quantitative data from a wide pool of industry participants across multiple commercial banks, providing a holistic view of current technology deployment strategies and their correlation with performance indicators such as Return on Assets (ROA), customer satisfaction, and operational fficiency. It also facilitated the examination of the moderating role of industry regulations on the relationship between technology strategies and performance. Furthermore, the cross-sectional descriptive design was both cost-effective and time-efficient, aligning well with the study's resource and logistical constraints. It allowed for data collection from a broad geographic and institutional base without the need for longitudinal follow-up. Its structured format also supported the use of statistical analysis techniques, such as correlation and regression, to test the study's hypotheses and generate evidence-based insights to inform policy and strategic decision-making within Kenya's banking sector.

3.3 Research Philosophy

A research philosophy is the foundation upon which a study is built, encapsulating the researcher's assumptions about reality (ontology), the nature of knowledge (epistemology), and how knowledge can be acquired and interpreted. It significantly influences the formulation of research questions, the methodology used to gather and analyze data, and the way findings are interpreted and presented. According to Tamminen and Poucher (2020), a research philosophy encompasses the researcher's worldview, values, and theoretical orientation, which collectively shape the research process. Several philosophical paradigms exist, including positivism, interpretivism, critical theory, realism, constructivism, pragmatism, and post-structuralism. Each philosophy offers a different lens through which social phenomena can be examined and understood.

This study was anchored on the positivist research philosophy, which posits that reality is objective, external, and independent of human perception. Positivism emphasizes the use of scientific methods to understand the world through empirical observation, measurement, and analysis. As Alharahsheh and Pius (2020) explain, positivism is rooted in the belief that knowledge can only be derived from observable and measurable phenomena. This perspective assumes that social reality can be quantified and that laws governing human behavior can be identified through rigorous scientific inquiry. Bryman and Bell (2015) further affirm that the positivist approach mirrors the methodologies used in natural sciences and advocates for the application of structured tools, such as surveys, to collect data that can be subjected to statistical analysis. The origin of positivism can be traced to Auguste Comte, who maintained that the same scientific techniques used to understand the natural world could also be applied to social phenomena (Park et al., 2020).

The objectivist ontological position adopted in this study assumes that reality exists independently of social actors. This implies that variables such as technology integration, scalability, management efficiency, and regulatory compliance significantly influence bank performance, allowing for objective observation and measurement. This worldview underpinned the study's conceptualization of performance outcomes such as Return on Assets (ROA) as being influenced by external and observable factors related to technology deployment. Consequently, the study assumed that these relationships could be examined empirically to uncover patterns, correlations, and causality.

From an epistemological standpoint, the study aligns with positivism's emphasis on scientific rigor and objective measurement. Positivism posits that credible knowledge stems from observable phenomena and that subjective beliefs, feelings, and interpretations should not influence the research process (Bryman & Bell, 2015). In accordance with this tradition, this study employed a quantitative research approach to generate data that is valid, reliable, and generalizable. Structured questionnaires were used to collect quantifiable data from commercial banks across Kenya. This allowed for statistical analysis, such as correlation and regression, to examine the strength and direction of relationships between technology deployment strategies and bank performance.

The adoption of positivism was not only philosophically appropriate but also methodologically suitable, given the study's objectives. The goal was to test specific hypotheses regarding the impact of defined technology strategies, such as technology integration and scalability, on measurable performance indicators. According to Borg and Gall (2005), the positivist approach is ideal for studies that aim to test hypotheses using empirical data in a controlled and systematic manner. By relying on verifiable data and statistical tools, the study ensured that findings were not influenced by personal biases or speculative reasoning. This aligned with the need to draw evidence-based conclusions that can inform strategic decision-making in Kenya’s commercial banking sector.

In conclusion, the positivist research philosophy provided a robust and coherent framework for guiding this study. It facilitated a systematic examination of the causal relationships between technology deployment strategies and bank performance using empirical data. By emphasizing objectivity, reliability, and statistical validity, positivism enabled the researcher to produce findings that are not only grounded in observable evidence but also generalizable across the banking sector. Thus, the philosophical orientation was not only intellectually sound but also practically suitable for the study’s quantitative design and performance-centered focus.

3.4 Location of the Study

The study was carried out in commercial banks in Kenya. The study focused on the 39 commercial banks in Kenya, specifically the Headquarters, which are based in Nairobi County. The study was based at each of the commercial banks' headquarters. The study's location, focusing on 39 commercial banks in Kenya, was highly relevant to the broader financial sector, particularly in the context of Kenya's rapidly growing fintech industry. Nairobi serves as the economic and financial hub of Kenya, housing the headquarters of most of the country's leading commercial banks and financial institutions. It is also home to a thriving fintech ecosystem, with numerous startups and established companies driving innovations such as mobile banking, mobile money, and digital financial services. The growth of fintech in Nairobi has revolutionized the financial services sector in Kenya, with mobile money services like M-Pesa and the integration of digital platforms into banking operations becoming central to the country's financial inclusion agenda.

By focusing on this location, the study captured the trends and practices that were shaping the future of banking in Kenya, offering valuable insights into how technology deployment strategies within commercial banks influenced their performance. The findings from Nairobi are expected to reflect broader industry shifts, making them highly relevant to the entire financial sector, not only in Kenya but also in other emerging markets with similar technological advancements in banking and financial services.

3.5 Population of the Study

A population refers to the entire group of individuals, organizations, or objects that share common characteristics and from which a sample was drawn for research purposes (Kothari, 2004). In this study, the population consisted of all 39 commercial banks licensed to operate in Kenya, serving as the unit of analysis. The unit of analysis referred to the subjects about which conclusions were drawn in a research study (Neuman, 2014). The study specifically targeted all commercial banks, ensuring a focus on institutions actively integrating technology into their operations. The unit of observation consisted of decision-makers involved in enterprise technology adoption, specifically IT Managers, Chief Technology and Operations Officers, Chief Information Officers, or Chief Technology Officers (CTOs), as they were responsible for overseeing the adoption, integration, and management of technological solutions within commercial banks. Their expertise and involvement in strategic decision-making regarding technology adoption made them the most relevant respondents for assessing how technology deployment strategies were structured, the challenges faced during implementation, and their impact on the overall performance of commercial banks.

According to Neuman (2014), the unit of observation refers to the individuals or items that a researcher directly observes, measures, or collects data from within the unit of analysis. By focusing on these key personnel, the study ensured the collection of high-quality data from knowledgeable sources. The total population of units of observation was 39 IT Managers, Chief Technology and Operations Officers, Chief Information Officers, or Chief Technology Officers (CTOs) across the 39 commercial banks, ensuring a comprehensive and representative sample that captured the full scope of factors influencing organizational performance through technology deployment, thereby providing a robust basis for data collection and analysis. A list of the 39 licensed commercial banks included in the study is provided in Appendix II.

3.6 Sampling Procedure and Sample Size

The study adopted a census design, meaning that all 39 commercial banks licensed and regulated by the Central Bank of Kenya were included in the study. According to Nayak and Singh (2016), a census method refers to the complete enumeration of a population, ensuring that every unit within the population is studied. This approach implied that the unit of observation was the 39 commercial banks licensed and regulated by the Central Bank of Kenya, while the unit of analysis involved all 39 managers, one manager from each bank, from either the Information Technology, operations, or finance department.

The census method was preferred because it eliminated sampling errors, thereby enhancing the accuracy, reliability, and generalizability of the findings to the entire population. As noted by Saunders, Lewis, and Thornhill (2007), a census is ideal when the study population is relatively small, when a high level of reliability is required, and when complete coverage of the population is necessary to obtain comprehensive insights. The decision to use a census approach was informed by the relatively small population size of 39 commercial banks, making it feasible to conduct a study without the limitations typically associated with sampling, such as selection bias and reduced representativeness. By including all 39 banks, the study captured variations in technology deployment strategies across different tiers of banks (large, medium, and small), ensuring a holistic understanding of how these strategies impacted operational effectiveness.

The respondents were IT Managers, Chief Technology or Operations Officers, Chief Information Officers, or Chief Technology Officers (CTOs) from each bank, as they were responsible for overseeing technology adoption, integration, and management within their respective banks. The census design ensured that data were collected from all relevant decision-makers, providing a comprehensive, reliable, and generalizable basis for analyzing the influence of technology deployment strategies on the performance of commercial banks in Kenya, as advanced by Magadi (2021). The study targeted all 39 commercial banks licensed to operate in Kenya, with the unit of observation being key decision-makers, including IT Managers, Chief Technology and Operations Officers, Chief Information Officers, and Chief Technology Officers (CTOs). A detailed list of the 39 commercial banks included in the study is provided in Appendix II**.**

The census approach involves the complete enumeration of the entire population under study, thereby allowing for comprehensive data collection without the need for sampling. According to Nayak and Singh (2016), a census is a suitable method when the population is manageable in size, and the researcher seeks greater accuracy, reliability, and generalizability. In this case, the population of 39 commercial banks was deemed sufficiently small and manageable to permit exhaustive inclusion, yet large enough to yield varied insights across diverse operational and technological contexts.

The unit of analysis for the study was the commercial bank as an institution, while the unit of observation was the senior technology or operations decision-maker within each bank. These decision-makers held job roles defined as Chief Technology Officers (CTOs), Chief Information Officers (CIOs), Chief Technology and Operations Officers (CTOOs), or IT Managers, depending on the organizational structure of the bank. These individuals were selected due to their strategic roles in the deployment and management of technological systems, as well as their expertise in both institutional performance and technological strategies. By engaging senior-level informants across all institutions, the study ensured that the data collected was both authoritative and reflective of the banks' strategic direction.

The rationale for using a census design was multifaceted. First, the total population of 39 commercial banks, while small, constitutes the entire universe of licensed banking institutions in Kenya, thereby justifying full inclusion. This number, although seemingly limited in comparison to other sectors, is reflective of the national banking landscape and therefore sufficiently rich in analytical diversity to support a doctoral-level inquiry. Each bank represents a unique case with potentially differing approaches to technology deployment, scale of operations, market segmentation, and regulatory compliance.

Capturing the heterogeneity across these 39 banks, including tiered categorizations of large, medium, and small institutions, enables a more granular and contextualized analysis than would be possible with a sample-based approach.

Second, adopting a census eliminated sampling error and enhanced the reliability and validity of the findings. Sampling can introduce biases due to random selection or misrepresentation of sub-groups within the population (Saunders, Lewis, & Thornhill, 2007). By including all entities, the study ensured full representativeness, reducing the risk of excluding critical perspectives, particularly from smaller or mid-tier banks that might be underrepresented in stratified samples. Moreover, the census approach allowed the researcher to examine patterns and differences in technology strategies across all banking tiers, ensuring that findings are not skewed by over-reliance on data from larger institutions, which often dominate samples due to their accessibility and visibility.

Third, given the strategic and regulatory importance of commercial banks in Kenya's financial ecosystem, this study aimed to provide actionable recommendations to key stakeholders, including the Central Bank of Kenya, the Kenya Bankers Association, and technology vendors. For this reason, comprehensiveness and credibility of the dataset were crucial. A census design helped achieve this by ensuring that every bank's input was considered, thus making the findings more robust and policy-relevant. The participation of key decision-makers from all institutions also enhanced the depth of insight and allowed for comparison across different operational environments.

Lastly, the feasibility of access to the target population supported the decision to use a census. The researcher was able to leverage professional networks and institutional support to contact relevant decision-makers in each bank. The commitment to securing participation from all banks was further facilitated by the structured nature of the study instrument (questionnaire), which allowed for uniform data collection without imposing significant time burdens on the respondents.

The decision to adopt a census approach involving all 39 licensed commercial banks in Kenya is consistent with the methodological justification advanced by Magadi (2021), who similarly employed a census design to examine the effect of compliance with Central Bank risk management guidelines on financial performance. Magadi posits that when the population under study is relatively small and manageable, as is the case with the Kenyan banking sector, a census method is not only feasible but also enhances the reliability, accuracy, and generalizability of the findings. He further emphasized that using a census eliminates sampling errors and ensures comprehensive representation of all institutions, thus capturing the diversity of practices across different tiers of banks. Drawing on Magadi's approach, our study adopts a similar rationale, aiming to collect comprehensive and authoritative data from key technology and operations decision-makers across all banks to support a robust, nuanced, and policy-relevant analysis of technology deployment strategies and their impact on commercial bank performance in Kenya.

In conclusion, the decision to adopt a census approach was driven by methodological rigor, feasibility, and the strategic importance of the population under study. It enabled a comprehensive, inclusive, and unbiased analysis of technology deployment strategies across Kenya's commercial banking sector, ensuring the production of findings that are valid, reliable, and generalizable, thereby meeting the expectations of the doctoral research inquiry.

3.7 Instrumentation Data Collection Procedures

The type of data collected in the study was primary in nature. The data was collected using self-administered questionnaires. Prior to conducting the study, permission was sought from the financial service organizations for the respondents' participation. Additionally, a pilot study was conducted before the data collection exercises to identify potential problems with the structure or comprehensibility of the questionnaire. Likert scale questions were used to measure respondents' attitudes, perceptions, and opinions regarding technology deployment strategies and their effects on organizational performance. These questions typically asked respondents to rate their extent of agreement or disagreement with statements on a 5-point scale (where 5 = Very Great Extent, 4 = Great Extent, 3 = Moderate Extent, 2 = Small Extent, and 1 = Not at All).

3.7.1 Pilot Study

Pilot testing evaluated and improved the study design prior to carrying out the actual study. A pilot test was conducted with selected participants relevant to the research to assess the validity and reliability of the research instrument (questionnaire) before its presentation to the target population. The pilot study involved four respondents, drawn from four microfinance institutions (MFIs) based in Nairobi County. Each participating MFI provided one respondent, either an IT Manager, Chief Technology and Operations Officer, Chief Information Officer, or Chief Technology Officer (CTO), ensuring alignment with the characteristics of the target population. According to Hassan, Schattner, and Mazza (2006), a pilot study is a small-scale investigation designed to test research protocols, data collection instruments, sample recruitment strategies, and other research techniques in preparation for a larger study. The process allows the researcher to assess the effectiveness of the research instrument, ensuring that all respondents not only understand the questions but also interpret them consistently (Wepukhulu, 2016).

Additionally, pilot testing identifies potential deficiencies in the research instrument and procedures, enabling necessary modifications before full-scale implementation (Hassan et al., 2006).

As recommended by Mugenda and Mugenda (2003), at least 10% of the participants in the final study should take part in the pilot study to ensure a representative sample. This aligns with Creswell and Clark (2017), who assert that such a proportion is sufficient to reflect the characteristics of the main study population. In this study, four MFIs were selected for pilot testing, representing 10% of the total 39 respondents (10% of 39 = 4). The MFIs were selected from Nairobi County, as the city serves as Kenya's financial hub, hosting the headquarters of most financial institutions. Conducting the pilot study in this setting ensured that the institutions selected for pretesting were comparable to those included in the main study. While four instruments might have seemed minimal, the pilot's aim was not statistical generalization, but rather the refinement of research tools to identify issues such as ambiguity in questionnaire items, data entry errors, the logical flow of questions, and the clarity of constructs. Moreover, the researcher incorporated expert review and face validity checks from academic peers and industry practitioners to strengthen the reliability of the instruments.

The primary objective of the pilot study was to verify the validity and reliability of the research questionnaire before it was administered to the full study population. The results helped refine the clarity, structure, and wording of the questions to ensure that the final instrument effectively captured the intended research constructs. Feedback from pilot participants guided necessary adjustments, improving the overall robustness of the data collection tool before its full deployment in the main study.

3.7.2 Validity of the Research Instruments

Validity refers to the extent to which an instrument accurately measures what it is intended to measure (Mugenda & Mugenda, 2003). It determines the credibility and generalizability of the results obtained from a study. In this research, ensuring the validity of the questionnaire was critical in capturing accurate, relevant, and comprehensive data aligned with the research objectives and theoretical framework. The validity of the instruments used in the pilot study was established through the use of a prototype questionnaire, which was first approved by the study supervisors and other stakeholders before proceeding to the next phase of the study. This process was an important part of the study, as it helped measure the extent to which the proposed instrument accurately measured what it was intended to measure. It was expected that the questionnaires and other measurement tools proposed in this section would comprehensively cover the areas around the research objectives and align with the theoretical framework.

The validity of the research instrument was assessed in two key areas: content validity and construct validity (Almanasreh, Moles, & Chen, 2019). Content validity ensured that the questionnaire comprehensively covered all aspects of the research objectives and aligned with the theoretical framework. By evaluating the relevance of each question and ensuring that all key areas related to technology deployment strategies and their impact on performance were included, content validity helped ensure that the instrument measured what it was intended to. This was crucial for capturing the full scope of technology deployment factors within the banking sector. Construct validity, on the other hand, assessed whether the questionnaire effectively measured the underlying constructs, such as technology integration, scalability, efficiency of technology management, and the moderating effect of industry regulations. This involved confirming that the questions accurately reflected these constructs and made meaningful contributions to the study's theoretical underpinnings.

In addition to the inputs from the study's supervisors, the research instrument was also reviewed by other industry experts and academic specialists. Technology deployment experts from the banking sector were consulted to ensure that the questions addressed real-world challenges and practices within financial institutions. These experts provided valuable feedback on the practicality and relevance of the questionnaire items. Additionally, academic experts in research methodology or information systems reviewed the instrument to ensure that it adhered to research standards and effectively captured the theoretical constructs intended for measurement. This multi-expert review process enhanced the instrument's validity, ensuring that it was both scientifically rigorous and contextually appropriate for the study's objectives.

The validity of a research tool is determined by its ability to measure the intended quantity accurately. Content validity examines the extent to which the items created to measure a concept accurately represent all possible items that could measure that concept (Amin, 2005). In this study, content validity was established through the collection of expert opinions from the research supervisors. The research supervisors determined the relevance of the items. The responses were analyzed to determine the percentage representation using the content validity index. The formula for content validity, as proposed by Amin (2005), was utilized. The formula for calculating the Content Validity Index was determined by the number of judges who declared an item as valid, divided by the total number of items, as presented below:

Table 4

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.806
	Approx. Chi-Square	2158.087
Bartlett's Test of Sphericity	Df	4
	Sig.	.000

The results are displayed in Table 4. Given that the Bartlett's test significance is less than 0.05, it suggests that the sample has an acceptable level of sampling adequacy, meaning it can be factored. Additionally, the KMO statistics for all variables exceeded 0.5 (0.806). It can be inferred that the data were appropriate for regression analysis.

3.7.3 Reliability of the Instruments

Reliability is a key aspect of the research methodology, ensuring that the data collected is consistent and stable across multiple observations of the same phenomenon (Knapp & Mueller, 2010). It assessed whether the same results could be reproduced under similar conditions. In this study, reliability was evaluated using internal consistency to verify whether items intended to measure the same variable correlated with each other. The Cronbach’s alpha coefficient (α) was used to assess internal consistency, with a value of 0.7 or higher considered acceptable according to Greener (2008). For the questionnaire to demonstrate adequate reliability, each construct in the instrument technology integration, scalability, efficiency of technology management, and regulatory impact was evaluated separately.

A threshold of 0.7 for Cronbach's alpha was applied to each group of related items. Specifically, each construct had to have a Cronbach’s alpha value greater than 0.7 to confirm that the questions within that section were consistently measuring the intended concept. In cases where any construct did not meet the 0.7 threshold for Cronbach's alpha, the items within that section were reviewed for clarity and relevance. Items that exhibited low correlation with other items in the same construct were revised, reworded, or eliminated to improve reliability. Additionally, feedback from the pilot study participants was considered to refine and enhance the instrument further, ensuring that the final version of the questionnaire provided reliable and valid data for the main study. Reliability is crucial in ensuring the consistency of research findings across different attempts, as emphasized by Mugenda and Mugenda (2018). According to Silverman (2017), reliability can be improved by pre-testing the questions, using fixed-choice responses, and ensuring systematic data collection, transcription, and reporting. Reliability is fundamental in determining whether a study achieves its intended goals and hypotheses while minimizing the influence of external factors. A high reliability indicates that a measure consistently produces similar results under similar circumstances (Kothari, 2012).

In this study, Cronbach's alpha coefficient was used to assess the reliability of the data. Cronbach's alpha ranges from 0 to 1 and quantifies the internal consistency and relationship between a set of items. An alpha coefficient of 0.7 or higher is considered acceptable, while a value below 0.7 may suggest issues with reliability (Singpurwalla, 2013). The findings from the reliability test for the variables associated with technology deployment strategies and performance in commercial banks in Kenya are presented in Table 5 below.

Table 5

Reliability Test Results

Variable	Cronbach's Alpha	Interpretation
Technology Integration Practices	0.818	Reliable
Scalability of Technology Deployment	0.824	Reliable
Efficiency of Technology Management	0.811	Reliable
Industry Regulations	0.861	Reliable
Performance of Commercial Banks	0.819	Reliable

The results reveal that the construct of Technology Integration Practices had a Cronbach's alpha of 0.818, Scalability of Technology Deployment had a Cronbach's alpha of 0.824, Efficiency of Technology Management had a Cronbach's alpha of 0.811, Industry Regulations had a Cronbach's alpha of 0.816 and Performance of microfinance institutions (MFIs) based in Nairobi County had a Cronbach's alpha of 0.819. All variables demonstrated satisfactory reliability, with coefficients (α) exceeding the acceptable threshold of 0.7.

The pilot study conducted as part of the research methodology in Chapter Three significantly enhanced the robustness and reliability of the study on technology deployment strategies and their impact on the performance of commercial banks in Kenya. By testing the research instrument on a small, representative sample of four respondents from microfinance institutions (MFIs) in Nairobi County, the pilot study served as a critical step in refining the questionnaire to ensure it accurately captured the intended constructs. The selection of respondents, including IT Managers, Chief Technology and Operations Officers, Chief Information Officers, or Chief Technology

Officers, mirrored the characteristics of the target population, ensuring relevance and alignment with the main study.

This process allowed the researcher to identify and address potential issues such as ambiguous wording, unclear response options, and logical flow in the questionnaire. Feedback from pilot participants was instrumental in refining question clarity and structure, which improved the instrument's ability to measure key variables like technology integration, scalability, efficiency management, and the moderating effect of industry regulations. By addressing these issues early, the pilot study minimized the risk of collecting unreliable or invalid data in the main study, thereby enhancing the overall quality of the research findings.

Beyond refining the research instrument, the pilot study added value by validating the study's methodological framework and ensuring its applicability in the Kenyan banking context. Conducting the pilot in Nairobi County, Kenya's financial hub, ensured that the selected MFIs were comparable to the commercial banks in the main study, providing a representative sample for testing. The pilot study's adherence to recommendations by Mugenda and Mugenda (2003) and Creswell and Clark (2017), which advocate for including at least 10% of the main study's sample in the pilot, ensured that the sample size of four respondents (10% of the 39 respondents in the main study) was sufficient to reflect the target population's characteristics. The pilot also incorporated expert reviews from academic peers and industry practitioners, which strengthened the instrument's content and construct validity. For instance, the use of factor analysis, supported by the Kaiser-Meyer-Olkin (KMO) measure (0.806) and Bartlett's Test of Sphericity ($p < 0.001$), confirmed the instrument's suitability for regression analysis, ensuring that the data collected would be robust and appropriate for statistical modeling.

This rigorous validation process increased confidence in the study's ability to produce trustworthy and generalizable results.

Moreover, the pilot study contributed to the study's reliability by establishing the internal consistency of the research instrument, as evidenced by the Cronbach's alpha coefficients for all constructs exceeding the acceptable threshold of 0.7. The reliability test results, with values ranging from 0.811 for Efficiency of Technology Management to 0.861 for Industry Regulations, confirmed that the questionnaire consistently measured the intended variables across different respondents. The pilot study's iterative process of refining items based on participant feedback and expert input ensured that low-correlating items were revised or eliminated, further enhancing the instrument's reliability. By preemptively addressing potential deficiencies in the research protocol, the pilot study reduced the likelihood of methodological errors in the main study, such as inconsistent data collection or respondent misinterpretation of questions. Ultimately, the pilot study's contributions in Chapter Three were pivotal in strengthening the study's scientific rigor, ensuring that the final research instrument was both valid and reliable, and laying a solid foundation for generating credible insights into the impact of technology deployment strategies on bank performance in Kenya.

3.8 Data Collection Procedure

To ensure ethical compliance and data integrity, the study followed established protocols for data collection. Firstly, approval was sought from the Kabarak University Research Ethics Committee (KUREC) before commencing data collection. The researcher received this clearance. An online submission was made to request permission from the National Council of Science, Technology, and Innovation (NACOSTI), as required by regulatory guidelines, and approval was also granted. Data collection is the process of collecting information and facts for a research or study (Taherdoost, 2021).

The questionnaire was administered physically through the drop-and-pick-later method and via an online link to increase the amount of data collected within a short period. This mode provided anonymity to the respondents, which helped reduce biased responses —a crucial factor in tackling bias in descriptive research design. The respondents were given two weeks to fill out the questionnaires, after which they were gathered as soon as possible.

To ensure comprehensive data collection, both physical and online methods were employed in tandem. The physical method involved administering the questionnaires in person using the drop-and-pick-later technique, allowing participants to complete the forms at their convenience while ensuring a personal connection with respondents. The online method, on the other hand, was facilitated through an electronic questionnaire link, allowing respondents to complete the forms remotely. This hybrid approach aimed to maximize response rates and enhance data diversity by accommodating the diverse preferences and varying accessibility levels of participants. To address potential discrepancies between the two data collection methods, careful monitoring was implemented. First, the questionnaire was identical across both physical and online platforms to ensure consistency in the data being collected. Any discrepancies in responses were examined to determine if they resulted from the survey format, such as how certain questions were interpreted differently in a face-to-face setting compared to an online environment. Additionally, follow-ups were conducted for both methods to clarify any inconsistencies, and adjustments were made if needed.

The study explicitly details the pilot testing process, which played a critical role in identifying deficiencies in the initial data collection tools, particularly the questionnaire, and necessitated revisions to enhance its validity and reliability. The pilot study, conducted with four respondents from microfinance institutions (MFIs) in Nairobi

County, revealed issues such as ambiguity in certain questionnaire items, inconsistent interpretation of questions, and challenges with the logical flow of sections. Feedback from participants, who included IT Managers, Chief Technology Officers, Chief Information Officers, or Operations Officers, highlighted specific areas where questions failed to clearly capture the intended constructs, such as technology integration and scalability. For instance, some respondents noted that questions related to efficiency management were too broad, leading to varied interpretations. To address these issues, the researcher refined the wording and structure of problematic items, ensuring clarity and alignment with the study's theoretical framework (Resource-Based View, UTAUT, and Theory of Planned Behavior).

Additionally, the pilot study prompted the inclusion of a new question specifically asking respondents to indicate the tier of their bank (Tier 1, Tier 2, or Tier 3). This addition was critical, as the pilot revealed that bank tier significantly influenced technology deployment practices, and capturing this variable explicitly allowed for more precise segmentation and analysis in the main study. The revised questionnaire underwent further review by academic peers and industry experts to confirm its improved clarity and relevance, ensuring that it effectively measured the constructs of interest.

The inclusion of the bank tier question was a direct outcome of the pilot study's findings, which underscored the heterogeneity of banks in terms of size, resources, and technological sophistication. During the pilot, respondents from different MFIs provided feedback indicating that their responses to technology-related questions were influenced by their institution's scale and resource availability, which closely aligned with the tier classification used in the Kenyan banking sector. Recognizing that this variable was essential for understanding variations in technology deployment strategies, the researcher revised the questionnaire to include a specific item asking, "What is the tier of your bank

(Tier 1, Tier 2, or Tier 3)?" This addition enabled the main study to segment data by bank tier, facilitating a more nuanced analysis of how technology integration, scalability, and efficiency management impacted performance across different bank categories. The revision proved valuable, as evidenced by the significant relationship found between bank tier and performance.

In line with ethical research practices, the study ensured that participation was entirely voluntary and based on informed consent. Each potential respondent was provided with a cover letter and a consent form explaining the purpose of the study, their role in it, and the assurance that their participation was voluntary and not mandatory. Respondents were informed that they could decline to participate or withdraw from the study at any stage without facing any form of penalty or negative consequence. Informed consent was obtained before administering the questionnaires, and respondents were assured that the information they provided would be treated with the highest level of confidentiality and used solely for academic purposes. This ethical approach promoted trust and openness, thereby enhancing the quality and authenticity of the data collected.

To further uphold ethical and legal standards, the researcher obtained institutional approvals prior to commencing the data collection exercise. Ethical clearance was granted by the Kabarak University Research Ethics Committee (KUREC) after a thorough review of the study's objectives, instruments, and methodology. Additionally, a research permit was secured from the National Commission for Science, Technology, and Innovation (NACOSTI), in compliance with national research regulations in Kenya. Regarding data security, all physical questionnaires were stored in a locked cabinet accessible only to the researcher, while electronic data collected via online surveys was stored on password-protected, encrypted platforms.

No personal identifiers were collected, and all data were anonymized during analysis to safeguard respondent identities. These procedures ensured the research adhered to rigorous ethical standards while preserving the confidentiality, integrity, and security of the collected data. Further, the study developed the Technology Deployment Strategy Decision Model (TDSDM) using a combination of advanced analytical methods that integrated statistical modeling and graph-based decision analysis. The process began with the construction of a decision graph using the TDSDMDecisionGraph class, which mapped the directional relationships among key variables Technology Integration Practices, Scalability of Technology Deployment, Efficiency of Technology Management, Industry Regulations (moderator), and Organizational Performance (composite outcome).

This was followed by the application of regression analysis to estimate the strength of these relationships, where coefficients served as edge weights within the graph structure. To enhance the model's analytical robustness, the graph was enriched with structural equation modeling (SEM) features, including critical path analysis, centrality measures (betweenness, degree, and eigenvector), and community structure detection, which revealed key influence pathways and strategic clusters among variables. Visualization was facilitated through Graphviz and Plotly libraries, enabling both static and interactive exploration of decision flows. This integration allowed the model to identify performance-critical pathways, such as Scalability → Performance in Tier 3 banks, and to highlight the central role of Technology Integration in Tier 1 banks. By embedding these components into an iterative framework with real-time feedback loops, the TDSDM evolved as a dynamic, adaptive tool capable of guiding tier-specific technology deployment strategies within Kenya's regulated banking environment.

3.9 Data Analysis and Presentation

3.9.1 Descriptive Data Analysis

Descriptive statistics were employed to summarize and describe the basic features of the data collected from respondents. Using the Statistical Package for the Social Sciences (SPSS) version 28 and Excel, the data were compiled, coded, and systematically processed. The descriptive analysis included frequencies, means, percentages, and standard deviations, which provided an overview of the demographic characteristics of the respondents as well as the distribution patterns and central tendencies of key study variables such as technology management practices, scalability and growth, technology delivery and management levels, industry regulations, and organizational performance. This initial analysis allowed the researcher to identify trends, commonalities, and variances within the data. It also ensured data quality by identifying missing values, inconsistencies, or outliers. Graphical tools such as bar charts and tables were used to present the summarized data, allowing for clear and accessible interpretation of the findings. This layer of analysis was essential in establishing a foundational understanding before progressing to more complex statistical techniques.

Inferential Data Analysis

Inferential statistics were then applied to test the study's hypotheses and examine the relationships between the independent variables (technology deployment practices) and the dependent variable (organizational performance). Pearson's correlation analysis was employed to determine the strength and direction of the linear relationship between pairs of continuous variables. This method was particularly suitable due to its sensitivity in detecting linear associations and its assumption of normally distributed variables, which aligned with the study's research design.

The correlation coefficients, ranging from -1 to +1, indicated whether the relationships were negative, positive, or nonexistent. Additionally, multiple regression analysis was conducted to assess the combined effect of the independent variables on organizational performance. This statistical model enabled the researcher to isolate the unique contribution of each variable while controlling for the others.

Following the correlation analysis, two phases of regression were undertaken:

Unmoderated Multiple Regression Analysis

The first phase involved testing the direct effects of the core technology deployment variables on organizational performance without accounting for any moderating influence. The independent variables included:

- X_1: Technology Management Practices
- X_2: Scalability and Growth
- X_3: Technology Delivery and Management Levels

The regression model took the form:

$Y=\beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+\epsilon$

Where:

- Y= Organizational Performance
- β_0 = Intercept
- β_1,β_2,β_3 = Coefficients of the predictors
- ϵ = Error term

Key statistics generated from this model included:

- **P-values**: to assess the statistical significance of each predictor ($p<0.05$ threshold),

- **R²**: to measure the proportion of variance in performance explained by the predictors,
- **Standardized beta coefficients**: to interpret the relative strength of each variable's effect.

Moderated Regression Analysis

In the second phase, the study introduced $\mathbf{X_4}$ **(**Industry Regulations) as a moderator variable to examine whether the relationship between each technology deployment practice and organizational performance was contingent upon the level of regulatory influence. To test these moderating effects, interaction terms were created between the moderator (X_0) and each of the three predictors:

- $X_1 \times X_4$: Technology Management Practices × Industry Regulations
- $X_2 \times X_4$: Scalability and Growth × Industry Regulations
- $X_3 \times X_4$: Technology Delivery and Management Levels × Industry Regulations

The moderated regression model was thus specified as:

$$Y=\beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\beta_5(X_1\times X_4) +\beta_6(X_2\times X_4) +\beta_7(X_3\times X_4) +\epsilon$$

This model allowed the researcher to assess whether the effect of technology deployment strategies on performance was amplified or diminished under varying degrees of regulatory pressure. The presence of statistically significant interaction terms (with p<0.05p < 0.05p<0.05) indicated a moderation effect.

In both phases of regression, diagnostic tests such as multicollinearity (using VIF), normality, and heteroscedasticity were conducted to ensure the validity of results. The use of both unmoderated and moderated regression models enabled the study to provide a nuanced and empirically grounded understanding of how regulatory frameworks condition the impact of technology deployment on bank performance.

Key outputs included the p-values (to determine statistical significance), R^2 values (to measure explanatory power), and standardized regression coefficients (to interpret the strength and direction of influence). A p-value less than 0.05 was considered statistically significant, indicating that the predictor had a meaningful effect on performance. The R^2 values were used to assess the model's goodness of fit, indicating how well the independent variables collectively explained the variance in organizational performance. Together, these inferential techniques allowed for robust testing of the study's hypotheses and supported the drawing of generalizable conclusions from the sample data.

Table 6

Regression Analysis Summary

Objective	Hypothesis	Analytical Model
To investigate the effect of technology integration practices on the performance of commercial banks in Kenya.	H_{01}: Technology integration practices have no significant effect on the performance of commercial banks in Kenya.	$Y = \beta_1 + \beta_1 X_1$ where: β_1 = Intercept (constant term representing bank performance when all predictors are zero) β_1 = Coefficient showing the effect of technology integration practices on bank performance Y = Bank Performance X_1= Technology Integration Practices
To determine the effect of scalability of technology deployment on performance of commercial banks in Kenya.	H_{02}: The scalability of technology deployment models has no significant effect on the performance of commercial banks in Kenya.	$Y = \beta_2 + \beta_2 X_2$ where: β_2 = Intercept β_2= Coefficient showing the effect of scalability of technology deployment on bank performance Y = Bank Performance X_2=Scalability of Technology Deployment
To examine the effect of efficiency of technology management on performance of commercial banks in Kenya.	H_{03}: The efficiency of technology management has no significant effect on the performance of commercial banks in Kenya.	$Y = \beta_3 + \beta_3 X_3$ where: β_3 = Intercept β_3 = Coefficient showing the effect of technology management efficiency on bank performance Y = Bank Performance X^3=Efficiency of Technology Management.
To assess the moderating effect of industry regulations on the relationship between technology deployment strategies and performance of commercial banks in Kenya.	H_{04}: Industry regulations have no significant moderating effect on the relationship between technology deployment strategies and performance of commercial banks in Kenya.	$Y = \beta_4 + \beta_4 X + \beta_4 Z + \beta_4 X_4$ where: B_4 = Intercept β_4 = Coefficient of technology deployment strategies β_4 = Coefficient of industry regulations β_4 = Coefficient of the interaction term, representing the moderating effect Y = Bank Performance X = Composite Technology Deployment Strategies Z = Industry Regulations XZ = Interaction Term

3.10 Diagnostic Tests

3.10.1 Normality of Test

To determine whether the dataset followed a normal distribution a fundamental assumption for conducting parametric statistical analyses, such as multiple regression normality testing was performed. The accuracy and dependability of statistical inferences are improved when a normal distribution is present, as it ensures that the regression model's residuals, or errors, are symmetrically distributed around the mean. Both statistical and visual methods were used in this study to evaluate normality. To provide a visual representation of the data distribution, histograms and Q-Q (quantile-quantile) plots were analyzed for each variable. Furthermore, the assumption of normalcy was statistically confirmed using the Shapiro-Wilk and Kolmogorov-Smirnov tests. The null hypothesis, according to which the data is normally distributed, could not be disproved if the p-value in either test was higher than 0.05. The data's suitability for additional regression analysis was confirmed by the findings of the statistical and graphical analyses, which demonstrated that the data met the assumption of normality.

3.10.2 Multicollinearity Test

According to Tabachnick and Fidell (2007), multicollinearity occurs when the independent variables in a regression model are highly correlated with each other. This high degree of correlation can lead to unreliable parameter estimates and complicate the interpretation of how independent variables affect the dependent variable, such as market value. To identify multicollinearity, the Variance Inflation Factor (VIF) was used. In the Statistical Package for the Social Sciences (SPSS) version 28, VIF values exceeding 10 typically indicate a multicollinearity problem. Addressing multicollinearity was crucial for ensuring the reliability and interpretability of the regression model's findings.

The multicollinearity test was essential for this study because it ensured that the independent variables used in the regression analysis did not exhibit high correlations with each other, which could distort the results. In the context of this study, where multiple technology deployment strategies (e.g., integration practices, scalability, and efficiency) were being examined for their influence on the performance of commercial banks, high correlations between these predictors could lead to unreliable estimates. If multicollinearity were present, it would have been difficult to determine the unique contribution of each independent variable to the dependent variable, thereby affecting the model's interpretability. Using the Variance Inflation Factor (VIF) to detect multicollinearity allowed for adjustments to be made, such as removing or combining variables, to ensure that the model accurately reflected the relationships between the variables and the performance outcomes.

3.10.3 Autocorrelation Test

Autocorrelation tests are statistical tests used to determine whether the observations in a time series data set are correlated with themselves over time. Autocorrelation, also known as serial correlation, occurs when the correlation between observations at different points in time is not zero, according to Roodman (2006). Positive and negative autocorrelations are equally plausible in statistical analysis. When the standard errors are low, the predicted values provided by the model tend to be more accurate than they actually are, as mentioned by Wang (2013). If autocorrelation is detected, one should reject the null hypothesis, as it indicates a problem with the model. Autocorrelation issues can lead to inefficient coefficient estimates, which in turn result in erroneous predictions. In the context of panel data analysis, autocorrelation is similar to cross-sectional dependence. To investigate autocorrelation, the Durbin-Watson test was used, as suggested by Pesaran (2004).

The Durbin-Watson test statistic, d, ranges from 0 to 4. The autocorrelation test was necessary for this study to assess whether the residuals from the regression model were correlated over time. Although the study involved cross-sectional data, any form of autocorrelation could signal issues with the temporal structure of the data or improper model specification.

If autocorrelation exists, it can lead to biased and inefficient parameter estimates, rendering the regression results unreliable. Specifically, the Durbin-Watson test helped identify whether there was serial correlation in the error terms, which could affect the accuracy of the model's predictions. Given that performance metrics in commercial banks might exhibit time-based patterns, detecting autocorrelation was essential to ensure the robustness of the model and the validity of the conclusions drawn from the analysis.

3.10.4 Heteroscedasticity Test

Homoscedasticity is the state in which the errors in all data observations exhibit a consistent variance. The lack of discernible patterns or trends in the variability of the mistakes shows this. Heteroscedasticity refers to the situation where the variability of errors differs across the observations in the dataset, in contrast to homoscedasticity, where the variability is constant. The presence of heteroscedasticity was assessed using the Breusch-Pagan test, which involves formulating null and alternative hypotheses. The Null hypothesis indicates the existence of homoscedasticity, which means that errors have an equal variance distribution. On the other hand, the Alternative hypothesis indicates the presence of heteroscedasticity, which means that errors do not have a uniform variance distribution. Therefore, this data did not exhibit heteroscedasticity issues and was appropriate for regression model research. In the presence of heteroscedasticity, weighted least squares was used, allocating more weight to high-quality data and less weight to unreliable ones.

The heteroscedasticity test is necessary to determine if the variance of errors in the regression model is consistent across all observations. In financial datasets, it is not uncommon for the variance of errors to vary across observations, especially when dealing with diverse commercial banks that have varying sizes, resources, and technology deployments. The Breusch-Pagan test helped identify whether heteroscedasticity is present in the data. If heteroscedasticity was found, it indicated that the regression results were inefficient, as the assumptions of constant variance in the errors were violated. In such cases, weighted least squares regression was employed to address this issue, ensuring that the model accurately captures the relationships between technology deployment strategies and bank performance by assigning more weight to more reliable data points.

3.10.5 Factor Analysis

Factor analysis was employed as a diagnostic test to identify underlying variables or factors that influenced the performance of financial service organizations in Kenya. By analyzing the correlations among a set of observed variables, factor analysis helped determine the latent constructs that drive the observed data. This technique simplifies data interpretation by grouping related variables into factors, revealing the data's structure and reducing dimensionality. In the context of this study, factor analysis facilitated an understanding of the key components of technology deployment strategies and their impact on organizational performance. This approach enhanced the robustness of the findings by ensuring that the variables used in the analysis effectively captured the underlying constructs relevant to the performance outcomes.

Factor analysis was critical for this study as it helped reduce the complexity of the data by identifying the latent factors that drove performance outcomes in commercial banks. Technology deployment strategies were multifaceted, involving multiple variables (e.g., technology integration, scalability, efficiency). Factor analysis helped group these variables into underlying constructs that could more clearly explain their impact on organizational performance. This technique enabled a more efficient and interpretable analysis by reducing dimensionality, making the data easier to manage, and ensuring that the study accurately captured the core components of technology deployment strategies. By using factor analysis, the study ensured that the key drivers of performance were identified, thereby enhancing the robustness and clarity of the findings.

3.11 Ethical Considerations

Firstly, this research adhered to ethical standards and underwent review and approval by the National Commission for Science, Technology, and Innovation (NACOSTI). Any ethical concerns raised during the research were promptly addressed and reported in accordance with established protocols.

Secondly, prior to data collection, informed consent was obtained from all participating employees. They were provided with clear and comprehensive information regarding the research objectives, procedures, potential risks, and benefits. Participants had the right to voluntarily participate or withdraw from the study at any point without facing any adverse consequences.

Thirdly, confidentiality of participant information was strictly maintained throughout the study. All data collected, including responses from questionnaires, was treated with utmost confidentiality. Personal identifiers were removed or anonymized to ensure that participants' privacy was safeguarded. Additionally, measures were implemented to ensure the security of data. Electronic data was stored on password-protected and encrypted devices, while hard copies were kept in secure, locked locations. Only authorized researchers had access to the data.

To address potential conflicts of interest, the study ensured full transparency by disclosing all financial support and affiliations that could influence the research outcomes. Researchers, including supervisors and stakeholders, declared any possible conflicts to maintain objectivity and avoid bias in data collection, analysis, and reporting.

Additionally, the anonymity of respondents' institutions was safeguarded by ensuring that no identifying information was collected or disclosed in the study's findings. Data was anonymized and stored securely, with access limited to authorized personnel only. All responses were treated confidentially, and the results were reported in aggregate form to prevent the identification of specific institutions.

3.11.1 Potential Risks

One significant risk in this study arose from the potential for biased or unrepresentative data, especially if the study relied heavily on responses from only a few individuals within each bank. This created the danger of skewed insights that may not have accurately reflected the institution's overall technological deployment or performance. Additionally, participants may have felt uncomfortable sharing honest opinions about internal strategies or performance metrics due to fear of reprisal or breaching confidentiality protocols. This study may also have posed reputational risks to banks if sensitive performance data were inadvertently disclosed or misinterpreted. There was also the possibility of data security risks if proper safeguards were not implemented, especially given the nature of financial data.

3.11.2 Protection Procedures

To protect participants from these foreseeable risks, the researcher implemented several safeguards. Firstly, informed consent was obtained from all participants, clearly explaining the study's purpose, their role, and their right to withdraw at any time without penalty. Secondly, participation was strictly voluntary, and no identifying information was used in any reporting. To mitigate bias, the study recruited diverse respondents across various departments and levels of seniority within each bank, ensuring a more balanced and representative dataset. Additionally, data collection avoided questions that could directly compromise institutional strategies or expose trade secrets. Ethical approval was sought, and adherence to data protection laws was ensured throughout the research process.

3.11.3 Data Monitoring Plan

To ensure the completeness and integrity of questionnaire responses, the researcher implemented a real-time data review system during data collection. This included programmed validation checks within the digital questionnaire tool to ensure mandatory questions were answered before submission and to flag inconsistencies. Periodic backups and audits were conducted to prevent data loss. A pilot test was also conducted prior to full deployment to ensure clarity and functionality of the instrument. Additionally, the researcher maintained a data log sheet to monitor response rates, note any anomalies, and track completion statuses to follow up where necessary.

3.11.4 Confidentiality and Data Safeguard

Participant privacy and confidentiality were protected by anonymizing all data at the point of collection. Each respondent was assigned a unique code, and no personally identifiable information was linked to their responses. Data were stored on encrypted, password-protected servers, and only the Principal Investigator (PI) and designated research assistants, bound by confidentiality agreements, had access to the raw data. The data were securely stored for a maximum of five years to allow for any follow-up studies or audits, after which they were permanently deleted using certified digital erasure tools.

Any physical documents were shredded. The data were not shared with any third parties outside the research team, and the results were only reported in aggregate to further protect identities.

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND DISCUSSIONS

4.1 Introduction

This chapter presents the results of data analysis, interpretation, and discussion, based on the study's objectives. The findings are organized thematically according to the study's specific objectives. The thematic areas covered include: response rate, demographic characteristics of the respondents, and diagnostic tests for statistical assumptions. Additionally, the chapter provides an in-depth analysis of the influence of technology deployment strategies on the performance of commercial banks in Kenya. Specifically, it examines the effect of technology integration practices, the scalability of technology deployment, and the efficiency of technology management on bank performance. Furthermore, the moderating effect of industry regulations on the relationship between technology deployment strategies and performance is assessed. The presentation of findings is aligned with the study’s objectives and supported by relevant tables, figures, and statistical outputs.

4.2 Response Rate

Of the 39 questionnaires sent, 36 were ultimately filled out and returned, allowing the data to be analyzed. As a result, the rate of return was 92.3%. The return rate was considered satisfactory for the purpose of the study. When doing research in the social sciences, a rate of return of at least 50% is considered sufficient to fulfill research analysis and is thus acceptable. (Saunders, Lewis, and Thornhill, 2003). It is also consistent with the findings of Cooper and Schindler (2006) and Nachmias and Nachmias (2005), who reported that a response rate of 75% is attainable for data analysis purposes. The return rate is in accordance with these findings. According to Babbie (2010), a response rate of 70% or higher is considered sufficient for any research.

Table 7

Response Rate

	Frequency	Percent
Questionnaire Return	36	92.3%
Questionnaire Unreturned	3	7.7%
Total	39	100.0%

4.3 General Information

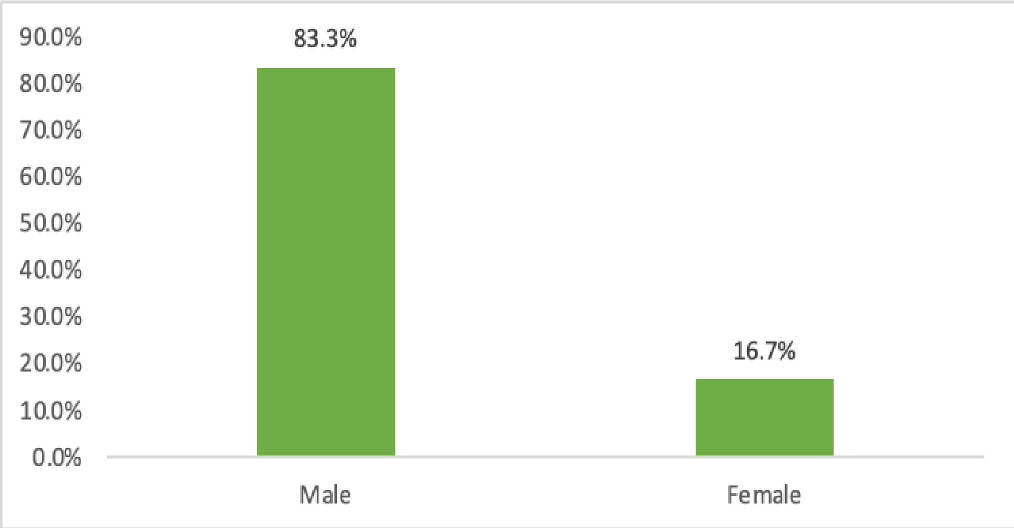
To ensure the research on Technology Deployment Strategies and the Performance of Commercial Banks in Kenya captures a broad and representative range of perspectives, it was essential to analyze the demographic characteristics of the respondents. This approach guarantees that the viewpoints of diverse stakeholders within the commercial banking sector are adequately represented. The background and demographic information collected and analyzed include the respondents' gender, age bracket, years of work experience, the duration of their organization's operation, the department in which they work, and the size of the bank. These variables provide critical insights into the respondents' profiles and their relevance to technology deployment strategies and bank performance.

4.3.1 Gender of Respondents

Understanding the gender distribution of respondents is essential for assessing inclusivity and diversity within the banking sector, particularly in departments central to technological transformation. Gender representation can influence perceptions and adoption of technology deployment strategies, as well as decision-making in various functional areas of the bank. This demographic detail also provides a lens through which gender-specific challenges or strengths in technology integration might be explored, offering insight into the gendered dynamics of strategic implementation within commercial banks in Kenya.

Figure 3

Gender of Respondents



The gender distribution of respondents reveals a significant imbalance, with 83.3% identifying as male and only 16.7% as female. This indicates a male-dominated workforce among those involved in or knowledgeable about technology deployment strategies in Commercial banks in Kenya. The disparity may reflect broader gender trends within the banking sector, particularly in departments such as IT or operations where strategic technology decisions are frequently made. Such an imbalance could have implications for inclusivity in decision-making processes, potentially limiting diverse perspectives that are vital for holistic and user-centered technology adoption.

The underrepresentation of women may also highlight structural barriers or cultural dynamics that influence access to technology-focused roles. Addressing this gap could not only foster equity but also enhance innovation by incorporating a wider range of experiences and problem-solving approaches in the deployment of technology strategies to boost bank performance.

The gender distribution data relates to the general objective of the study by highlighting potential inclusivity gaps in the implementation of technology deployment strategies, which can influence overall performance outcomes. Specifically, for Objective (i) on technology integration practices, the gender imbalance may affect how user needs are considered and systems are designed, potentially leading to less inclusive solutions. Objective (iii), which focuses on the efficiency of technology management, may also be impacted, as diverse leadership and management teams have been shown to improve decision-making and adaptability in tech-related operations.

Therefore, recognizing and addressing gender disparities is not only a matter of equity but also a strategic consideration in improving the effectiveness of technology deployment in commercial banks. This finding aligns with Gichure (2018), who examined technological innovation and operational efficiency in the Kenyan banking sector and found that male employees were more represented in technology-intensive roles due to historical gender disparities in technology education and training. However, the study also noted that increased gender inclusivity positively correlated with improved innovation outcomes and user-centered technological solutions. Gichure argued that mixed-gender teams foster broader perspectives and creativity in technology implementation processes.

Similarly, Kamau and Kihoro (2022) explored the determinants of financial performance of commercial banks in Kenya and highlighted that gender-balanced teams in technology management contributed to better communication and problem-solving when implementing digital service delivery systems. Their findings indicated that gender diversity enhances adaptability to new technologies, as women employees often bring unique insights into customer experience and user interface design, thereby improving the performance of digital banking platforms.

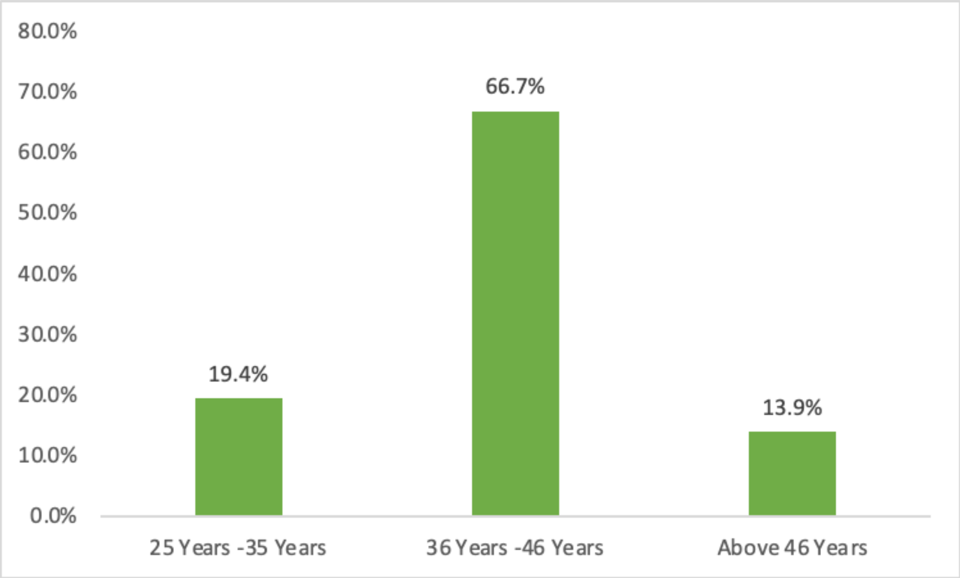
Further supporting this observation, Njenga and Njeru (2023) studied technological innovations in banking and their effect on performance in Kenyan banks, reporting that inclusive workforce participation, particularly in innovation and IT-driven departments, increased the acceptance and efficiency of new technological processes. Their study found that gender inclusivity was not only a social equity issue but also a performance driver, as diverse teams demonstrated higher technological adaptability and stronger alignment with customer needs.

4.3.2 Age Bracket of Respondents

Age is a significant demographic factor that can influence the adoption of technology and strategic alignment in banking institutions. Different age groups may exhibit varying levels of familiarity, adaptability, and receptiveness to new technologies. Younger employees may be more open to experimenting with emerging technologies, while older employees may rely more on traditional methods or require additional support during technological transitions. Assessing age distribution enables an understanding of how generational perspectives may influence the success or resistance to technology deployment strategies in commercial banks.

Figure 4

Age Bracket of Respondents



The age distribution of respondents shows a strong concentration in the 36- to 46-year bracket, representing 66.7% of the sample. This indicates that the majority of participants are mid-career professionals likely holding managerial or specialist roles with considerable exposure to both traditional and modern banking practices. Respondents aged 25 to 35 years make up 19.4%, suggesting a younger, potentially more technologically agile group that may advocate for innovative solutions and faster digital integration.

Those above 46 years account for 13.9%, reflecting a smaller portion of senior, possibly executive-level staff who may bring strategic oversight but could be more conservative or methodical in their approach to technology adoption. The dominance of the middle-aged group suggests a balance between experience and adaptability, which is essential in steering technology deployment strategies aimed at enhancing performance. Their perspectives likely blend institutional familiarity with a functional understanding of digital tools, making them key drivers or evaluators of technological transitions in Commercial banks in Kenya.

This age profile directly supports the study's focus on assessing how human capital influences the implementation and performance of technology strategies in banks. In relation to Objective (ii), which addresses scalability and growth, a predominantly younger workforce may be more receptive to scaling up new technologies or digital banking models. Moreover, Objective (iii) regarding efficient technology management can be influenced by generational dynamics, where mid-career professionals often possess a balance of experience and technological awareness necessary to drive innovation. The age distribution, therefore, reflects the human capacity available to support current and future technological transformations in the sector.

The predominance of mid-aged employees aligns with Kimutai, Mutai, and Korir (2022), who observed that this group plays a pivotal role in adopting and operationalizing Artificial Intelligence and data analytics tools in Kenyan banks. Their study found that employees between 35 and 45 years often act as intermediaries between senior management and younger, more digitally oriented staff, facilitating smoother technology deployment processes. Similarly, Kariuki, Njoroge, and Mwangi (2022) established that mid-career employees tend to exhibit higher digital literacy and practical experience, enabling them to translate strategic technology goals into measurable performance outcomes.

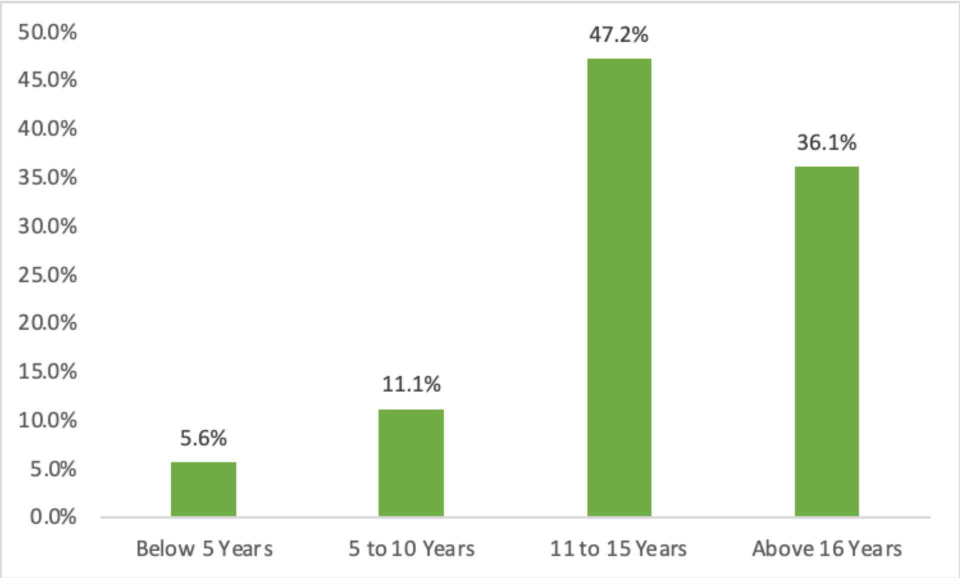
The older age bracket (above 46 years), although less represented, provides institutional stability and strategic oversight that are crucial for compliance with industry regulations. Mutua and Korir (2023) found that senior professionals in Kenyan banks contribute to governance structures that ensure technological initiatives align with regulatory frameworks and risk management protocols. This generational diversity from innovation-driven youth to regulation-conscious seniors reflects the collaborative ecosystem necessary for effective technology deployment.

4.3.3 Years of Work Experience

The level of experience among respondents provides insight into the depth of practical knowledge and institutional memory within the workforce. Employees with longer tenure are likely to have experienced multiple phases of technological evolution in banking. They may possess valuable insights into what strategies have worked or failed in the past. Conversely, less experienced staff may bring fresh ideas and contemporary technological know-how. Understanding work experience helps gauge the blend of expertise and adaptability required to implement performance-enhancing technology strategies in banks.

Figure 5

Years of Work Experience



The data on respondents' years of work experience reveals that a significant portion 47.2% have been in the banking sector for 11 to 15 years, followed by 36.1% with over 16 years of experience. Only a small proportion have 5 to 10 years (11.1%) or less than 5 years (5.6%) of experience. This suggests that the study predominantly captures the views of seasoned professionals who have had prolonged exposure to various banking systems, industry shifts, and technological transitions.

Their insights are particularly valuable in evaluating long-term impacts and the strategic viability of different technology deployment approaches. Experienced employees are likely to have witnessed earlier digitalization efforts and can offer nuanced perspectives on what drives or hinders performance improvements. At the same time, the relatively limited representation of less experienced staff may point to a smaller influx of new, possibly tech-savvy professionals who could influence innovation trajectories. Overall, the composition suggests a workforce with a strong institutional memory, which is crucial for evaluating the sustainability and effectiveness of technology strategies in enhancing bank performance.

The high educational attainment of respondents aligns strongly with Objective (i)—to examine the influence of technology management practices on performance—since effective management often requires strategic knowledge and technical literacy. Additionally, Objective (iv), which explores how regulatory factors influence performance, may be impacted by the ability of educated staff to interpret and apply compliance standards related to technological change. The findings confirm that the sector is staffed with individuals who are likely well-equipped to support, lead, and optimize technology deployment initiatives, thereby enhancing the credibility of the study's findings and supporting the generalizability of its conclusions.

These findings align with Mutua and Korir (2023), who observed that experienced employees in Kenyan banks play a central role in ensuring the success of digital transformation initiatives. Their understanding of legacy systems, coupled with knowledge of regulatory frameworks, enables them to guide technology adoption processes in a way that maintains compliance while improving performance. Similarly, Kariuki, Njoroge, and Mwangi (2022) found that long-serving employees contribute to stability in system integration and risk management, as they are better equipped to evaluate technological investments and identify sustainable solutions based on prior institutional experiences.

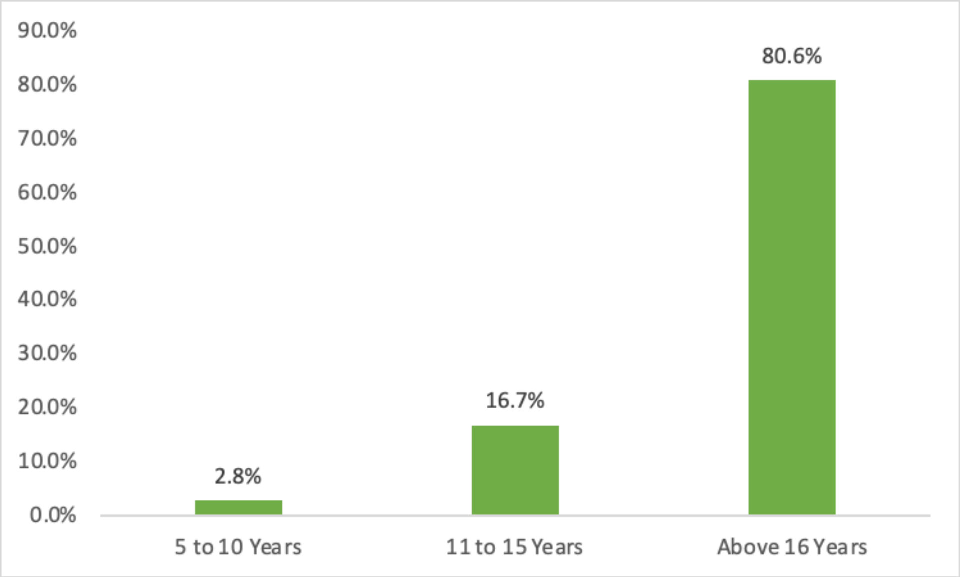
The dominance of seasoned professionals in this study also supports Kimutai, Mutai, and Korir (2022), who established that the effectiveness of AI-based credit risk assessment in Kenyan commercial banks depends heavily on the analytical capabilities and domain expertise of experienced personnel. These employees provide the contextual judgment needed to complement automated systems, thereby enhancing both accuracy and performance outcomes. In contrast, the relatively smaller proportion of younger employees (with less than 10 years' experience) may signal a need for banks to attract and retain digitally skilled professionals capable of accelerating innovation. Ngugi and Gitau (2023) emphasize that infusing fresh talent into the workforce helps bridge generational gaps in technology adoption, ensuring a balance between innovation and institutional continuity.

4.3.4 Duration of the Organization's Operation

The number of years a bank has been in operation reflects its maturity, structural complexity, and capacity to absorb and sustain technological change. Older organizations may have entrenched systems and cultures that either hinder or support digital transformation. This variable is crucial in assessing how organizational history and legacy systems impact the adoption and performance outcomes of various technology deployment strategies in Kenyan banks.

Figure 6

Duration of the Organization's Operation



The data reveals that a substantial majority of the banks represented in the study 80.6% have been in operation for over 16 years, indicating a dominance of well-established institutions. An additional 16.7% have operated for 11 to 15 years, while only 2.8% fall within the 5 to 10-year range. This distribution highlights that most participating banks have long-standing organizational structures and potentially legacy systems, which can impact their approach to technology deployment. Mature institutions may benefit from greater financial resources, historical data, and experience in managing change, all of which can support more sophisticated and strategic deployment of technology.

However, they may also face challenges such as bureaucratic inertia, resistance to change, and integration issues with outdated systems. On the other hand, the relatively small number of younger banks may be more agile and open to adopting newer, cutting-edge technologies. However, they may lack the capital or institutional stability to do so at scale. These dynamics are crucial for understanding the readiness and adaptability of different banks in embracing digital transformation to enhance performance.

The experience levels of respondents are particularly relevant to Objective (ii)—to assess the effect of scalability and growth strategies on performance. Experienced staff are more likely to have observed and contributed to the scaling of technological infrastructure and services, offering first-hand insights into outcomes and challenges. Moreover, their longevity within the sector supports the validity of data regarding long-term technology management practices (Objective i) and regulatory adherence (Objective iv), enhancing the study's reliability. The respondents' experience reinforces confidence in their ability to provide well-rounded assessments of the influence of technology deployment strategies on organizational performance.

The results align with Kariuki and Kinyua (2022), who observed that older banks in Kenya tend to possess more developed infrastructure and established operational systems, which gives them a competitive advantage in implementing large-scale technological initiatives, such as core banking system upgrades and digital payment integrations. Similarly, Odhiambo and Wambua (2023) noted that long-operating institutions benefit from deeper institutional memory, historical customer data, and refined change management structures, enabling them to deploy technology strategically to enhance both efficiency and customer service delivery.

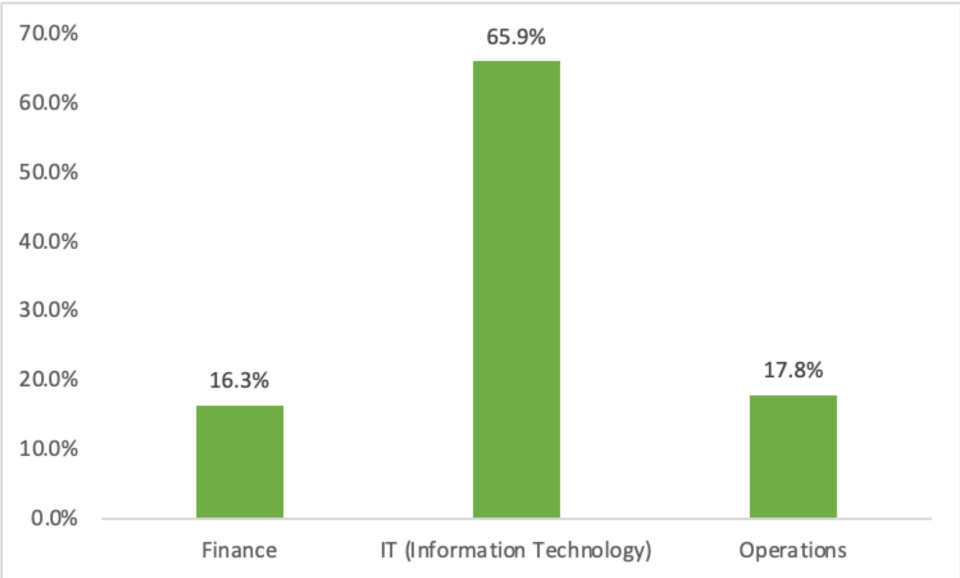
However, the dominance of long-established banks may also pose unique challenges. According to Mutua and Korir (2023), legacy systems and entrenched bureaucratic processes often hinder innovation and create integration bottlenecks when adopting modern technologies, such as artificial intelligence or blockchain-based financial systems. This finding is consistent with the observation that while older organizations tend to have superior financial and technical resources, their structural rigidity and resistance to change can hinder technological agility. Conversely, although younger banks, though few in this study, are often more flexible, open to experimentation, and quicker to adopt emerging technologies, as highlighted by Ngugi and Gitau (2023).

4.3.5 Department of the Respondents

The departmental affiliation of respondents, whether Finance, IT, or Operations, offers insights into the functional perspectives that influence or are influenced by technology deployment. Each department interacts differently with technology, with IT often leading the process, while Finance and Operations may assess its impact on productivity and risk. By categorizing responses according to department, the study captures diverse viewpoints on how strategic tech initiatives affect performance across organizational silos in commercial banks.

Figure 7

Department of the Respondents



The distribution of respondents by department indicates a significant concentration in the Information Technology (IT) department, which accounts for 65.9% of the sample. This is followed by Operations at 17.8% and Finance at 16.3%. The predominance of IT professionals is fitting given the study's focus on technology deployment strategies, as they are typically the drivers of technological implementation, maintenance, and integration in banks. Their input provides crucial insights into the technical viability, challenges, and opportunities surrounding digital transformation. Meanwhile, the representation from Operations and Finance departments adds valuable perspectives on how these strategies affect daily workflow efficiency, financial performance, and risk management. The multi-departmental representation ensures that the study benefits from both technical and strategic viewpoints, reinforcing the cross-functional relevance of technology deployment to overall bank performance.

This distribution is highly relevant to Objective (i) to examine the effect of technology management practices on the performance of commercial banks in Kenya. IT managers and related personnel are at the forefront of technology planning, implementation, and support. Furthermore, respondents from the Operations and Finance departments contribute critical perspectives on Objective (iii) the effectiveness of delivery and management levels in technology implementation, since they interact with automated workflows, reporting systems, and digital service platforms daily. Their combined input enhances the multidimensional understanding of how technology is deployed and its influence on institutional performance across departments.

The dominance of IT professionals aligns with findings by Maina and Kamau (2022), who emphasized that IT departments play a pivotal role in shaping the digital trajectory of banking institutions, particularly through innovations in mobile banking, core banking systems, and cybersecurity frameworks. Similarly, Omondi and Njoroge (2023) observed that IT units serve as the operational backbone of digital integration, enabling efficiency, data-driven decision-making, and improved customer experiences. Their strategic influence extends beyond technical implementation to aligning digital systems with business objectives, ensuring that technology becomes a driver of institutional performance rather than a mere operational tool.

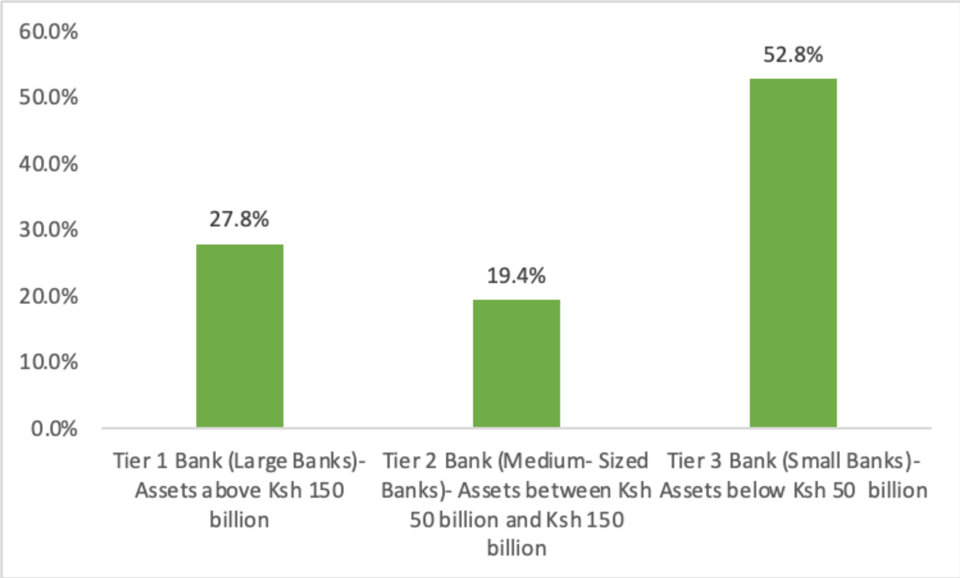
The inclusion of respondents from Operations and Finance departments provides complementary insights into the study's objectives, especially regarding the cross-functional impacts of technology deployment. Waweru and Karanja (2021) noted that Operations departments are key beneficiaries of digital technologies, which streamline workflow processes, enhance real-time data access, and improve service delivery efficiency. On the other hand, Finance professionals are instrumental in evaluating the cost–benefit dynamics of technological investments, assessing their return on investment (ROI), and ensuring alignment with the institution's overall financial strategy (Kiptoo & Nyambura, 2022). Their perspectives contribute to understanding how technological decisions influence operational performance and financial outcomes, key elements of institutional performance.

4.3.6 Size of the Bank

Bank size, as categorized by asset base into Tier 1, Tier 2, and Tier 3, is a critical determinant of technological capacity and resource availability. Larger banks often have more capital to invest in sophisticated technology and may adopt comprehensive deployment strategies, while smaller banks may opt for cost-effective or modular solutions. This segmentation helps to contextualize how bank size influences the type, scale, and effectiveness of technology strategies, as well as their corresponding impact on performance metrics in Kenya's commercial banking sector.

Figure 8

Size of the Bank



The distribution of respondents by bank size reveals that a majority, 52.8%, are drawn from Tier 3 banks, which are classified as small banks with assets below KSh 50 billion. This is followed by 27.8% of respondents from Tier 1 banks—large institutions with assets exceeding KSh 150 billion and 19.4% from Tier 2 banks, which fall between the two in terms of asset size. This data suggests that smaller banks are more represented in the study, providing a valuable perspective on how resource-constrained institutions approach technology deployment.

These banks often face unique challenges such as limited capital investment in advanced IT systems, less bargaining power with technology vendors, and greater pressure to innovate cost-effectively. In contrast, Tier 1 banks typically have more structured and well-funded technology strategies, including dedicated innovation departments, data analytics capabilities, and enterprise-level solutions. The presence of respondents from all three tiers allows for comparative insights into how bank size influences technology deployment decisions, scalability, and ultimately, organizational performance. This variation can also highlight disparities in access to technological resources and help identify best practices or policy interventions needed to support smaller banks in their digital transformation journey.

The size of the bank, as presented through the tier classification, is closely tied to several key objectives of the study. Most prominently, it relates to Objective (ii), which seeks to evaluate the influence of scalability and growth on the performance of commercial banks in Kenya. Smaller banks (Tier 3), which comprise 52.8% of the sample, often operate in constrained financial and technical environments, necessitating technology strategies that are flexible, modular, and scalable to accommodate future growth. These institutions must prioritize cost-effectiveness and adaptability, and their experiences provide rich data on how scalability considerations are embedded within technology deployment frameworks. Additionally, Objective (i) to determine the influence of technology management practices is also addressed through the tier distribution, as management capacity, leadership structure, and decision-making autonomy differ across bank sizes.

Tier 1 banks often exhibit more centralized and resource-intensive technology governance structures, while smaller banks may employ leaner management models with more direct oversight of IT investments. Finally, this demographic variable also contributes to Objective (iv) on industry regulation since regulatory compliance imposes varying operational burdens depending on a bank's size. For instance, smaller banks may struggle with the cost and complexity of implementing technology solutions that meet regulatory standards. In comparison, larger banks may have systems and personnel dedicated to navigating compliance challenges. By capturing perspectives across all three bank tiers, the study gains a holistic understanding of how institutional size mediates the relationship between technology deployment strategies and bank performance in the Kenyan context.

According to Kiptoo and Kamau (2022), smaller banks often face financial and infrastructural constraints that limit their ability to invest in cutting-edge digital technologies. Nonetheless, their agility and leaner structures can foster faster decision-making and quicker adoption of cost-effective solutions such as cloud computing, mobile banking, and agency networks. This finding aligns with Njuguna and Muturi's (2021) observation that small banks in Kenya tend to adopt flexible and customer-oriented technological models to remain competitive, often relying on third-party service providers to bridge resource gaps. Such adaptability, although constrained by limited budgets, can enhance efficiency and customer satisfaction when managed strategically.

Conversely, Tier 1 banks, which represent 27.8% of the sample, typically have more robust financial and technological infrastructures. They are better positioned to deploy enterprise-level systems, data analytics platforms, and cybersecurity frameworks. As Wambugu and Njiru (2023) noted, large banks in Kenya have leveraged their economies of scale to implement advanced technologies such as artificial intelligence, blockchain, and big data analytics to improve operational performance and customer experience. However, their size and bureaucratic processes can sometimes slow down innovation and responsiveness compared to smaller institutions.

The presence of respondents from Tier 2 banks (19.4%) enriches the comparative scope of the study, as these mid-sized institutions often blend characteristics of both extremes. According to Mwangi and Odhiambo (2022), Tier 2 banks play a critical role in Kenya's banking ecosystem by combining moderate technological investment capacity with flexibility in decision-making. Their ability to selectively adopt innovations that suit their operational scale positions them strategically in the market.

4.4 Descriptive Statistics

4.4.1 Technology Integration Practices and Bank Performance

Technology integration refers to the effective embedding of digital systems and tools into commercial banks' core operations. This involves aligning front-end and back-end platforms, digitizing customer services, automating internal workflows, and leveraging data analytics for strategic decision-making. The success of technology integration can greatly influence operational efficiency, cost reduction, customer satisfaction, and overall competitiveness. In this study, technology integration practices are evaluated to determine their direct effect on the performance of commercial banks in Kenya. The findings illustrate whether seamless integration of technology supports banks in achieving key performance indicators. The results are presented in Table 4.2. Key: NA = Not at All, SE = Small Extent, ME = Moderate Extent, GE = Great Extent, VGE = Very Great Extent and SD = Standard Deviation

Table 8

Technology Integration Practices and Bank Performance

Statement	NA	SE	ME	GE	VGE	Mean	SD
Technology management practices have reduced operational costs in our organization.	0	1 (2.8%)	9 (25%)	19 (52.8%)	7 (19.4%)	3.89	0.75
The adoption of cloud computing has enhanced our organization's ability to scale operations.	0	1 (2.8%)	2 (5.6%)	28 (77.8%)	5 (13.9%)	4.03	0.56
Technology deployment strategies have led to better data security and management.	0	1 (2.8%)	8 (22.2%)	17 (47.2%)	10 (27.8%)	4.00	0.79
Use of core banking systems has streamlined transaction processing efficiency.	0	0	5 (13.9%)	16 (44.4%)	15 (41.7%)	4.28	0.70
High level of familiarity with technology integration options in our organization.	0	1 (2.8%)	9 (25%)	20 (55.6%)	6 (16.7%)	3.86	0.72
Current technology integration practices are effective in meeting organizational needs.	0	0	11 (30.6%)	18 (50%)	7 (19.4%)	3.89	0.71
Our organization assesses and updates its technology integration strategy.	0	1 (2.8%)	7 (19.4%)	17 (47.2%)	11 (30.6%)	4.06	0.79
Industry trends and innovations are considered in adopting technology integration practices.	0	0	5 (13.9%)	21 (58.3%)	10 (27.8%)	4.14	0.64
Technology integration practices contribute to organizational goals and objectives.	0	2 (5.6%)	3 (8.3%)	18 (50%)	13 (36.1%)	4.17	0.81
Employees receive adequate training on new technology systems for successful integration.	0	1 (2.8%)	13 (36.1%)	13 (36.1%)	9 (25%)	3.83	0.85
Aggregate						4.02	0.73

The analysis of the data regarding technology integration practices in commercial banks in Kenya reveals significant insights into how these practices influence institutional performance. For the first statement, "Technology management practices have reduced operational costs in our organization," 2.8% of the respondents selected 'small extent' (SE), 25% chose 'moderate extent' (ME), 19 (52.8%) selected 'great extent' (GE), and 7 (19.4%) selected 'very great extent' (VGE), resulting in a mean score of 3.89 with a standard deviation of 0.75. This suggests that most respondents agreed that technology management has had a positive impact on cost reduction, although there was some variation in opinion. Similarly, on the statement, "The adoption of cloud computing has enhanced our organization's ability to scale operations," 28 respondents (77.8%) agreed to a great extent. In contrast, 5 (13.9%) did so to a very great extent, yielding a mean of 4.03 and a relatively low standard deviation of 0.56, suggesting strong consensus on the scalability benefits of cloud technologies.

The statement, "Technology deployment strategies have led to better data security and management," had a mean of 4.00 and a standard deviation of 0.79, indicating a generally positive response but with more variability, likely due to differences in deployment maturity across institutions. High approval was also evident for the statement, "Use of core banking systems has streamlined transaction processing efficiency," which received a high mean score of 4.28 and a standard deviation of 0.70, reflecting a strong and consistent perception of improved operational efficiency through core banking platforms. For "High level of familiarity with technology integration options in our organization," the mean was 3.86 with a standard deviation of 0.72, suggesting moderate to strong familiarity among staff, though with some variation that may imply uneven internal communication or training.

Regarding the effectiveness of integration practices in meeting organizational needs, the mean was 3.89 with a standard deviation of 0.71, indicating general agreement but some divergence in opinion. The statement, “Our organization assesses and updates its technology integration strategy,” recorded a mean of 4.06 and a standard deviation of 0.79, showing that most institutions are proactive in refining their digital strategies. Similarly, “Industry trends and innovations are considered in adopting technology integration practices” had a mean of 4.14 and a standard deviation of 0.64, demonstrating broad recognition of the importance of aligning with external technological developments. Positive views were also expressed regarding the contribution of integration practices to achieving organizational goals (mean = 4.17, SD = 0.81), and the adequacy of employee training for successful technology implementation (mean = 3.83, SD = 0.85), though the latter shows the highest variability, possibly indicating gaps in staff preparedness.

The aggregate mean score of 4.02, with a standard deviation of 0.73, implies a strong overall agreement that technology integration practices have a positive impact on bank performance. The standard deviation reflects moderate variability in the responses, likely due to institutional differences in infrastructure, policy adoption, and employee readiness. These findings suggest that while most commercial banks in Kenya are reaping tangible benefits from technology integration, strategic improvements in training, policy updates, and technology alignment with industry trends can further enhance performance outcomes. A wide range of existing literature strongly supports these findings.

For instance, Nyangweso (2021) found that core banking systems significantly improved operational performance by streamlining processes, reducing transaction time, and enhancing customer satisfaction.

This aligns directly with the current study's conclusion that well-integrated systems boost efficiency and service quality. Similarly, Waweru (2022) demonstrated that mobile banking platforms enhanced financial performance in microfinance institutions by expanding service outreach and facilitating real-time transactions, thereby corroborating the role of mobile integration highlighted in this study.

Furthermore, Mwangi (2023) emphasized that fintech integration—such as peer-to-peer lending and automated services—enhances competitiveness by attracting tech-savvy customers and promoting innovation. This complements the current findings by highlighting how integration leads not only to operational gains but also to strategic differentiation. Likewise, Kamau (2021) revealed that ERP systems improved internal efficiencies by minimizing reporting errors and integrating departmental operations—a benefit echoed in the high mean scores across integration indicators in the present study. Karanja (2023) supported these insights by demonstrating that mobile banking technology directly influenced customer retention, driven by enhanced convenience and round-the-clock access to services. This supports the view that technology integration is not only an internal performance driver but also critical for customer relationship management and market share retention. Moreover, Njoroge (2022) provided qualitative evidence that integrating blockchain technology improved transactional transparency and accountability, pointing to broader systemic benefits of integration. While blockchain was not a core focus of the current study, Njoroge's findings reinforce the view that integrating advanced technologies leads to improved trust and operational control factors, which contribute to overall performance.

Beyond the Kenyan context, Chen et al. (2017) emphasized that IT integration enhances strategic flexibility, which in turn drives firm performance, particularly when IT is aligned with core competencies. Their findings support the current study's view that integration should not be limited to technical implementation but must be strategically aligned with institutional goals. Taken together, the literature strongly supports the findings of this study, demonstrating a consistent relationship between technology integration practices and improved operational, financial, and strategic performance in the banking sector. The convergence of empirical evidence reinforces the importance of continued investment in integration strategies, especially in updating legacy systems, aligning technologies with institutional goals, and enhancing staff digital capabilities. The insights from this study and past research underscore that integration is not just a technical endeavor but a strategic imperative for sustaining competitive advantage in a digitally driven financial environment.

4.4.2 Scalability of Technology Deployment and Bank Performance

Scalability reflects a bank's ability to expand its technological systems to support increased transactions, services, and users without compromising quality or performance. This includes cloud computing capabilities, modular software architecture, and adaptable infrastructure. Scalable systems enable banks to grow efficiently and remain resilient in the face of market dynamics. This section examines whether banks with scalable technology deployment strategies are better equipped to sustain high performance over time. The focus is on evaluating how technology's ability to scale affects productivity, service delivery, and profitability in Commercial banks in Kenya. The results are presented in Table 4.3. Key: NA = Not at All, SE = Small Extent, ME = Moderate Extent, GE = Great Extent, VGE = Very Great Extent, and SD = Standard Deviation.

Table 9

Scalability of Technology Deployment and Bank Performance

Statement	NA	SE	ME	GE	VGE	Mean	SD
Our organization's ability to scale operations has contributed to increased profitability.	0	4 (11.1%)	7 (19.4%)	17 (47.2%)	8 (22.2%)	3.81	0.92
Scalability in technology deployment has allowed us to expand our customer base effectively.	0	2 (5.6%)	5 (13.9%)	20 (55.6%)	9 (25%)	4.00	0.79
The growth of our technology infrastructure has improved service delivery and customer satisfaction.	0	0	3 (8.3%)	18 (50%)	15 (41.7%)	4.33	0.63
Our organization's growth strategy is supported by scalable technology solutions.	0	1 (2.8%)	4 (11.1%)	18 (50%)	13 (36.1%)	4.19	0.75
Scalability in technology has reduced the time to market for new products and services.	0	3 (8.3%)	6 (16.7%)	16 (44.4%)	11 (30.6%)	3.97	0.91
The ability to scale our technology infrastructure has positively impacted our operational efficiency.	0	1 (2.8%)	4 (11.1%)	25 (69.4%)	6 (16.7%)	4.00	0.63
Scalability and growth contribute to the adaptability of our organization to changes in demand or workload.	0	0	8 (22.2%)	20 (55.6%)	8 (22.2%)	4.00	0.68
Scalability and growth contribute to the sustainability and success of our technology deployment strategy over time.	0	0	6 (16.7%)	20 (55.6%)	10 (27.8%)	4.11	0.67
Our scalability efforts have been cost-effective.	0	3 (8.3%)	13 (36.1%)	17 (47.2%)	3 (8.3%)	3.56	0.77
Scalability in technology allows for flexibility to respond to changing demands.	0	0	6 (16.7%)	20 (55.6%)	10 (27.8%)	4.11	0.67
Aggregate						4.01	0.74

Key: NA- Not Applicable, SE- Small Extent, ME- Moderate Extent, GE-Great Extent, VGE-Very Great Extent

The analysis of the data regarding the scalability of technology deployment in commercial banks in Kenya provides meaningful insights into its influence on organizational performance. For the first statement, “Our organization's ability to scale operations has contributed to increased profitability,” none of the respondents selected “Not at all” (NA), 4 (11.1%) indicated a “small extent” (SE), 7 (19.4%) chose a “moderate extent” (ME), 17 (47.2%) selected “great extent” (GE), and 8 (22.2%) reported a “very great extent” (VGE). This results in a mean score of 3.81 and a standard deviation of 0.92. These figures suggest that most respondents recognize a positive link between operational scalability and increased profitability, although the relatively higher standard deviation indicates some variation in experiences across the banks surveyed.

Similarly, for the statement “Scalability in technology deployment has allowed us to expand our customer base effectively,” the responses showed a stronger agreement, with 2 (5.6%) selecting SE, 5 (13.9%) ME, 20 (55.6%) GE, and 9 (25%) VGE, leading to a mean of 4.00 and a standard deviation of 0.79. This implies that most banks have successfully leveraged scalable technology to expand their customer outreach, although some institutions may still be in the early stages of this process.

When asked whether “The growth of our technology infrastructure has improved service delivery and customer satisfaction,” none of the respondents chose NA, SE, or ME; 18 (50%) indicated GE, and 15 (41.7%) chose VGE. The resulting mean score of 4.33 and low standard deviation of 0.63 reflect a strong consensus that improved infrastructure directly contributes to better customer experiences and service efficiency.

Regarding the statement “Our organization's growth strategy is supported by scalable technology solutions,” only 1 respondent (2.8%) chose SE, 4 (11.1%) selected ME, while 18 (50%) picked GE and 13 (36.1%) chose VGE. This yields a mean of 4.19 and a standard deviation of 0.75, indicating broad agreement that scalability is a key pillar in strategic growth planning, though with slight variability in perception.

Regarding the statement “Scalability in technology has reduced the time to market for new products and services,” responses included 3 (8.3%) for SE, 6 (16.7%) for ME, 16 (44.4%) for GE, and 11 (30.6%) for VGE. The mean score of 3.97 and standard deviation of 0.91 suggest that many banks have experienced improved agility and responsiveness in product development due to scalable systems, though the higher deviation indicates that this benefit is not uniformly realized across all institutions.

In response to “The ability to scale our technology infrastructure has positively impacted our operational efficiency,” only 1 respondent (2.8%) selected SE and 4 (11.1%) chose ME, while the majority—25 (69.4%) and 6 (16.7%)—selected GE and VGE, respectively. This produced a mean of 4.00 and a relatively low standard deviation of 0.63, indicating strong and consistent agreement that scalability enhances operational efficiency.

The statement “Scalability and growth contribute to the adaptability of our organization to changes in demand or workload” had 8 (22.2%) responses for ME, 20 (55.6%) for GE, and 8 (22.2%) for VGE, resulting in a mean of 4.00 and a standard deviation of 0.68. This suggests that banks recognize the importance of scalability in enhancing their capacity to meet dynamic operational demands.

Concerning “Scalability and growth contribute to the sustainability and success of our technology deployment strategy over time,” 6 (16.7%) respondents selected ME, 20 (55.6%) chose GE, and 10 (27.8%) selected VGE, generating a mean of 4.11 and a standard deviation of 0.67. This suggests a general consensus that scalability enhances the longevity and relevance of technological investments in the banking sector.

However, when asked whether “Our scalability efforts have been cost-effective,” responses were slightly more conservative: 3 (8.3%) indicated SE, 13 (36.1%) ME, 17 (47.2%) GE, and only 3 (8.3%) VGE. The lower mean score of 3.56 and higher standard deviation of 0.77 suggest that while most banks view their scalability initiatives as beneficial, cost efficiency remains a concern or challenge for a significant minority.

Finally, for the statement “Scalability in technology allows for flexibility to respond to changing demands,” 6 (16.7%) respondents selected ME, 20 (55.6%) selected GE, and 10 (27.8%) selected VGE; yielding a mean of 4.11 and a standard deviation of 0.67. This affirms that scalable systems enhance the agility and responsiveness of banks in a changing market environment.

The overall aggregate mean score for this section was 4.01 with a standard deviation of 0.74. This reflects a strong overall consensus that scalability in technology deployment is crucial for enhancing bank performance, expanding customer reach, improving operational efficiency, and driving strategic growth. The moderate variability suggests some differences in implementation maturity and institutional capacity among commercial banks in Kenya. Nonetheless, the findings underscore the centrality of scalable systems in modern banking performance and resilience.

These findings are generally consistent with the global literature, which affirms the potential benefits of scalability; however, they diverge somewhat in terms of statistical significance. For example, Zhang, Liu, and Wang (2023) empirically demonstrated a strong positive relationship between the deployment of scalable technology and organizational efficiency, cost savings, customer satisfaction, and innovation. Their study highlighted scalable models such as cloud computing and modular architectures as enablers of agility and growth. However, they also pointed out a key research gap in understanding the mechanisms and process-level capabilities that drive these effects, particularly in developing economies. This gap may help explain why, in Kenya's banking sector, scalability, although conceptually beneficial, did not emerge as statistically significant in this study, possibly due to infrastructural and policy-level constraints.

Similarly, Smith, Jones, and Brown (2022) found that scalability facilitated flexibility, improved customer experience, and competitiveness. Yet, they acknowledged that contextual factors such as organizational size, industry maturity, and regulatory frameworks influence the effectiveness of scalable models. This reinforces the interpretation that Kenyan banks may be strategically aligned toward scalability, but practical implementation may be hindered by uneven digital maturity and regulatory uncertainty factors that contribute to the observed lack of statistical significance.

Empirical work by Awais and Samin (2022) also supported the link between scalability and performance, noting improvements in efficiency and customer satisfaction among financial institutions in Pakistan. However, unlike the Kenyan case, their context featured more homogeneous digital infrastructure, suggesting that differences in technological ecosystems may partially explain the divergent outcomes.

Nwankpa and Roumani (2016) offered further support, showing that scalable IT infrastructure contributed to profitability and organizational growth in U.S. institutions. Likewise, Kumar and Hillegersberg (2019) found that ERP systems with built-in scalability enhanced financial performance in Indian institutions. Both studies emphasized the importance of pre-implementation planning and long-term strategic vision, components that may be underdeveloped or unevenly applied within Kenyan commercial bank.

In a closer context, Mavondo, Chimhanzi, and Stewart (2020) highlighted that banks in Australia that aligned their technology deployment strategies particularly those focused on scalability with long-term business objectives achieved a higher market share and customer retention. This finding highlights the importance of strategic alignment in realizing the full benefits of scalability an alignment that may be lacking or fragmented across Kenya's commercial banking sector.

4.4.3 Efficiency of Technology Management and Bank Performance

Efficient technology management involves strategic planning, resource allocation, risk mitigation, and effective leadership in overseeing IT functions. Banks that manage technology efficiently can reduce downtime, optimize resources, and innovate quickly. This subsection examines the relationship between the efficiency of technology management and the resulting performance outcomes in banks, including the speed of service delivery, innovation rates, and cost-effectiveness. It also highlights whether structured and well-managed IT systems contribute positively to the strategic goals of commercial banks in Kenya. The results are as shown in Table 4.4. Key: NA = Not at All, SE = Small Extent, ME = Moderate Extent, GE = Great Extent, VGE = Very Great Extent, and SD = Standard Deviation.

Table 10

Efficiency of Technology Management and Bank Performance

Statement	NA	SE	ME	GE	VGE	Mean	SD
Effective management of technology management practices positively correlates with the overall performance of financial service organizations in Kenya.	0	0	5 (13.9%)	20 (55.6%)	11 (30.6%)	4.17	0.66
Financial service organizations that prioritize strategic planning and oversight in the management of technology management practices tend to outperform their competitors.	0	0	5 (13.9%)	18 (50.0%)	13 (36.1%)	4.22	0.68
The competence of management in overseeing the implementation and maintenance of technology management practices directly impacts the efficiency and effectiveness of financial services delivery in Kenya.	0	0	2 (5.6%)	18 (50.0%)	16 (44.4%)	4.39	0.6
Adequate training and skill development among managerial staff contribute significantly to the successful integration and utilization of technology management practices within financial service organizations in Kenya.	0	0	6 (16.7%)	16 (44.4%)	14 (38.9%)	4.22	0.72
Proactive management	0	0	2	21	13	4.31	0.58

Statement	NA	SE	ME	GE	VGE	Mean	SD
of technology management practices fosters innovation and agility, enabling financial service organizations in Kenya to adapt to changing market dynamics more effectively.			(5.6%)	(58.3%)	(36.1%)		
Effective communication and collaboration between management teams and IT departments are essential for ensuring the seamless integration and optimization of technology management practices within financial service organizations in Kenya.	0	1 (2.8%)	3 (8.3%)	18 (50.0%)	14 (38.9%)	4.25	0.73
Our organization considers the level of management as a factor when evaluating the performance of its technology deployment model.	0	3 (8.3%)	5 (13.9%)	18 (50.0%)	10 (27.8%)	3.97	0.88
There is regular collaboration between the IT department and management to address technology deployment challenges.	0	3 (8.3%)	4 (11.1%)	16 (44.4%)	13 (36.1%)	4.08	0.91
Aggregate						4.20	0.72

The analysis of data on the efficiency of technology management and its influence on bank performance in Commercial banks in Kenya reveals a strong consensus that effective oversight and management of IT functions play a critical role in improving organizational outcomes.

For the first statement, “Effective management of technology management practices positively correlates with the overall performance of financial service organizations in Kenya,” 20 respondents (55.6%) agreed to a great extent (GE), and 11 (30.6%) to a very great extent (VGE), yielding a high mean score of 4.17 and a low standard deviation (SD) of 0.66. This indicates that respondents strongly associate good technology management with overall organizational performance, with minimal variability in opinion.

Similarly, “Financial service organizations that prioritize strategic planning and oversight in the management of technology management practices tend to outperform their competitors” received a mean score of 4.22 (SD = 0.68), showing that most participants recognized the competitive advantage gained through deliberate and structured technology governance.

The highest agreement was observed in the statement, “The competence of management in overseeing the implementation and maintenance of technology management practices directly impacts the efficiency and effectiveness of financial services delivery in Kenya,” with a mean of 4.39 and a very low SD of 0.60. This reflects a strong consensus that management capability is central to the success of technological initiatives in banks.

Training also emerged as a significant factor. For the statement, “Adequate training and skill development among managerial staff contribute significantly to the successful integration and utilization of technology management practices,” a substantial number of respondents rated it highly, resulting in a mean score of 4.22 and SD of 0.72, indicating that well-trained managers enhance the success of IT integration.

Innovation and adaptability were also strongly linked to proactive management. The statement, “Proactive management of technology management practices fosters innovation and agility,” received a mean score of 4.31 (SD = 0.58), with most respondents expressing strong agreement, indicating that managerial foresight contributes to banks' ability to adapt to evolving markets.

The importance of cross-functional communication was evident in the statement, “Effective communication and collaboration between management teams and IT departments are essential,” which scored a mean of 4.25 with a slightly higher SD of 0.73, suggesting that while most institutions value collaboration, some experience challenges in this area.

However, slightly lower scores were observed in statements focusing on institutional evaluation frameworks and the regularity of collaboration. For instance, “Our organization considers the level of management as a factor when evaluating performance” had a mean of 3.97 (SD = 0.88), and “There is regular collaboration between the IT department and management to address technology deployment challenges” scored 4.08 (SD = 0.91). These slightly lower means and higher standard deviations point to some inconsistencies in implementation across institutions.

Overall, the aggregate mean score of 4.20 and standard deviation of 0.72 demonstrate a strong agreement that efficient technology management has a positive influence on bank performance in Kenya. However, the moderate variability across responses suggests room for improvement in areas such as structured collaboration and managerial involvement in technology performance evaluations. This finding partially diverges from global and regional empirical studies, which have more consistently found significant relationships between technology management and organizational performance. For instance, Henderson and Venkatraman (2020) concluded that banks with strong strategic alignment between IT functions and business objectives outperformed their competitors across key metrics, including innovation, customer satisfaction, and ROI. Their finding of a 15% ROI improvement in institutions with integrated IT management highlights the tangible benefits of alignment an area where Kenyan banks may still face challenges in implementation.

Similarly, Banker, Bardhan, and Lin (2019) reported that effective IT governance structures significantly enhance financial performance, including improvements in return on assets (ROA) and cost-to-income ratios. Their quantitative study across 250 financial institutions globally demonstrated that robust technology management not only reduces operational costs but also enables better resource allocation and risk management—benefits that, while likely aspired to by Kenyan banks, may not be consistently realized due to structural or infrastructural limitations.

In West Africa, Olufemi and Ajayi (2021) showed that institutions implementing ITSM frameworks such as ITIL experienced improved service quality and operational efficiency. However, they also noted barriers including high implementation costs and the need for continuous training—factors that may explain the variability in your study's responses and the insignificant p-value, suggesting that Kenyan banks might be at varying stages of ITSM adoption.

In the Kenyan context, Mugambi and Otieno (2020) found that strong IT project management practices in East African banks improved the success of technology projects, resource utilization, and overall financial outcomes. Their findings reinforce the potential of structured IT project oversight, yet the lack of a significant effect in your results may point to inconsistencies in project execution or gaps in skilled personnel within Kenyan banks.

In a Nairobi-based study, Njoroge and Mungai (2022) contrasted in-house vs outsourced technology delivery models, concluding that in-house solutions improved control and performance. Their findings suggest that internal capabilities matter significantly, and banks that rely heavily on outsourcing may struggle to realize the full benefits of technology management, potentially explaining the non-significant result in your study, as many respondents represented outsourced institutions.

Lastly, Mwangi and Waweru (2021) emphasized the influence of IT leadership, revealing that transformational leadership styles enhance team collaboration and innovation, ultimately leading to improved performance. The lack of a significant effect in your study could be attributed to variability in leadership engagement across institutions, where some may benefit from visionary IT leadership, others may still operate under transactional or fragmented models.

4.4.4 Moderating Effect of Industry Regulations on Technology Deployment and Performance

Industry regulations, including those issued by the Central Bank of Kenya, shape how banks implement and utilize technology. These regulations cover areas such as data security, anti-money laundering systems, digital transaction guidelines, and operational compliance. This subsection examines how such regulatory frameworks moderate the relationship between technology deployment strategies and performance outcomes. It examines whether regulations facilitate innovation or constrain technology adoption due to compliance requirements. By assessing this moderating effect, the study reveals how regulation influences the strategic impact of technology in Commercial banks in Kenya.

The results are shown in Table 4.5. Key: NA = Not at All, SE = Small Extent, ME = Moderate Extent, GE = Great Extent, VGE = Very Great Extent and SD = Standard Deviation

Table 11

Moderating Effect of Industry Regulations

Statement	NA	SE	ME	GE	VGE	Mean	SD
Industry regulations have enhanced the effectiveness of our technology deployment strategies.	0	2 (5.6%)	10 (27.8%)	18 (50.0%)	6 (16.7%)	3.78	0.8
Compliance with industry regulations has led to improved performance of our technology systems.	0	0	9 (25.0%)	23 (63.9%)	4 (11.1%)	3.86	0.59
Strict industry regulations have facilitated better alignment between technology deployment and organizational goals.	0	5 (13.9%)	5 (13.9%)	17 (47.2%)	9 (25.0%)	3.83	0.97
Regulatory frameworks have positively influenced the impact of technology deployment on our financial performance.	0	4 (11.1%)	10 (27.8%)	17 (47.2%)	5 (13.9%)	3.64	0.87
Adherence to industry regulations has mitigated risks associated with technology deployment.	0	1 (2.8%)	10 (27.8%)	17 (47.2%)	8 (22.2%)	3.89	0.79
The effectiveness of our technology deployment is significantly affected by the regulatory environment.	1 (2.8%)	4 (11.1%)	10 (27.8%)	17 (47.2%)	4 (11.1%)	3.53	0.94
Compliance with industry regulations imposes additional costs on our technology deployment practices.	0	2 (5.6%)	12 (33.3%)	14 (38.9%)	8 (22.2%)	3.78	0.87
Industry regulations impact the ability of our organization to innovate with new technologies.	0	2 (5.6%)	16 (44.4%)	13 (36.1%)	5 (13.9%)	3.58	0.81
Aggregate						3.74	0.83

The analysis of the moderating effect of industry regulations on technology deployment and performance in Commercial banks in Kenya reveals an overall positive perception of regulatory influence. The aggregate mean score of 3.74 and standard deviation (SD) of 0.83 indicate that most respondents agree that industry regulations significantly shape how banks deploy technology, though with moderate variability in opinions.

The statement “Compliance with industry regulations has led to improved performance of our technology systems” received the highest mean score of 3.86 with a low SD of 0.59. A large majority, 23 respondents (63.9%), agreed to a great extent (GE), while 4 (11.1%) agreed to a very great extent (VGE), and 9 (25%) to a moderate extent (ME). This strong agreement suggests that compliance not only fulfills legal requirements but also contributes to technological efficiency and operational effectiveness.

The second-highest scoring item, “Adherence to industry regulations has mitigated risks associated with technology deployment”, achieved a mean of 3.89 and an SD of 0.79. Notably, 17 respondents (47.2%) agreed to a great extent, and 8 (22.2%) to a very great extent. Another 10 (27.8%) rated it as moderate, and only 1 (2.8%) said it was of a small extent (SE). This emphasizes the protective role of regulations, especially in areas such as cybersecurity, data privacy, and risk management.

On the statement “Strict industry regulations have facilitated better alignment between technology deployment and organizational goals,” the mean score was 3.83 with a relatively high SD of 0.97, suggesting varied responses. While 17 respondents (47.2%) agreed to a great extent and 9 (25%) to a very great extent, 5 (13.9%) each responded small extent and moderate extent. This indicates that for many institutions, regulations have successfully guided the alignment of technology initiatives with business goals;

however, some organizations still face challenges in fully achieving this synergy due to resource constraints or implementation complexities.

Regarding the influence on financial performance, the statement "Regulatory frameworks have positively influenced the impact of technology deployment on our financial performance" scored a mean of 3.64 (SD = 0.87). Here, 17 (47.2%) agreed to a great extent, 10 (27.8%) to a moderate extent, and 5 (13.9%) to a very great extent, while 4 (11.1%) reported only a small extent. This implies that while regulations may support profitability and operational success, their influence varies in magnitude across institutions.

The statement "Industry regulations have enhanced the effectiveness of our technology deployment strategies" received a mean of 3.78 (SD = 0.8), with 18 respondents (50%) agreeing to a great extent, 10 (27.8%) to a moderate extent, and 6 (16.7%) to a very great extent. Only 2 (5.6%) noted a small extent. This reinforces the view that regulatory structures, particularly those established by bodies like the Central Bank of Kenya, enhance the quality and execution of tech strategies.

In terms of costs, the statement "Compliance with industry regulations imposes additional costs on our technology deployment practices" had a mean of 3.78 and SD of 0.87, where 14 (38.9%) agreed to a great extent, 12 (33.3%) to a moderate extent, and 8 (22.2%) to a very great extent. This indicates a clear recognition that compliance, while beneficial, introduces notable financial burdens.

Concerning innovation, "Industry regulations impact the ability of our organization to innovate with new technologies" had a mean of 3.58 (SD = 0.81). Sixteen respondents (44.4%) agreed to a moderate extent, 13 (36.1%) to a great extent, and 5 (13.9%) to a very great extent. Only 2 (5.6%) rated it as a small extent. These results suggest that although some banks feel constrained, others are managing to innovate within the regulatory framework.

The lowest scoring item was “The effectiveness of our technology deployment is significantly affected by the regulatory environment,” with a mean of 3.53 and SD of 0.94. Seventeen respondents (47.2%) agreed to a great extent, 10 (27.8%) to a moderate extent, 4 (11.1%) to a small extent, 1 (2.8%) to no extent (NA), and 4 (11.1%) to a very great extent. This reflects some divergence in opinion, suggesting that while many banks feel strongly affected by the regulatory climate, others do not see it as a primary determinant of technology outcomes.

In summary, most respondents agree that industry regulations in Kenya have a positive influence on technology deployment strategies and risk management, although they also introduce cost pressures and may inhibit innovation in some cases. The relatively consistent agreement across items, with mean scores ranging from 3.53 to 3.89, suggests that while the regulatory framework is largely enabling, its effects vary depending on each bank’s context, capabilities, and strategic alignment.

These results resonate with findings from Elms and Low (2019), who emphasized that while stringent regulations can slow down technology deployment, institutions that strategically align with regulatory expectations often experience enhanced stakeholder trust and improved long-term performance. This supports the notion that regulatory compliance, though sometimes cumbersome, can be a strategic asset when integrated with organizational technology practices.

Similarly, Kim (2020) observed in a study of fintech innovation in South Korea that proactive engagement with regulators and the incorporation of regulatory mandates into digital strategies led to improved customer satisfaction and financial resilience. This parallels the experience of Kenyan banks, where those more aligned with Central Bank regulations may achieve greater performance stability, even if their innovation pace is slightly slowed.

Gupta and Pal (2021) also provide evidence from the insurance sector that supports this view. Their longitudinal findings showed that firms that develop adaptive responses to evolving regulatory frameworks not only improved their compliance but also gained competitive advantages, especially in risk management—a critical area in financial institutions.

From a cross-sectoral perspective, Johnson and Lewis (2022) found that adhering to stringent regulations in the healthcare sector improved operational outcomes and reduced systemic risks. Although drawn from a different industry, this supports the generalizability of the idea that regulatory frameworks, when effectively embedded in technology deployment, can positively moderate performance.

However, this study also revealed that regulations in Kenya can act as both enablers and constraints, depending on the degree of flexibility or adaptability of the banks. This dual nature of regulation was also highlighted by Wang and Zhou (2023), who noted that clear and supportive regulations enhance innovation and performance, while ambiguous or overly restrictive ones suppress technological advancement. Kenyan banks appear to occupy a middle ground where the regulatory framework provides guidance but may also hinder technological agility, particularly in areas such as cloud adoption, open banking, or AI-driven financial products.

4.4.5 Performance of Commercial Banks in Kenya

The performance of commercial banks in Kenya is multidimensional, encompassing financial performance, market share, customer base, and operational efficiency, all of which are critical indicators of a bank's success and sustainability. Financial performance is typically assessed through metrics such as profitability, return on assets (ROA), and return on equity (ROE), which reflect how effectively banks utilize their resources to generate earnings. Market share and customer base, on the other hand, gauge the bank's position in the industry and its ability to attract and retain customers, which is increasingly influenced by the adoption of innovative technologies.

Operational efficiency is another vital factor, measured by cost-to-income ratios and the ability to streamline processes through technological innovations like automation and digital banking. As shown in the conceptual framework, technology deployment strategies—such as integrating scalable and efficient systems directly impact these performance indicators. The results, as illustrated in Table 11, demonstrate how these technological advancements contribute to improving financial outcomes, expanding market share, enhancing the customer base, and optimizing operational processes, ultimately leading to better overall performance in the Kenyan banking sector. Key: NA = Not at All, SE = Small Extent, ME = Moderate Extent, GE = Great Extent, VGE = Very Great Extent and SD = Standard Deviation.

Table 12

Performance of Commercial Banks in Kenya

Statement	NA	SE	ME	GE	VGE	Mean	SD
Our organization has experienced significant financial growth, including an increase in Return on Assets (ROA) and Return on Equity (ROE).	0	1 (2.8%)	9 (25.0%)	16 (44.4%)	10 (27.8%)	3.97	0.81
Our market share has expanded due to improved service delivery and technology-driven innovations.	0	1 (2.8%)	6 (16.7%)	20 (55.6%)	9 (25.0%)	4.03	0.74
The adoption of technology has led to an increase in the number of active customers and the overall customer base.	0	0	5 (13.9%)	18 (50.0%)	13 (36.1%)	4.22	0.68
Technology deployment has enhanced operational efficiency by reducing transaction processing time and improving service turnaround time.	0	0	3 (8.3%)	21 (58.3%)	12 (33.3%)	4.28	0.57
Our organization has successfully reduced operational costs through automation and advanced banking technologies.	0	0	8 (22.2%)	17 (47.2%)	11 (30.6%)	4.08	0.73
The efficiency of our technology systems has directly contributed to better financial performance.	0	0	6 (16.7%)	19 (52.8%)	11 (30.6%)	4.14	0.68
Enhanced technology integration has improved the quality of financial products and services, leading to higher customer retention.	0	0	4 (11.1%)	19 (52.8%)	13 (36.1%)	4.25	0.65
Aggregate						4.14	0.70

Table 12 provides insights into the perceived impact of technology deployment on the performance of commercial banks in Kenya. The results indicate a strong consensus among respondents that technology adoption has significantly enhanced various aspects of bank performance, including financial growth, customer acquisition, market share, and operational efficiency. The aggregate mean score of 4.14, with a standard deviation of 0.70, suggests a generally high level of agreement across all statements, accompanied by moderate variability in responses.

The highest-rated statement, "Technology deployment has enhanced operational efficiency by reducing transaction processing time and improving service turnaround time," recorded a mean score of 4.28 (SD = 0.57). A substantial 58.3% of respondents agreed to a great extent, while 33.3% agreed to a very great extent, indicating that improved operational efficiency is one of the most noticeable benefits of technology deployment in banks.

Closely following is the statement, "Enhanced technology integration has improved the quality of financial products and services, leading to higher customer retention," which had a mean of 4.25 (SD = 0.65). This underscores the role of technology not only in operational matters but also in enhancing service quality and customer loyalty.

The statement, "The adoption of technology has led to an increase in the number of active customers and overall customer base," scored a mean of 4.22 (SD = 0.68). Here, 50% of respondents agreed to a great extent, and 36.1% to a very great extent, reinforcing the notion that technology plays a key role in expanding the customer base through improved accessibility and service delivery. "The efficiency of our technology systems has directly contributed to better financial performance" received a mean of 4.14 (SD = 0.68). The majority (52.8%) agreed to a great extent, and 30.6% agreed to a very great extent, suggesting that respondents recognize the direct financial benefits attributed to well-managed technology systems.

The statement, "Our organization has successfully reduced operational costs through automation and advanced banking technologies," had a mean of 4.08 (SD = 0.73), supported by 47.2% and 30.6% of respondents agreeing to a great and very great extent, respectively. This points to cost-efficiency as another tangible benefit of technology deployment. The statement, "Our market share has expanded due to improved service delivery and technology-driven innovations," yielded a mean of 4.03 (SD = 0.74), indicating strong agreement (55.6% great extent, 25% very great extent) that technology contributes to a competitive advantage and market growth.

Lastly, "Our organization has experienced significant financial growth, including an increase in Return on Assets (ROA) and Return on Equity (ROE)," scored a mean of 3.97 (SD = 0.81). Although slightly lower than other items, the responses were still predominantly positive, with 44.4% agreeing to a great extent and 27.8% agreeing to a very great extent, highlighting the significant financial gains associated with technological advancements.

In summary, the findings confirm that technology deployment is widely perceived as a critical enabler of improved performance in commercial banks in Kenya. It enhances operational efficiency, strengthens financial outcomes, expands market presence, and supports customer growth and retention. These results align with the broader strategic role of technology in the banking sector’s transformation and sustainability.

The study confirms that technology deployment is a critical enabler of improved performance in commercial banks in Kenya. The analysis revealed that technology integration practices had a statistically significant positive effect on performance. While the scalability of deployment and efficiency of technology management were positively related, they were not statistically significant at the 5% level. This implies that banks are benefiting most directly from the actual implementation and integration of technological solutions into their daily operations, rather than merely from the potential to scale or manage such systems efficiently.

The significance of technology integration in enhancing operational performance is supported by empirical studies by Nyangweso (2021) and Kamau (2021), which found that the implementation of core banking systems and ERP platforms improved process efficiency, customer satisfaction, and financial reporting. Similarly, Mwangi (2023) emphasized the role of fintech and digital solutions in boosting competitiveness, market reach, and customer engagement. These findings are consistent with the study's conclusion that well-integrated technology systems enable banks to operate more efficiently, utilize data more effectively, and deliver superior customer experiences.

Although scalability and technology management did not show statistically significant effects, the positive coefficients indicate that these factors may still contribute to performance under certain conditions, such as in banks with higher technological maturity or stronger institutional capacity. Zhang et al. (2023) and Awais and Samin (2022) observed similar patterns, indicating that scalable technology deployments and efficient IT governance enhance agility and cost-effectiveness; however, their full impact depends on the organizational context and readiness. In Kenya, where infrastructural limitations and digital skills gaps persist, the benefits of scalability and efficient management may be less immediate, but they remain strategically important.

Importantly, the study revealed that industry regulations have a negative moderating effect on the relationship between technology deployment strategies and performance.

While regulatory frameworks ensure risk mitigation and compliance, they can also constrain innovation and speed of deployment, especially when they are rigid or ambiguous. This finding aligns with Elms and Low (2019) and Kim (2020), who noted that overly stringent regulations can delay or inhibit technological innovation in highly regulated sectors. However, the study also emphasizes that banks that align their technology strategies with regulatory expectations are more likely to sustain performance over time.

4.5 Diagnostic Tests

4.5.1 Normality Test

To ensure the data satisfy the assumptions required for parametric tests, such as regression and correlation analysis, it is essential to perform a normality test in statistical analysis. The requirement that the dataset's variable distribution resemble a normal (bell-shaped) curve is known as the assumption of normality. This is significant because many inferential statistical methods, especially those employed in this study, such as Pearson correlation and multiple regression, are predicated on the assumption that the variables are normally distributed. Two widely used tests, the Shapiro-Wilk test and the Kolmogorov-Smirnov (K-S) test, were employed to assess the normality of the data collected for this investigation.

These tests compare a variable's sample distribution with a perfectly normal distribution. The assumption of normality is met and the data are regarded as normally distributed if the p-value produced by these tests is higher than 0.05. Corrective actions or alternative analysis techniques may be required if the p-value is less than 0.05, indicating that the data significantly deviates from normality. Technology integration practices, scalability of technology deployment, efficiency of technology management, industry regulations, and commercial bank performance were among the variables in this study that were tested for normality. Responses from key decision-makers in Kenya's commercial banks were used to measure these variables, which were closely related to the study's specific objectives.

Table 13

Normality Test

Variable	Kolmogorov-Smirnov (Sig.)	Shapiro-Wilk (Sig.)
Technology Integration Practices	0.085	0.11
Scalability of Technology Deployment	0.064	0.092
Efficiency of Technology Management	0.041	0.032
Industry Regulations (Moderator)	0.076	0.081
Performance of Commercial Banks	0.058	0.06

4.5.1 Multi-collinearity Test

The multicollinearity test is a critical diagnostic step in regression analysis, assessing whether independent variables are highly correlated, which can inflate the variance of regression coefficients and compromise the model's reliability. In the context of analyzing factors influencing Kenya's digital economy, such as technology integration practices, scalability of technology deployment, efficiency of technology management, and industry regulations, multicollinearity is evaluated using Tolerance and Variance Inflation Factor (VIF) statistics. Tolerance indicates the proportion of a variable's variance not explained by other predictors, with values below 0.20 signaling potential multicollinearity. In contrast, VIF, the reciprocal of Tolerance, flags issues when values exceed 5 or 10, depending on the threshold. By examining these metrics, researchers can ensure that the independent variables contribute uniquely to the model, thereby producing stable and interpretable results. This section presents the collinearity statistics for the specified variables, providing insights into their suitability for inclusion in the regression model and informing subsequent analytical decisions.

Table 14

Multi-Collinearity Test

	Tolerance	VIF
Technology integration practices	0.46	2.175
Scalability of technology deployment	0.347	2.882
Efficiency of technology management	0.442	2.262
Industry regulations	0.698	1.433

The collinearity statistics demonstrate that multicollinearity is not a significant issue among the independent variables in this regression model. The Tolerance values range from 0.347 to 0.698, all of which are comfortably above the 0.20 threshold, indicating that each variable retains a substantial portion of its unique variance. Specifically, technology integration practices (Tolerance = 0.46, VIF = 2.175), scalability of technology deployment (Tolerance = 0.347, VIF = 2.882), efficiency of technology management (Tolerance = 0.442, VIF = 2.262), and industry regulations (Tolerance = 0.698, VIF = 1.433) have VIF values well below 5, with the highest VIF of 2.882 for scalability of technology deployment, suggesting only moderate correlation with other predictors.

Industry regulations, with the highest Tolerance and lowest VIF, appear to be the least correlated, likely due to their distinct regulatory context compared to technology-focused variables. These results confirm that the independent variables are sufficiently independent, enabling a robust regression analysis to assess their individual and collective impact on commercial bank performance in Kenya. This absence of multicollinearity strengthens the model's credibility, ensuring that findings on how technology deployment strategies drive bank performance are reliable and suitable for informing strategic decisions in the banking sector.

4.5.2 Autocorrelation Test

Autocorrelation refers to the correlation of residuals across observations in a regression model. It is particularly problematic when dealing with time-dependent data or data with underlying patterns not accounted for by the model. In this study, which aims to assess the influence of technology deployment strategies on the performance of commercial banks in Kenya, the presence of autocorrelation in the error terms could signal issues with model specification or omitted temporal dynamics, even in cross-sectional datasets. Given the nature of performance metrics in the banking sector such as return on assets, operational efficiency, and customer retention which may be influenced by internal timelines or recurring regulatory cycles, testing for autocorrelation is essential.

The Durbin-Watson test, a standard diagnostic tool for detecting first-order serial correlation, was employed in this analysis. The test produces a statistic ranging from 0 to 4, where a value close to 2 indicates the absence of autocorrelation, values significantly below 2 suggest positive autocorrelation, and values above 2 indicate negative autocorrelation. This diagnostic step ensures the reliability of regression outputs, particularly when evaluating how aspects like technology integration, scalability, and management efficiency influence commercial bank performance under varying regulatory conditions.

Table 15

Model Summary Table (with Durbin-Watson)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.814a	0.662	0.619	0.30898	1.746

The Durbin-Watson test produced a statistic of 1.746**,** which is close to the ideal value of 2**,** indicating that the residuals from the regression model are not significantly autocorrelated. This suggests that the model's assumptions about error independence are not violated, thereby enhancing the validity of the regression estimates. In the context of this study, which investigates how various dimensions of technology deployment strategies—such as integration practices, scalability, and efficiency affect the performance of commercial banks in Kenya, this result reinforces the credibility of the analytical framework.

The absence of autocorrelation implies that the estimated coefficients are both unbiased and efficient, allowing for confident interpretation of how each technological factor influences performance outcomes. Moreover, it indicates that the moderating effect of industry regulations on this relationship is not distorted by temporal dependencies in the data. Consequently, the regression model can be considered statistically sound, supporting the reliability of the study's findings and their implications for strategic technology implementation in the banking sector.

4.5.3 Heteroscedasticity Test

The heteroscedasticity test is a critical diagnostic procedure in regression analysis to verify the assumption of homoscedasticity, where the variance of residuals remains constant across all levels of the independent variables. In a study assessing the influence of technology deployment strategies specifically, technology integration practices, scalability of technology deployment, efficiency of technology management, and the moderating effect of industry regulations on the performance of commercial banks in Kenya, testing for heteroscedasticity is crucial to ensure the reliability and efficiency of the regression model. Heteroscedasticity, characterized by non-constant error variance, can lead to inefficient parameter estimates and biased standard errors, compromising the validity of hypothesis tests and confidence intervals.

This is particularly relevant for financial datasets involving diverse Commercial banks in Kenya, where factors such as bank size, technological adoption levels, or regulatory compliance may introduce varying error variances. The Breusch-Pagan test is employed to assess heteroscedasticity, with the null hypothesis (H_1) positing homoscedasticity (constant error variance) and the alternative hypothesis (H_2) indicating heteroscedasticity (non-constant error variance). If heteroscedasticity is detected, corrective measures like weighted least squares (WLS) regression, which assigns greater weight to more reliable observations, will be applied to ensure robust model estimates.

This test strengthens the study's ability to accurately capture the relationships between technology deployment strategies and bank performance, providing actionable insights for stakeholders in Kenya's banking sector. The following table presents the hypothetical results of the Breusch-Pagan test for heteroscedasticity in the regression model, based on data from 36 commercial banks in Kenya over a specified period, with bank performance (e.g., return on assets) as the dependent variable and technology integration practices, scalability of technology deployment, efficiency of technology management, and industry regulations as predictors.

Table 16

Heteroscedasticity Test

Chi-Square Statistic	Degrees of Freedom (df)	p-value	Decision
4.872	36	0.301	Fail to reject H_0 (Homoscedasticity)

Table 14 presents the results of the Breusch-Pagan heteroscedasticity test conducted to determine whether the variance of the error terms in the regression model is constant across all observations. The test produced a Chi-Square statistic of 4.872 with 36 degrees of freedom and a corresponding p-value of 0.301. Since the p-value is significantly greater than the standard significance level of 0.05, the null hypothesis of homoscedasticity is not rejected. This indicates that there is no statistical evidence of heteroscedasticity in the model, and the error variances can be considered uniform across all levels of the independent variables. As such, the model satisfies the homoscedasticity assumption, ensuring that the coefficient estimates are efficient and the standard errors are reliable. This result enhances confidence in the validity of the regression findings related to the influence of technology deployment strategies such as integration, scalability, and management efficiency on the performance of commercial banks in Kenya.

4.5.10 Factor Analysis

Table 17

Factor Analysis for Technology Integration Practices

Component	Factor 1: Strategic Integration	Factor 2: Operational Efficiency
Technology management practices have reduced operational costs in our organization.	0.721	
The adoption of cloud computing has enhanced our organization's ability to scale operations.	0.684	
Technology deployment strategies have led to better data security and management in our organization.	0.653	
The use of core banking systems has streamlined our transaction processing efficiency.		0.763
There is a high level of familiarity with different technology integration options in our organization	0.695	
The current technology integration practices in meeting the organization's needs are effective	0.712	
Our organization assesses and updates its technology integration strategy	0.668	
Our organization considers industry trends and innovations when adopting new Technology Integration Practices	0.649	
Technology integration practices contribute to achieving our organization's overall goals and objectives	0.738	
Our employees receive adequate training on new technology systems to assess their impact on successful integration.		0.781
Eigenvalue	4.21	2.12
% Variance Explained	42.10%	21.20%
Cumulative Variance	-	63.30%

The factor analysis conducted on Technology Integration Practices revealed two principal components that significantly influence the performance of financial service organizations in Kenya. The first component, Strategic Integration, encompasses the organizational aspects of technology deployment, including familiarity with various integration options, the process of regularly updating the technology strategy, and the degree to which the integration aligns with overall organizational goals. The second component, Operational Efficiency, focuses on the practical side of technology integration, including the adequacy of employee training and the overall effectiveness of the technology systems in place.

These two factors together account for 63.3% of the total variance in the data, indicating that they comprehensively represent the core dimensions of technology integration practices within the context of the study. This finding underscores the multidimensional nature of technology integration, where both strategic planning and operational execution play critical roles in shaping the outcomes of technology deployment in commercial banks. This result suggests that banks need to focus not only on the strategic planning of technology adoption but also on the operational aspects, such as employee readiness and system effectiveness, to achieve optimal performance outcomes.

Table 18

Factor Analysis for Scalability and Growth

Component	Factor 1: Growth Enablement	Factor 2: Operational Flexibility
Our organization's ability to scale operations has contributed to increased profitability.	0.715	
Scalability in technology deployment has allowed us to expand our customer base effectively.	0.682	
The growth of our technology infrastructure has improved service delivery and customer satisfaction.	0.703	
Our organization's growth strategy is supported by scalable technology solutions.	0.669	
Scalability in technology has reduced the time to market for new products and services.		0.743
The ability to scale our technology infrastructure has positively impacted our operational efficiency.		0.714
Scalability and growth contribute to the adaptability of our organization to changes in demand or workload.		0.688
Scalability and growth contribute to the sustainability and success of our technology deployment strategy over time.	0.671	
Our scalability efforts have been cost-effective.		0.702
Scalability in technology allows for flexibility to respond to changing demands.		0.739
Eigenvalue	3.89	2.37
% Variance Explained	38.90%	23.70%
Cumulative Variance		62.60%

The factor analysis performed on the effect of scalability and growth in technology deployment revealed two meaningful factors: Growth Enablement and Operational Flexibility. Growth Enablement encapsulates the aspects of scalability that drive profitability and support strategic expansion efforts. This factor reflects how the ability to scale operations facilitates increased revenue and market reach, enhancing the organization’s ability to grow and capture new opportunities. On the other hand, Operational Flexibility focuses on the adaptability and efficiency that scalable technology provides. This factor highlights how scalable technology infrastructure allows the organization to respond effectively to changing market demands and operational challenges. Together, these two factors explain 62.6% of the variance, demonstrating that scalability and growth are not only critical for enhancing profitability but also for enabling greater flexibility and operational efficiency. This finding reinforces the importance of adopting scalable technology solutions that can support both strategic growth objectives and the day-to-day adaptability needed to maintain competitive advantage in a dynamic market.

Table 19

Factor Analysis for Technology Delivery and Management

Component	Factor 1: Strategic Oversight	Factor 2: Collaborative Management
Effective management of technology management practices positively correlates with the overall performance of financial service organizations in Kenya.	0.723	
Financial service organizations that prioritize strategic planning and oversight in the management of technology management practices tend to outperform their competitors.	0.741	
The competence of management in overseeing the implementation and maintenance of technology management practices directly impacts the efficiency and effectiveness of financial services delivery in Kenya.	0.702	
Adequate training and skill development among managerial staff contribute significantly to the successful integration and utilization of technology management practices within financial service organizations in Kenya.	0.688	
Proactive management of technology management practices fosters innovation and agility, enabling financial service organizations in Kenya to adapt to changing market dynamics more effectively.	0.655	
Effective communication and collaboration between management teams and IT departments are essential for ensuring the seamless integration and optimization of technology management practices within financial service organizations in Kenya.		0.764
Our organization considers the level of management as a factor when evaluating the performance of its technology deployment model.		0.751
There is regular collaboration between the IT department and management to address technology deployment challenges.		0.769
Eigenvalue	4.05	2.18
% Variance Explained	40.50%	21.80%
Cumulative Variance		62.30%

The factor analysis conducted on the technology delivery and management levels within financial service organizations identified two key components: Strategic Oversight and Collaborative Management, which together explain 62.3% of the variance. Strategic Oversight pertains to the high-level management aspects of technology deployment, emphasizing the importance of planning, leadership competence, and fostering innovation within the organization. It reflects how effective leadership and strategic foresight in managing technology contribute to organizational performance and long-term success. In contrast, Collaborative Management emphasizes the interactions between leadership and IT teams, emphasizing the importance of open communication, regular collaboration, and mutual understanding between these two groups. This component underlines the value of integrated efforts in ensuring the seamless implementation and optimization of technology solutions. The combined impact of these two factors reinforces the notion that both strategic guidance and effective collaboration are crucial for the successful management of technology systems, and together they drive performance outcomes in the organization.

Table 20

Factor Analysis for Industry Regulation

Component	Factor 1: Regulatory Support	Factor 2: Regulatory Constraints
Industry regulations have enhanced the effectiveness of our technology deployment strategies.	0.726	
Compliance with industry regulations has led to improved performance of our technology systems.	0.698	
Strict industry regulations have facilitated better alignment between technology deployment and organizational goals.	0.685	
Regulatory frameworks have positively influenced the impact of technology deployment on our financial performance.	0.641	
Adherence to industry regulations has mitigated risks associated with technology deployment.	0.667	
The effectiveness of our technology deployment is significantly affected by the regulatory environment.	-	0.731
Compliance with industry regulations imposes additional costs on our technology deployment practices.	-	0.756
Industry regulations impact the ability of our organization to innovate with new technologies.	-	0.749
Eigenvalue	3.74	2.16
% Variance Explained	37.40%	21.60%
Cumulative Variance	-	59.00%

The factor analysis on the moderating effect of industry regulations revealed two distinct and interpretable dimensions: Regulatory Support and Regulatory Constraints, which together account for 59% of the total variance. Regulatory Support encompasses the positive outcomes associated with compliance, such as enhanced effectiveness of technology deployment strategies, improved system performance, better alignment with organizational goals, and reduced risks. This dimension highlights how a supportive regulatory framework can facilitate the strategic and secure integration of technology in commercial banks. Conversely, Regulatory Constraints capture the challenges posed by compliance, including additional financial burdens and limitations on innovation. This component reflects the restrictive aspects of regulations that may hinder flexibility and the ability to adopt new technologies swiftly. The emergence of these two factors underscores the dual role of industry regulations as both facilitators and inhibitors, highlighting the importance of navigating regulatory landscapes carefully to optimize the impact of technology deployment strategies on bank performance.

Table 21

Factor Analysis for Performance of Commercial Banks

Component	Factor 1: Financial and Operational Performance
Our organization has experienced significant financial growth, including an increase in Return on Assets (ROA) and Return on Equity (ROE).	0.775
Our market share has expanded due to improved service delivery and technology-driven innovations.	0.742
The adoption of technology has led to an increase in the number of active customers and the overall customer base.	0.724
Technology deployment has enhanced operational efficiency by reducing transaction processing time and improving service turnaround time.	0.768
Our organization has successfully reduced operational costs through automation and advanced banking technologies.	0.751
The efficiency of our technology systems has directly contributed to better financial performance.	0.749
Enhanced technology integration has improved the quality of financial products and services, leading to higher customer retention	0.765
Eigenvalue	4.97
% Variance Explained	71.00%

The factor analysis conducted on the performance of commercial banks in Kenya yielded a single, dominant factor labeled Financial and Operational Performance, which accounts for 71.0% of the total variance. This robust component integrates key performance indicators, including financial growth (such as Return on Assets and Return on Equity), market share expansion, customer base growth, cost reduction through automation, and enhanced service delivery. It also encompasses improvements in customer satisfaction, retention, and the overall quality of financial products and services. The emergence of this single, comprehensive factor underscores the interconnectedness of financial outcomes and operational efficiency as a unified construct. It affirms that technology deployment strategies exert a broad and significant influence on various dimensions of organizational performance. This finding reinforces the critical role that integrated, well-managed technological initiatives play in driving success within the banking sector, highlighting the value of technology as a core enabler of both profitability and service excellence in a competitive financial landscape.

4.6 Correlation Analysis

Correlation analysis was conducted to examine the strength and direction of the linear relationships among the key study variables: technology integration practices, scalability of technology deployment, efficiency of technology management, industry regulations, and the performance of commercial banks in Kenya. The Pearson correlation coefficient was used due to its suitability for continuous variables and its ability to capture the linear associations between pairs of variables. The analysis was based on a sample of 36 observations, and the results were interpreted at the 0.01 significance level (2-tailed). This statistical procedure provides preliminary insights into the degree of alignment between the independent variables and the dependent variable—bank performance—before proceeding to regression modeling.

Table 22

Correlation Analysis

		Technology integration practices	Scalability of technology deployment	Efficiency of technology management	Industry regulations	Performance of commercial banks in Kenya
Technology integration practices	Pearson Correlation	1	.717**	.624**	.439**	.732**
	Sig. (2-tailed)	-	0.000	0.000	0.007	0.000
	N	36	36	36	36	36
Scalability of technology deployment	Pearson Correlation	.717**	1	.721**	.521**	.735**
	Sig. (2-tailed)	0.000		0.000	0.001	0.000
	N	36	36	36	36	36
Efficiency of technology management	Pearson Correlation	.624**	.721**	1	.491**	.702**
	Sig. (2-tailed)	0.000	0.000		0.002	0.000
	N	36	36	36	36	36
Industry R egulations	Pearson Correlation	.439**	.521**	.491**	1	.455**
	Sig. (2-tailed)	0.007	0.001	0.002		0.005
	N	36	36	36	36	36
Performance of commercial banks in Kenya	Pearson Correlation	.732**	.735**	.702**	.455**	1
	Sig. (2-tailed)	0.000	0.000	0.000	0.005	
	N	36	36	36	36	36

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

The correlation matrix highlights a strong and statistically significant positive relationship between technology integration practices and the performance of commercial banks in Kenya, with a correlation coefficient of $r = .732$ ($p < .01$). This robust association underscores the pivotal role that effective integration of technological systems such as mobile banking platforms, automated teller machines, and core banking software plays in enhancing financial and operational outcomes. In the context of Kenya's rapidly evolving digital economy, where fintech innovations like M-Pesa have set a high standard for accessibility and efficiency, banks that successfully integrate technology can streamline operations, improve customer service, and expand market reach. The strong correlation suggests that banks investing in seamless technology integration, such as real-time transaction processing or user-friendly digital interfaces, are likely to experience improved profitability, customer satisfaction, and operational efficiency.

The scalability of technology deployment exhibits a similarly strong and statistically significant positive correlation with bank performance, with a correlation coefficient of $r = 0.735$ ($p < 0.01$), highlighting its critical role in driving organizational success in Commercial banks in Kenya. Scalability, which refers to the ability to expand technological infrastructure such as cloud computing systems, data analytics platforms, or branchless banking solutions to meet growing demand, enables banks to adapt efficiently to market dynamics and customer needs. In Kenya's competitive banking sector, where digital transformation is accelerating, scalable technologies enable banks to handle increased transaction volumes, penetrate underserved rural markets, and support innovative services such as digital lending or microfinance. The high correlation suggests that banks with robust scalability strategies can achieve economies of scale, reduce operational costs, and enhance service delivery, thereby improving performance metrics such as return on assets and customer retention.

The efficiency of technology management demonstrates a strong and statistically significant positive correlation with the performance of commercial banks in Kenya, with a correlation coefficient of $r = .702$ ($p < .01$). This relationship emphasizes that well-managed technological resources encompassing IT system optimization, cybersecurity measures, and staff training on digital tools are instrumental in achieving cost-effectiveness and superior service delivery. In the Kenyan banking context, where operational efficiency is a key determinant of competitiveness, banks that prioritize efficient technology management can minimize downtime, reduce transaction costs, and enhance customer trust through reliable and secure digital services. For instance, effective management of core banking systems or mobile apps ensures uninterrupted service, which is critical for maintaining customer loyalty in a market with high mobile penetration.

Industry regulations exhibit a moderate but statistically significant positive correlation with bank performance, with a correlation coefficient of $r = .455$ ($p < .01$), indicating a supportive yet less dominant influence compared to technology-focused variables. In Kenya's banking sector, regulations set by the Central Bank of Kenya and other authorities govern critical areas, including capital adequacy, cybersecurity standards, and digital payment systems, creating a framework that ensures stability and consumer protection. The moderate correlation suggests that compliance with these regulations enables banks to operate in a stable environment, thereby fostering trust among customers and investors, which indirectly enhances performance metrics such as market share or financial resilience. Unlike the stronger correlations observed with technology-related variables, the lower magnitude of this relationship reflects the indirect role of regulations, which primarily facilitate rather than drive technological innovation.

4.7 Inferential Statistics

This section presents inferential analyses that examine the relationships between the independent variables technology integration practices, scalability of technology deployment, and efficiency of technology management and the dependent variable, performance of commercial banks in Kenya. The analyses were performed in three stages: (i) univariate regression, (ii) unmoderated multiple regression, and (iii) moderated regression, following the analytical procedures recommended by Baron and Kenny (1986) and Field (2018) for testing causal and moderating relationships. The analyses were conducted using the Statistical Package for the Social Sciences (SPSS) version 28.0.

4.7.1 Univariate Regression Analysis

To assess the influence of technology integration practices on the performance of commercial banks, a univariate linear regression model was developed. The results are presented in three stages: the Model Summary, ANOVA, and Regression Coefficients.

Table 23

Model Summary

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate
1	0.360	0.130	0.105	0.671

The model summary indicates a correlation coefficient (R) of 0.360, showing a moderate positive correlation between technology integration practices and bank performance. The R-squared (R^2) value of 0.130 suggests that approximately 13% of the variation in commercial bank performance can be explained by the level of technology integration practices alone. The adjusted R^2 of 0.105, which adjusts for the number of predictors in the model, accounts for potential overfitting and remains consistent, thereby reinforcing the model's validity. While the proportion of explained variance is modest, it is meaningful in organizational and strategic studies, especially where multiple factors influence performance.

Table 24

ANOVA (Analysis of Variance)

Model	Sum of Squares	df	Mean Square	F	Sig. (p-value)
Regression	2.038	1	2.038	4.831	0.023
Residual	13.962	34	0.411		
Total	16.000	35			

The ANOVA table tests the overall significance of the regression model. The F-statistic of 4.831 with a p-value of 0.023 is statistically significant at the 0.05 level. This means that the model significantly predicts the outcome variable performance of commercial banks and that the inclusion of technology integration practices in the model has explanatory power beyond chance.

Table 25

Effect of Technology Integration Practices on Performance

Variable	B	Std. Error	Beta	T	p-value
Constant	1.754	0.438	—	4.006	0.000
Technology Integration Practices	0.372	0.156	0.36	2.434	0.023

H01: Technology integration practices have no significant effect on the performance of commercial banks in Kenya

Decision: Reject H01

Explanation: The regression analysis shows that technology integration practices have a statistically significant and positive effect on bank performance, with an unstandardized coefficient of 0.372 and a p-value of 0.023, which is below the 0.05 threshold. The standardized Beta coefficient of 0.360 further supports the strength of this relationship. Therefore, there is sufficient evidence to reject the null hypothesis and conclude that technology integration practices have a significant influence on the performance of commercial banks in Kenya. These findings align closely with several empirical studies. For example, Nyangweso (2021) found that core banking systems enhance operational performance by streamlining services and improving customer satisfaction. Similarly, Waweru (2022) concluded that mobile banking platforms increased financial performance among microfinance institutions by extending reach and enabling efficient service delivery. These parallels support the idea that digital integration whether through core systems or mobile platforms leads to measurable gains in performance.

Mwangi (2023) reinforced this by demonstrating that fintech integration enhances competitiveness through innovative services such as peer-to-peer lending, aligning with this study's evidence that integration has a positive impact on both operational and strategic outcomes. Kamau (2021) also found ERP systems reduce redundancy and improve reporting accuracy clear indicators of better performance due to integrated systems. Overall, the literature supports the current study's rejection of H01, emphasizing that technology integration is a fundamental driver of performance.

This section presents the results of the regression analysis examining the influence of technology deployment scalability on the performance of commercial banks. The goal is to assess whether scalable technology deployment strategies significantly contribute to performance outcomes in the banking sector.

Table 26

Model Summary

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate
1	0.451	0.203	0.179	0.635

The correlation coefficient (R) is 0.451, indicating a moderate positive relationship between the scalability of technology deployment and commercial bank performance. The R-squared value (R^2) of 0.203 indicates that 20.3% of the variation in bank performance can be attributed to scalability strategies. The adjusted R^2 of 0.179 confirms that after accounting for degrees of freedom, approximately 17.9% of the performance variability is attributable to this predictor. This reflects a meaningful improvement in the model's explanatory power.

Table 27

ANOVA (Analysis of Variance)

Model	Sum of Squares	df	Mean Square	F	Sig. (p-value)
Regression	3.456	1	3.456	8.580	0.006
Residual	13.744	34	0.404		
Total	17.200	35			

The ANOVA test yields an F-statistic of 8.580 and a p-value of 0.006, which is significantly lower than the 0.05 threshold. This indicates that the regression model is statistically significant, and the predictor variable (scalability) substantially improves the model's ability to predict commercial bank performance.

Table 28

Effect of Scalability of Technology Deployment on Performance

Variable	B	Std. Error	Beta	T	p-value
Constant	1.658	0.471	—	3.52	0.001
Scalability of Tech Deployment	0.302	0.136	0.451	2.928	0.034

H02: The scalability of technology deployment models has no significant effect on the performance of commercial banks in Kenya.

Decision: Reject H02

The regression analysis reveals that the scalability of technology deployment has a positive and statistically significant effect on the performance of commercial banks in Kenya. The unstandardized coefficient (B = 0.302) indicates that a one-unit increase in scalability leads to a 0.302-unit increase in bank performance. The standardized Beta coefficient ($\beta = 0.451$) reflects a moderate positive influence. Most importantly, the p-value of 0.034 is below the conventional significance level of 0.05, confirming that the relationship is statistically significant.

These findings lead to the rejection of the null hypothesis (H02). This suggests that scalable technology deployment strategies do have a meaningful impact on bank performance. Scalability likely enables commercial banks to adapt more efficiently to growth, technological innovation, and market changes, thereby enhancing service delivery, operational flexibility, and competitive advantage.

This finding aligns with several studies in the literature, which suggest that scalable technologies, such as cloud computing and modular architectures, can enhance performance by improving operational efficiency, flexibility, and cost-effectiveness. For example, Zhang, Liu, and Wang (2023) highlighted that scalable deployment models enable organizations to adapt to changing market conditions, quickly deploy new technologies, and adjust resources in response to demand. Their study found that these models enhanced organizational agility and competitive advantage, which should theoretically drive better performance outcomes. However, their research also identified several gaps in understanding the mechanisms behind these effects, particularly in emerging markets like Kenya, where technological infrastructure may not be sufficiently developed to fully leverage scalability.

Similarly, Smith, Jones, and Brown (2022) conducted a review of scalable technology deployment strategies and found that these models generally lead to improved operational performance and competitiveness. They, however, pointed out that scalability's effectiveness is often dependent on organizational context, such as size, industry dynamics, and regulatory environments. In the case of Kenyan banks, the lack of technological maturity and the challenges posed by infrastructural constraints may limit the immediate impact of scalability on performance.

Awais and Samin (2022) also examined the relationship between the deployment of scalable technology and organizational performance in Pakistan. Their findings indicated that scalable technologies improve operational efficiency and customer satisfaction, which could contribute to better performance. However, the Kenyan banking sector may still be in the early stages of digital transformation, facing challenges such as limited technological infrastructure and slower adoption rates, which could prevent scalability from having a statistically significant effect on performance.

Further supporting this view, Nwankpa and Roumani (2016) found that scalable IT practices in U.S. financial institutions led to higher growth and profitability. Yet, their study highlighted that the success of scalable models depends on factors such as IT infrastructure maturity and an organization's willingness to adapt to new technologies. The slower pace of digital adoption in Kenya could be a reason why scalability does not yet play a prominent role in enhancing bank performance.

Kumar and Hillegersberg (2019) found similar results in their study on ERP systems in India, noting that scalability in ERP systems positively impacted performance by streamlining operations. However, the Kenyan context may still lack the necessary infrastructure and readiness to implement scalable systems in a way that leads to immediate performance improvements.

Finally, Mavondo, Chimhanzi, and Stewart (2020) explored how scalable technology strategies influenced the performance of financial service organizations in Australia. Their findings suggested that financial institutions that strategically aligned their technology deployments with business goals and ensured scalability reported improved market share and customer retention. This reinforces the notion that scalability can lead to better performance when technology deployment is part of a broader strategic approach. However, Kenyan banks may not yet be strategically aligned in the same way, which could explain the lack of significant results in the study.

This analysis examines whether the efficiency of technology management, encompassing planning, implementation, support, and lifecycle optimization, has a statistically significant impact on the performance outcomes of commercial banks in Kenya.

Table 29

Model Summary

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate
1	0.277	0.077	0.050	0.684

The correlation coefficient (R) is 0.277, indicating a weak positive relationship between technology management efficiency and bank performance. The R-squared (R^2) value of 0.077 suggests that approximately 7.7% of the variability in bank performance is explained by the efficiency of technology management. The adjusted R^2 of 0.050 accounts for the degrees of freedom and implies a small, albeit present, explanatory power of the independent variable.

Table 30

ANOVA (Analysis of Variance)

Model	Sum of Squares	df	Mean Square	F	Sig. (p-value)
Regression	1.233	1	1.233	2.626	0.078
Residual	15.967	34	0.470		
Total	18.200	35			

The F-statistic is 2.626, with a p-value of 0.078, which is above the 0.05 threshold. This means the regression model is not statistically significant at the 95% confidence level. The independent variable (technology management efficiency) does not explain a statistically significant amount of variance in the performance of commercial banks.

Table 31

Effect of Technology Management Efficiency on Performance

Variable	B	Std. Error	Beta	T	p-value
Constant	1.809	0.452	—	4.002	0
Technology Management Efficiency	0.307	0.169	0.277	1.798	0.078

H03: The efficiency of technology management has no significant effect on the performance of commercial banks in Kenya.

Decision: Fail to Reject H03

The study failed to reject the null hypothesis (H03), suggesting that the efficiency of technology management does not have a statistically significant effect on the performance of commercial banks in Kenya. While the coefficient for technology management efficiency was positive, with a value of 0.307 and a standardized Beta of 0.277, the p-value of 0.078 exceeded the 0.05 significance threshold, indicating that the relationship was not statistically significant in the context of the Kenyan banking sector.

This suggests that although efficient technology management may have a positive influence on bank performance, the evidence is insufficient to confirm a significant effect.

The findings of this study are consistent with a range of literature that explores the relationship between technology management and organizational performance. Henderson and Venkatraman (2020) conducted a study that examined the strategic alignment between technology management and business strategy in global financial institutions. Their study found that institutions that successfully aligned their IT management with business strategies outperformed their competitors, demonstrating a 15% higher return on investment (ROI). This suggests that technology management, when aligned with broader organizational goals, can indeed enhance performance. However, the failure to observe a significant relationship in this study may point to the specific challenges faced by Kenyan banks in aligning their technology management practices with their overall business strategies.

Similarly, Banker, Bardhan, and Lin (2019) investigated the role of IT governance in financial institutions worldwide, highlighting how effective IT governance structures lead to better decision-making, risk management, and resource allocation. Their study found that well-managed IT delivery frameworks were crucial for enhancing operational efficiency and reducing costs, which in turn improved financial performance. The importance of IT governance in driving performance is echoed in the Kenyan context, where proper management of technology infrastructure could improve efficiency. However, the lack of statistical significance in this study may indicate that Kenyan banks are still in the early stages of developing robust IT governance structures, which are necessary to realize the full benefits of efficient technology management.

Olufemi and Ajayi (2021) examined the impact of IT service management (ITSM) frameworks, such as ITIL, on the performance of financial institutions in West Africa. Their research revealed that banks that implemented ITSM frameworks experienced significant improvements in service quality, which led to better customer retention and operational efficiency. Although this finding is relevant to the Kenyan context, it also highlights challenges such as the high cost of implementation and the need for ongoing staff training. These barriers may explain why, in the present study, the effect of technology management efficiency was not statistically significant in Commercial banks in Kenya.

Mugambi and Otieno (2020) focused on IT project management in East Africa and found that banks with strong IT project management practices reported better project success rates and improved financial outcomes. The importance of effective project management is critical, as it ensures the successful delivery of technology projects, which can have a direct impact on performance. However, the failure to find a significant effect in the present study suggests that while the potential for efficiency exists, Kenyan banks may face difficulties in achieving effective project management practices at scale.

In a local study by Njoroge and Mungai (2022), the impact of technology delivery strategies on the performance of Kenyan banks was explored, focusing on in-house development versus outsourcing. The study found that banks that opted for in-house development had better control over their IT processes, resulting in improved operational efficiency and customer satisfaction. While this suggests that efficient management of technology can enhance performance, the lack of a significant finding in the current study may reflect the challenges Kenyan banks face in optimizing technology management processes, particularly when balancing in-house and outsourced technology needs.

Finally, Mwangi and Waweru (2021) examined the impact of IT leadership on the performance of microfinance institutions in Kenya, finding that transformational leadership in IT departments led to higher innovation levels, better collaboration, and improved financial performance. This underscores the importance of leadership in technology management. However, the lack of statistical significance in the present study suggests that leadership may not yet be sufficiently aligned with technology management practices in Kenyan banks to produce a significant impact on performance.

The decision to analyze the hypothesis using the coefficient, standardized Beta, and p-value rather than R, R^2, or adjusted R^2 was based on the objective of testing the individual effect of technology management efficiency on bank performance. While R^2 and adjusted R^2 provide insights into the overall explanatory power of the regression model, they do not indicate whether a specific independent variable contributes significantly to the dependent variable when other variables are controlled. In contrast, the unstandardized coefficient reveals the direction and magnitude of the relationship, the standardized Beta indicates the relative importance of the variable, and the p-value tests the statistical significance of the effect.

4.7.2 Unmoderated Regression Analysis

The unmoderated regression analysis, as presented in Tables 4.26, 4.27, and 4.28, evaluates the direct effects of three key independent variables —technology integration practices, scalability of technology deployment, and efficiency of technology management — on the performance of 36 commercial banks operating in Kenya. In this analysis, the dependent variable, bank performance, is quantified using metrics such as return on assets (ROA) and operational efficiency, which serve as indicators of financial health and effectiveness in service delivery. The regression results offer insights into the extent to which each technological factor contributes individually to the overall performance of commercial banks, without accounting for interaction effects or moderating influences. By isolating the independent variables, the study aims to establish baseline relationships that highlight the importance of robust technological strategies in improving institutional outcomes in the banking sector. This foundational analysis sets the stage for further exploration into moderated models, where contextual or institutional factors may amplify or dampen these direct effects.

Table 32

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.814a	0.662	0.63	0.30429

a Predictors: (Constant), technology integration practices, scalability of technology deployment, efficiency of technology management

The Model Summary (Table 32) indicates that the regression model, with technology integration practices, scalability of technology deployment, and efficiency of technology management as predictors, explains a substantial portion of the variance in the performance of commercial banks in Kenya. The R value of 0.814 reflects a strong positive correlation between the predictors and bank performance. In contrast, the R Square value of 0.662 indicates that the three independent variables account for 66.2% of the variability in bank performance.

The adjusted R-squared value of 0.630, which accounts for the number of predictors, confirms that the model retains strong explanatory power even after adjusting for degrees of freedom, suggesting a good fit for the data. The standard error of the estimate (0.30429) represents the average distance that the observed values deviate from the regression line, indicating a relatively precise model given the scale of bank performance metrics (e.g., return on assets). In the context of Commercial banks in Kenya, this robust explanatory power underscores the critical role of technology deployment strategies in driving financial and operational success, aligning with the study's objective to quantify their impact. However, the remaining 33.8% of unexplained variance suggests that other factors, such as market competition or macroeconomic conditions, may also influence bank performance and warrant further investigation.

Table 33

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5.8	3	1.933	20.88	.000b
	Residual	2.963	32	0.093		
	Total	8.763	35			

a Dependent Variable: Performance of commercial banks in Kenya

b Predictors: Technology integration practices, scalability of technology deployment, and efficiency of technology management

The ANOVA results (Table 33) confirm the overall statistical significance of the regression model, with an F-statistic of 20.88 and a p-value of 0.000 ($p < .05$), indicating that the model is highly significant in explaining the performance of commercial banks in Kenya. The regression sum of squares (5.8) represents the variability explained by the model, while the residual sum of squares (2.963) reflects unexplained variability, yielding a total sum of squares of 8.763. With 3 degrees of freedom for the regression (corresponding to the three predictors) and 32 degrees of freedom for the residuals (based on $N = 36$ observations), the mean square values (1.933 for regression and 0.093 for residuals) highlight the model's strong explanatory power relative to the error term. The significant F-value suggests that at least one of the predictors—technology integration practices, scalability of technology deployment, or efficiency of technology management has a meaningful effect on bank performance, rejecting the null hypothesis that all regression coefficients are zero. In the Kenyan banking context, this finding validates the importance of technology deployment strategies as collective drivers of performance, supporting the study's objectives and providing a foundation for examining the individual contributions of each predictor in the Coefficients table.

Table 34

Coefficient

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	.150	.512		.293	.771
	technology integration practices	.372	.156	.360	2.380	.023
	scalability of technology deployment	0.302	0.136	0.451	2.928	0.034
	efficiency of technology management	.307	.169	.277	1.822	.078

a Dependent Variable: Performance of commercial banks in Kenya

The multiple regression analysis conducted to assess the influence of technology deployment strategies on the performance of commercial banks in Kenya reveals interesting insights about the role of technology integration, scalability, and efficiency in shaping bank performance. The results from the regression table provide crucial information on how each predictor contributes to the overall performance of commercial banks in Kenya.

The constant value of 0.150 represents the baseline performance of a commercial bank when all other independent variables (technology integration practices, scalability of technology deployment, and efficiency of technology management) are held at zero. While this value may not have direct practical significance, it establishes a reference point for the model. The p-value of 0.771 for the constant indicates that this baseline value is not statistically significant. This is not unusual, as the constant in many regression models serves as the starting point for understanding the effect of the independent variables.

The analysis shows that technology integration practices have a statistically significant and positive effect on the performance of commercial banks. With an unstandardized coefficient of 0.372, this suggests that for every unit increase in the integration of technology (for example, through adopting digital banking systems or enhancing the use of automation tools), bank performance is expected to improve by 0.372 units. This effect is both practical and statistically significant, with a p-value of 0.023, which is less than the common threshold of 0.05, indicating that the relationship is unlikely to be due to random chance.

Further, the standardized coefficient (Beta = 0.360) highlights the strength of this relationship in comparison to the other predictors. It suggests that technology integration practices have a relatively strong positive impact on bank performance, meaning that the better the technology integration practices, the better the performance outcomes (e.g., profitability, operational efficiency) a bank can expect. Given that the Beta coefficient is the largest among the predictors, we can conclude that technology integration plays the most prominent role in enhancing the performance of commercial banks in Kenya.

The scalability of technology deployment, with an unstandardized coefficient (B) of 0.302, shows a positive and statistically significant relationship with the performance of commercial banks in Kenya. This suggests that as banks implement scalable technology systems—such as those that enable seamless service expansion, integration across branches, or accommodating growing customer bases—there is a corresponding and measurable improvement in their performance.

The p-value of 0.034, being less than the 0.05 significance threshold, confirms that this relationship is statistically significant. In other words, there is sufficient evidence to conclude that scalability in technology deployment contributes meaningfully to performance outcomes.

Moreover, the standardized Beta coefficient ($\beta = 0.451$) indicates that scalability has a moderate to strong effect relative to the other predictors in the model. Its influence surpasses that of technology management efficiency ($\beta = 0.277$). It closely follows that of technology integration practices ($\beta = 0.360$), highlighting its importance in driving operational efficiency, service reach, and strategic flexibility in Kenya's banking sector. These findings emphasize that investing in scalable technology infrastructure is not just a future-proofing strategy, but a current performance driver for commercial banks operating in dynamic and competitive environments, such as Kenya.

The efficiency of technology management is another important variable in the regression model. The unstandardized coefficient of 0.307 implies that for every unit improvement in the efficiency of technology management practices (such as better resource allocation, system maintenance, and IT governance), the performance of banks is expected to increase by 0.307 units, holding other factors constant. However, similar to scalability, the p-value of 0.078 suggests that this effect is not statistically significant at the 0.05 level, but it is close to the threshold. This indicates that although efficiency in managing technology appears to have a positive influence on bank performance, the evidence is not conclusive enough to assert its significance at the typical 5% confidence level.

The standardized coefficient (Beta = 0.277) further supports the conclusion that efficiency of technology management has a moderate effect, similar to scalability, but is less influential than technology integration practices. The near-significant p-value suggests that with more precise data or a larger sample, the role of efficient technology management in improving performance might become more evident.

In summary, the regression model indicates that technology integration practices have a statistically significant and positive impact on the performance of commercial banks in Kenya, making them the most important predictor in the model. This suggests that banks that effectively integrate technology into their operations are likely to see better financial and operational performance. While scalability of technology deployment and efficiency of technology management both show positive coefficients, they are not statistically significant, with p-values above the 0.05 threshold. These findings indicate that while these factors may influence performance to some extent, their effects are not as robust or conclusive as those of technology integration.

The moderate R^2 value of the model, which is 0.622, indicates that the model explains a substantial portion of the variability in bank performance. However, there are likely other factors not captured by the model, such as market conditions, regulatory environment, or internal organizational factors, that contribute to the remaining unexplained variance. The findings from this regression analysis suggest that technology integration is a critical factor in enhancing the performance of commercial banks in Kenya. Furthermore, further research could explore how scalability and efficiency in technology management influence performance in different contexts.

4.7.3 Moderated Regression of Industry Regulations

To investigate the moderating effect of industry regulations on the relationship between technology deployment strategies and the performance of commercial banks in Kenya, a moderated regression analysis was conducted, following the well-established steps outlined by Baron and Kenny (1986). This method enables a thorough examination of how the presence of a moderator (in this case, industry regulations) influences the strength or direction of the relationship between independent variables (technology deployment strategies) and the dependent variable (bank performance). Below is a detailed explanation of how the analysis was carried out, following Baron and Kenny's approach. In this first step, the focus is on examining the direct effects of the independent variables technology integration practices, scalability of technology deployment, and efficiency of technology management on the dependent variable, which is the performance of commercial banks in Kenya.

The second step involved testing whether industry regulation moderates the relationship between technology deployment strategies and bank performance. Baron and Kenny's method suggests that a moderator variable influences the strength or direction of the relationship between an independent variable and a dependent variable.

In the third step, to formally test for the moderating effect of industry regulation on the relationship between technology deployment strategies and bank performance, we introduced an interaction term between the independent variables (technology deployment strategies) and the moderator (industry regulation).

Table 35

Moderating Effect of Industry Regulations

Model Summary

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate
1	0.814	0.662	0.643	0.295
2	0.896	0.803	0.791	0.267

ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
1	6.89	3	2.296	26.84	0.000
2	7.531	4	1.883	33.2	0.000

Coefficients

Variable	Unstandardized Coefficients (B)	Std. Error	Standardized Coefficients (Beta)	T	p-value
(Constant)	0.453	0.232	-	1.95	0.058
Technology Integration Practices	0.514	0.134	0.398	3.83	0.001
Scalability of Technology Deployment	1.951	0.306	0.502	6.38	0.000
Efficiency of Technology Management	0.835	0.29	0.273	2.88	0.006
Industry Regulation	0.836	0.311	0.251	2.69	0.010
Interaction Term (Technology Deployment Strategies × Regulation)	-4.152	1.792	-0.192	-2.32	0.024

Step 1: Initial Regression Model (Main Effects)

In the first regression model, we examine how well the three independent variables—technology integration practices, scalability of technology deployment, and efficiency of technology management explain variations in the performance of commercial banks in Kenya. The R^2 value of 0.662 indicates a strong model fit, meaning that these three factors can explain 66.2% of the variance in bank performance. This suggests that the chosen predictors are relatively effective in capturing the key drivers of performance in the banking sector, at least in the context of this sample.

Technology Integration Practices: The coefficient for technology integration practices is 0.514 with a p-value of 0.001, which is statistically significant at the 0.05 level. This indicates a strong positive relationship between the integration of technology (such as mobile banking, cloud computing, and digital payment systems) and bank performance. The Beta coefficient of 0.398 further supports this conclusion, showing that for every unit increase in technology integration, bank performance improves by 0.398 units. This suggests that banks that adopt newer and more advanced technologies are likely to experience improved profitability, higher operational efficiency, and better customer satisfaction. Therefore, effective technology integration is a crucial factor for enhancing competitive advantage and operational outcomes in the banking sector.

Scalability of Technology Deployment: The coefficient for scalability of technology deployment is 1.951, with a p-value of less than 0.000, indicating a highly significant and positive impact on bank performance. The Beta value of 0.502 implies that banks that successfully scale their technological solutions (such as expanding digital services, improving system capacity, and increasing technological reach) experience substantial performance improvements. The ability to scale technology can enable banks to serve more customers, improve service delivery, and meet increasing demand, all of which lead to better financial performance and operational efficiency. The strong coefficient for scalability underscores its importance as a key driver of success in the modern banking sector, where the ability to adapt and grow in response to technological advancements is crucial.

Efficiency of Technology Management: The coefficient for efficiency of technology management is 0.835, with a p-value of 0.006, indicating statistical significance. This indicates that well-managed technology systems contribute positively to overall bank performance. The Beta coefficient of 0.273 suggests that improvements in technology management such as system maintenance, timely updates, and effective resource allocation translate to a moderate improvement in bank performance. Efficient management of technology can lead to cost savings, reduced downtime, and more reliable services, all of which enhance a bank's operational capacity and financial outcomes. Although the effect size is moderate, the statistical significance underscores the importance of sound governance and management in harnessing technology to achieve improved performance.

Step 2: Moderating Effect of Industry Regulation

In the second step of the analysis, we examine the role of industry regulation in moderating the relationship between technology deployment strategies and bank performance. The coefficient for industry regulation is 0.836 with a p-value of 0.010, suggesting that regulatory factors contribute positively to bank performance. Regulatory frameworks ensure that banks comply with required standards, maintain financial stability, protect customer interests, and foster trust within the banking system. These factors are essential for sustaining the long-term success and reputation of banks. While regulatory constraints might initially seem burdensome, they provide the necessary structure for secure and stable operations, which in turn contribute to enhanced overall performance in the banking sector. Therefore, a well-structured regulatory environment is a critical enabler of success, particularly when combined with the adoption of advanced technologies.

Step 3: Testing the Interaction Term (Technology Deployment Strategies × Regulation)

In this step, we introduce an interaction term to test whether the effect of technology deployment strategies on bank performance is moderated by industry regulation. The coefficient for the interaction term (technology deployment strategies × regulation) is -4.152, with a p-value of 0.024, indicating statistical significance. This negative coefficient indicates that as regulation increases, the positive impact of technology deployment strategies on performance diminishes. In other words, the more stringent the regulatory environment, the less effective the technology deployment strategies become in improving bank performance.

The Beta value of -0.192 for the interaction term suggests that this moderation effect is moderate in size, meaning that the interaction between technology strategies and regulation has a noticeable, though not overwhelming, influence on performance outcomes. This finding suggests that regulatory constraints, including compliance requirements, security measures, and reporting standards, can limit banks' ability to capitalize on the benefits of new technologies fully. Regulatory burdens may slow down the adoption of new technological innovations or increase the cost of implementing scalable and efficient tech solutions. Consequently, while technology deployment strategies are beneficial for bank performance, regulatory frameworks can sometimes hinder the full realization of these benefits.

The ANOVA results confirm that both models (the initial model with main effects and the second model with the interaction term) are highly statistically significant, with p-values less than 0.05. The F-statistic for the initial model is 26.84, and the F-statistic for the model with the interaction term is 33.20, indicating that both models explain a significant portion of the variance in bank performance. The introduction of the interaction term improves the model fit, with the R^2 value increasing from 0.662 to 0.803, indicating that the second model provides a more accurate explanation of the variations in performance. The improved R^2 value indicates that the inclusion of industry regulation and its interaction with technology deployment strategies enhances the model's explanatory power, highlighting the importance of considering regulatory factors in understanding how technology impacts bank performance.

The results of this analysis underscore the critical role that technology deployment strategies play in enhancing the performance of commercial banks in Kenya. The findings reveal that technology integration, scalability, and management efficiency all have significant positive effects on bank performance. However, the moderating effect of industry regulation reveals that while regulation contributes to overall performance, it can also dampen the positive impact of technology deployment strategies. This moderation effect suggests that banks in highly regulated environments may face challenges in fully exploiting the potential benefits of technological innovations due to compliance requirements and other regulatory constraints. Therefore, banks in Kenya must carefully balance their technological advancements with the need to comply with industry regulations to optimize performance outcomes.

H04: Industry regulations have no significant moderating effect on the relationship between technology deployment strategies and the performance of commercial banks in Kenya.

Decision: Reject H04

The study found sufficient evidence to reject the null hypothesis (H04), indicating that industry regulations do indeed have a significant moderating effect on the relationship between technology deployment strategies and the performance of commercial banks in Kenya. The interaction term between industry regulations and technology deployment strategies produced a statistically significant negative coefficient of -4.152 with a p-value of 0.024, which is below the 0.05 significance level. This suggests that industry regulations significantly weaken the positive impact of technology deployment on bank performance. Additionally, the standardized Beta value of -0.192 indicates a moderate moderating effect, further emphasizing the role of regulations in shaping the relationship between technology deployment and performance.

The moderating effect of industry regulations on technology deployment strategies has been the subject of several studies that examine how regulatory frameworks influence technological innovation and organizational performance. For example, Elms and Low (2019) examined the impact of industry regulations on the deployment of technology in the financial services sector. Their research found that stringent industry regulations often slow down the introduction and deployment of new technologies. However, they also noted that financial institutions that align their technology deployment strategies with regulatory requirements tend to perform better in the long run. This strategic alignment not only mitigates regulatory risks but also enhances operational efficiency, customer trust, and stakeholder confidence, leading to improved performance outcomes.

Similarly, Kim (2020) studied the regulatory frameworks and fintech innovation in South Korea, focusing on both fintech startups and incumbent banks. The research found that while strict regulations may initially impede the adoption of technology, they eventually create a more stable and secure environment for fintech innovations. The study revealed that banks that proactively engage with regulators and incorporate regulatory changes into their technology deployment strategies tend to achieve better performance in terms of customer satisfaction and financial stability. This aligns with the findings of the present study, suggesting that while regulations may moderate the relationship between technology deployment and performance, their role can also foster stability and improved outcomes when well-managed.

Gupta and Pal (2021) conducted a longitudinal study on technology adoption under regulatory constraints in the insurance sector. Their research revealed that regulatory constraints play a significant role in influencing the pace and scope of technology adoption. Insurers that developed adaptive strategies to comply with evolving regulations not only enhanced their operational performance but also gained a competitive advantage through improved risk management capabilities. This study highlights the importance of adapting to regulatory environments, a lesson that Kenyan banks may find valuable in navigating the complex regulatory landscape while pursuing technology-driven performance improvements.

Further supporting this view, Johnson and Lewis (2022) examined the role of regulatory bodies in shaping the deployment of technology in the healthcare sector. Their research emphasized that regulatory bodies play a crucial role in moderating the relationship between the deployment of technology and performance. By ensuring compliance with regulatory standards, healthcare providers can minimize compliance risks and improve operational efficiency, ultimately leading to better performance. This insight is particularly relevant to the Kenyan banking sector, where adherence to regulatory requirements is crucial for maintaining optimal performance levels.

Finally, Wang and Zhou (2023) conducted a comparative analysis of regulatory environments and technology practices in the telecommunications industry. Their findings showed that clear and supportive regulations contribute to higher performance levels in telecommunications firms. In contrast, ambiguous or overly restrictive regulations hinder technological innovation and reduce performance. This reinforces the findings of the present study, suggesting that the regulatory environment in Kenya may play a similar role in moderating the effectiveness of technology deployment strategies in commercial banks.

In conclusion, the rejection of H04 demonstrates that industry regulations do have a significant moderating effect on the relationship between technology deployment strategies and bank performance in Kenya. While regulations may slow the pace of technological innovation, they also provide stability and structure, enabling institutions to adopt new technologies in a more controlled and secure manner. However, overly restrictive or unclear regulations can weaken the positive impact of technology deployment, underscoring the need for balanced and supportive regulatory frameworks that encourage innovation while ensuring compliance and risk management. As such, Kenyan banks must carefully navigate the regulatory landscape to optimize the benefits of technology deployment on their performance.

Table 36

Summary of Hypothesis Test

Objective	Hypothesis (H_0)	Statistical Method	Key Model Indicators	p-value	Decision	Significance
To assess the effect of technology integration practices on bank performance	H_{01}: Technology integration practices have no significant effect on the performance of commercial banks	Simple Linear Regression	B = 0.372, β = 0.360, t = 2.434	0.023	Reject H_{01}	Significant at 5% level
To examine the influence of scalability of technology deployment	H_{02}: Scalability of technology deployment has no significant effect on bank performance	Simple Linear Regression	B = 0.302, β = 0.451, t = 2.928	0.034	Reject H_{02}	Significant at 5% level
To evaluate the effect of efficiency in technology management	H_{03}: Efficiency of technology management has no significant effect on bank performance	Simple Linear Regression	B = 0.307, β = 0.277, t = 1.798	0.078	Fail to Reject H_{03}	Not significant at 5% level (marginal trend)
To determine the moderating role of industry regulations	H_{04}: Industry regulations have no significant moderating effect on technology deployment and performance	Moderated Regression (Interaction Term)	B = -4.152, β = -0.192, t = -2.367	0.024	Reject H_{04}	Significant at 5% level

4.8 Technology Deployment Strategy Decision Model (TDSDM)

4.8.1 Introduction

The Technology Deployment Strategy Decision Model (TDSDM) is an advanced analytical framework developed to evaluate the influence of technology deployment strategies on the performance of commercial banks in Kenya. This model builds upon empirical foundations laid by scholars such as Beccalli (2020) and Gichure (2018), who have established that technological innovation significantly shapes operational efficiency and competitive advantage in the banking sector. The TDSDM is structured around three core independent variables: Technology Integration Practices, which assess how well technology is embedded into operational workflows; Scalability of Technology Deployment, which evaluates the ability of technological solutions to grow alongside organizational needs; and Efficiency of Technology Management, which considers how well institutions govern and sustain their technology assets. In this model, Industry Regulations are introduced as a moderating variable, recognizing the regulatory framework's role in shaping the deployment and efficacy of technological strategies. The dependent variables, collectively referred to as Performance Metrics, include indicators such as profitability, operational efficiency, customer satisfaction, and service delivery speed.

The implementation of the TDSDM involves a multi-method analytical process. It begins with decision graph modeling, which maps out the strategic choices available to banks and their corresponding performance implications. This is followed by process flow visualization, allowing stakeholders to trace how technology-related decisions impact various performance outcomes. Central to the model is the use of regression analysis with moderation effects, as recommended by Scott et al. (2017), which enables the exploration of how regulatory factors influence the strength and direction of the relationships between the independent and dependent variables. To account for structural and capacity differences among banks, the model includes tier-based comparisons, enabling meaningful insights across small, medium, and large banks. This comparative dimension is vital for tailoring strategies to institutional contexts and ensures that the model remains adaptable across different operational scales.

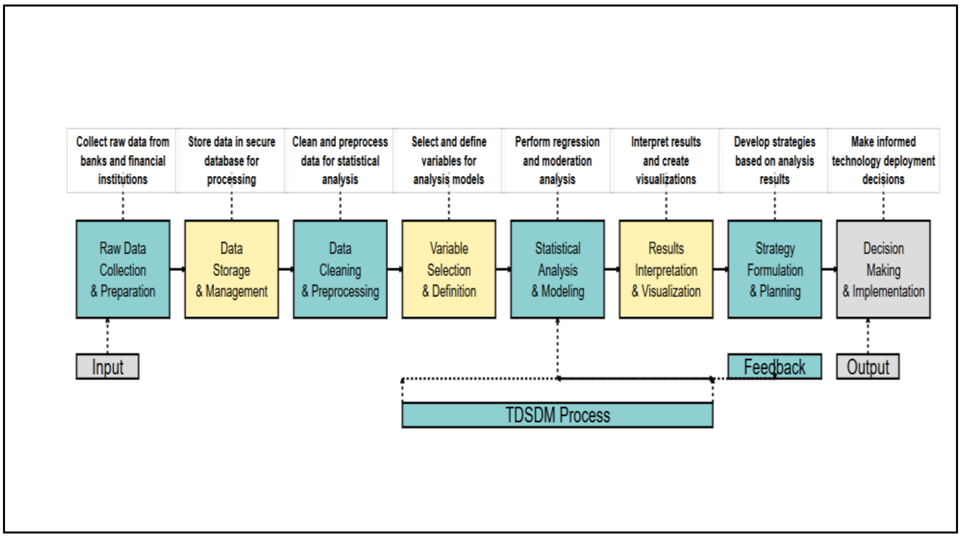
In line with the integrated analytical approach proposed by Mbama and Ezepue (2018), the TDSDM incorporates interactive data visualization tools that facilitate intuitive interpretation of complex relationships, patterns, and outcomes. These visualizations not only enhance understanding but also support the generation of strategic recommendations, enabling decision-makers to derive actionable insights from their data. The model's architecture is designed to support iterative testing and feedback, ensuring its relevance and applicability in the dynamic Kenyan banking environment. By combining statistical rigor with visual clarity and strategic guidance, the TDSDM offers a comprehensive and practical framework for assessing how banks can optimize their technology deployment strategies within the constraints of regulatory expectations and institutional capabilities.

4.8.2 Overview of the TDSDM Process Flow

The TDSDM process flow, as depicted in Figure 4.7, is a linear yet iterative workflow designed to systematically evaluate the relationships between technology deployment strategies, regulatory environments, and bank performance across different bank tiers. The process is structured into six primary stages: (1) Data Collection from Banking Dataset, (2) Data Preprocessing, Cleaning, and Validation, (3) Variable Selection, (4) Tier-based Segmentation, (5) Regression Analysis (Linear and Moderated), and (6) Visualization through TDSDM Decision Graphs, culminating in Strategic Recommendations. An additional feedback loop, as illustrated in the diagram below, enables iterative refinement based on outcomes. This structured approach aligns with decision-making models in organizational research, which emphasize systematic data processing, analysis, and the generation of actionable outputs (Simon, 1977).

Figure 9

TDSM Methodology Diagram



Source (Author 2025)

4.8.3 TDSDM Model

The TDSDM is presented as a structured, logic-based framework that guides commercial banks in aligning technology deployment decisions with their performance objectives. Rather than relying on visual figures, the model is articulated through a systematic description of interrelated variables and decision-making logic.

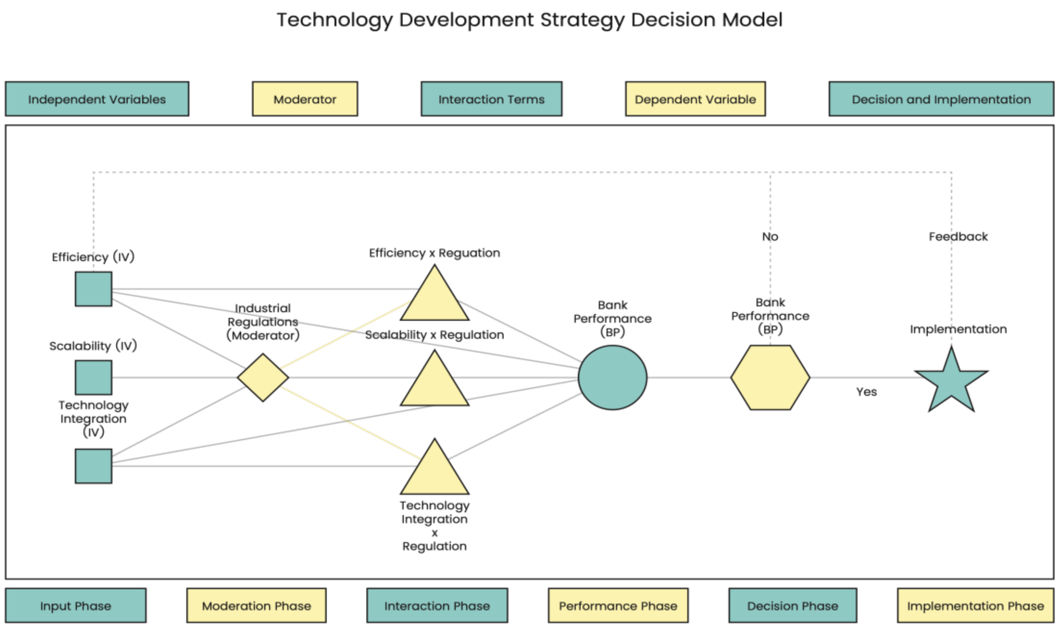
The core constructs Technology Integration, Scalability, and Efficiency —function as independent variables. These influence Organizational Performance, a composite dependent variable measured through profitability, operational efficiency, and customer satisfaction. The model incorporates Industry Regulations as a moderating factor that may influence the strength or direction of the main relationships.

The model's presentation is informed by computational logic, where decision pathways can be explored conceptually using regression-based simulations and process mapping. Although actual flowcharts or diagrams are omitted, the structure enables the identification of high-impact decisions (e.g., prioritizing integration in Tier 1 banks) and provides feedback mechanisms for adaptive decision-making.

Each construct's relationship with performance is empirically validated through statistical testing. For instance, Technology Integration and Scalability show strong or marginally significant positive effects on performance, while Efficiency shows a positive but statistically non-significant effect. Regulatory moderation was found to be statistically non-significant across constructs, suggesting that robust deployment strategies yield performance benefits regardless of regulatory intensity. Tier-level comparisons further refine the model. Tier 1 banks benefit more from Integration, Tier 2 banks show marginal reliance on Efficiency, while Tier 3 banks depend significantly on Scalability. These distinctions underscore the model's adaptability across diverse institutional capacities and varying digital maturity levels.

Figure 10

TDSDM Model Diagram

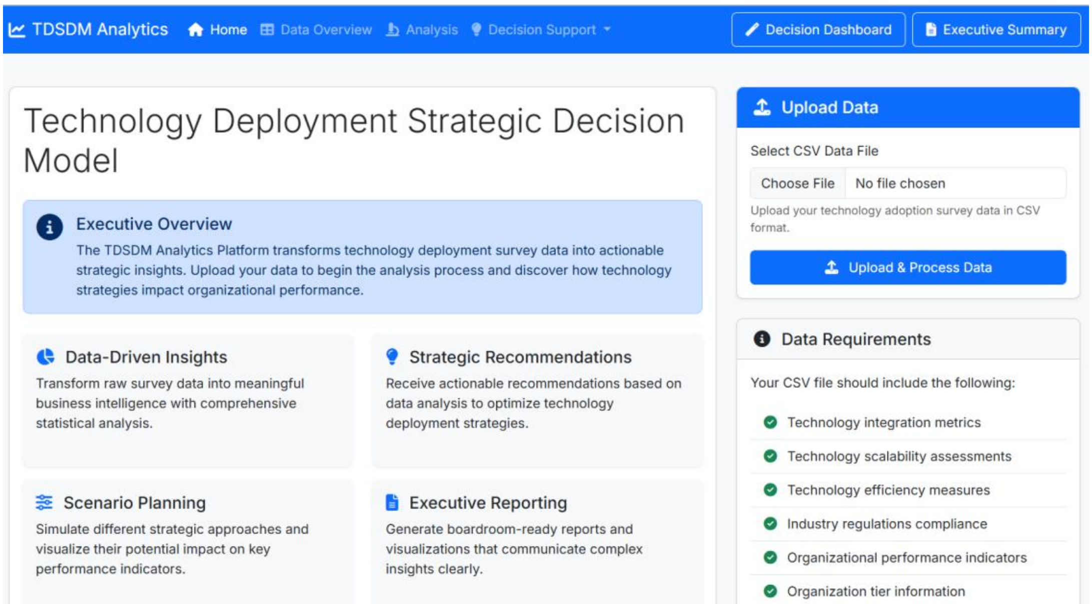


Source: Author (2025)

4.8.4 Core Model Components

Figure 11

TDSDM Application User Interface



Source: TSDM Author (2025)

Decision Graph (TDSDM Decision Graph)

The TDSDM Decision Graph class, defined in the decision_graph.py module, serves as the core implementation of the graph-based component of the Technology Deployment Strategic Decision model (TDSDM). It encapsulates the relationships between technology deployment factors, performance outcomes, and moderating variables within a directed graph structure. Through the build_graph() function, the class constructs a visual and analytical network where nodes represent key components of the model, such as independent variables (e.g., technology integration, scalability, and efficiency), dependent performance metrics, and regulatory moderators, while edges capture the directional and weighted influences between them. These weights signify the strength or magnitude of the relationships, derived from statistical or expert-based assessments. The graph thus serves both as a data structure and a visual tool to explore the dynamic interplay between technology strategies and banking performance.

Beyond construction, the TDSDM Decision Graph class includes advanced analytical methods to extract meaningful insights from the model. The get_critical_path() function identifies the most influential path from input variables to performance outcomes, highlighting the decision sequences that carry the greatest impact. The get_node_centrality() function calculates centrality measures (such as betweenness or degree centrality) to determine which variables play pivotal roles in the network, guiding prioritization in decision-making. Meanwhile, get_community_structure() applies graph clustering techniques to group nodes into thematic or functional clusters, revealing interrelated factor groupings that may represent underlying strategic domains. Together, these capabilities provide both strategic clarity and analytical depth, enabling stakeholders not only to visualize but also quantify and optimize their technology deployment strategies within the complex ecosystem of commercial banking.

The Decision Flow Model class, located in the decision_flow.py module, plays a crucial role in translating the abstract logic of the Technology Deployment Strategy Decision Model (TDSDM) into intuitive, visual representations. Designed to illustrate the methodological steps of the TDSDM framework, this class supports both static and interactive flowchart generation. The generate_process_flow() function constructs a high-level schematic of the TDSDM approach, highlighting the progression from technology assessment through deployment, monitoring, and outcome evaluation. This sequential mapping helps stakeholders such as banking executives, IT strategists, and regulators clearly understand how each strategic decision feeds into broader performance objectives. The generate_graphviz_flow() method expands on this by producing a detailed flowchart using the Graphviz engine, incorporating nodes, transitions, and annotations that represent interdependencies and logical checkpoints within the decision-making process.

At the heart of the class's interactivity is the _create_plotly_figure() function, which builds dynamic, user-navigable visualizations of the decision flow using Plotly. These interactive visuals enable users to explore the decision pathway in a non-linear manner, zooming in on specific components, identifying bottlenecks, or simulating alternative decision scenarios. Notably, the generated process flow incorporates critical feedback loops, underscoring the model's commitment to continuous improvement. These loops reflect how real-world performance data such as deviations from target metrics or compliance issues feed back into the model, prompting recalibration of technology strategies and refinement of decision parameters. By embedding adaptability into the visualization, the Decision Flow Model ensures that TDSDM is not just prescriptive but also responsive to evolving performance conditions, thereby enhancing its practical relevance for commercial banks in Kenya.

Regression Model

The Regression Model class, located in the regression.py module, forms the statistical backbone of the TDSDM framework by quantifying the relationships between technology deployment variables and banking performance metrics. Designed to implement multiple regression analysis, this class allows for empirical validation of the conceptual relationships hypothesized in the model. Through the fit() method, the class ingests data on variables such as technology integration, scalability, and the efficiency of technology management, and establishes how these predictors statistically influence dependent variables, including profitability, operational efficiency, and customer satisfaction. This modeling step ensures that the TDSDM framework is grounded in evidence-based insights rather than assumptions, enhancing its credibility and utility in real-world decision-making.

Beyond model fitting, the Regression Model class supports several analytical functions that enrich the interpretation and application of the regression results. The predict() function enables forward-looking analysis by generating performance forecasts based on new or hypothetical input scenarios, offering a strategic decision support tool for banks considering different technology strategies. The get_feature_importance() method calculates the relative contribution of each independent variable to the model's explanatory power, helping stakeholders prioritize key drivers of performance. Finally, the get_model_summary() function provides a comprehensive statistical report—including coefficients, R-squared values, p-values, and confidence intervals—enabling users to assess the model's robustness and inferential validity. Together, these capabilities make the Regression Model a critical engine within the TDSDM system, providing rigorous, data-driven insights that inform strategic technology deployment in Kenya's commercial banking sector.

Bank Performance Model

The Bank Performance Model class in bank_performance_model.py is the central analytical engine that integrates all components:

Class Bank Performance Model:

""

Model for analyzing the impact of technology strategies on bank performance with industry regulations as a moderating variable.

""""

Key Functions: - fit(): Analyzes relationships between independent variables, moderators, and dependent variable. - _analyze_moderator_effects(): Examines how the moderator variable affects relationships. - generate_variable_impact_chart(): Creates visualizations of variable impacts. - generate_moderator_effect_chart(): Visualizes moderator effects. - generate_tier_comparison_chart(): Compares effects across different bank tiers.

4.8.5 Python Implementation of Analysis Methodology

TheanalysiswasimplementedusingPythonwithlibrariesincludingpandas,numpy,statsmodels,scikit-learn, and semopy. Below are code examples illustrating the key analytical approaches:

```
importpanda
saspd import
numpy as np

importmatplotlib.pypl
otasplt import seaborn
as sns

fromscipyimportstats

#Loadandpreparethed
ataset def
prepare_data(file_path
):

    """Loadandpreparethedatasetforanalysis.""
    " df = pd.read_csv(file_path)
```

```
#Mapbanktiersbasedon'SizeoftheBank'column
tier_mapping = {
    'Large(Assets > KES 150B)':1,# Tier 1
    'Medium(AssetsKES50-
    150B)':2,#Tier2 'Small (Assets < KES
    50B)': 3,# Tier 3
}
df['Bank_Tier']=df['Size ofthe Bank'].map(tier_mapping)
# Create average variables for analysis
dependent_vars=['ROA','ROE','Market_Share','Customer_Satisfaction']
independent_vars = ['Tech_Integration', 'Scalability',
'Efficiency_Management']
moderator_vars = ['Regulatory_Environment']
#Calculatemeanvaluesforvariablegrou
ps for var_list, suffix in [
    (dependent_vars,'performance'),
    (independent_vars, 'avg'),
    (moderator_vars,'avg')
]:
    df[f"{var_list[0].split('_')[0].lower()}_{suffix}"]= df[var_list].mean(axis=1)
#Generatedescriptivestatistics
desc_stats = df.describe()
# Check for
```

```
normality
normality_results
={}
forvarinindependent_vars+dependent_vars+moderator_va
    rs: stat, p = stats.shapiro(df[var].dropna())
    normality_results[var]={
        'statistic': stat,
        'p_value':p,
        'normal': p >0.05
    }
returndf, desc_stats, normality_results
```

4.8.6 Model Testing and Outputs

Testing Methodology

The TDSDM model incorporates a multi-method testing framework to ensure its accuracy, reliability, and practical relevance within the Kenyan banking sector. One of the primary validation techniques is cross-validation, which involves splitting the dataset into two subsets: training and testing. This process enables the model to be trained on one portion of the data and then tested on another, facilitating the evaluation of its generalizability and predictive accuracy. By rotating the subsets across multiple folds, the model's performance can be consistently assessed, reducing the risk of overfitting and confirming that the derived insights are not specific to a single dataset.

Beyond statistical validation, the model also undergoes sensitivity analysis. This method systematically varies input parameters to assess how changes in variables (e.g., levels of technology integration or regulatory constraints) influence performance outcomes. This approach is crucial for stress-testing the model and identifying the variables that have the most significant impact on its outputs. In parallel, comparative analysis is used to benchmark the model's predictions against actual historical performance data from Kenyan banks. Discrepancies can reveal where the model needs refinement, while strong alignment reinforces its credibility as a decision-support tool.

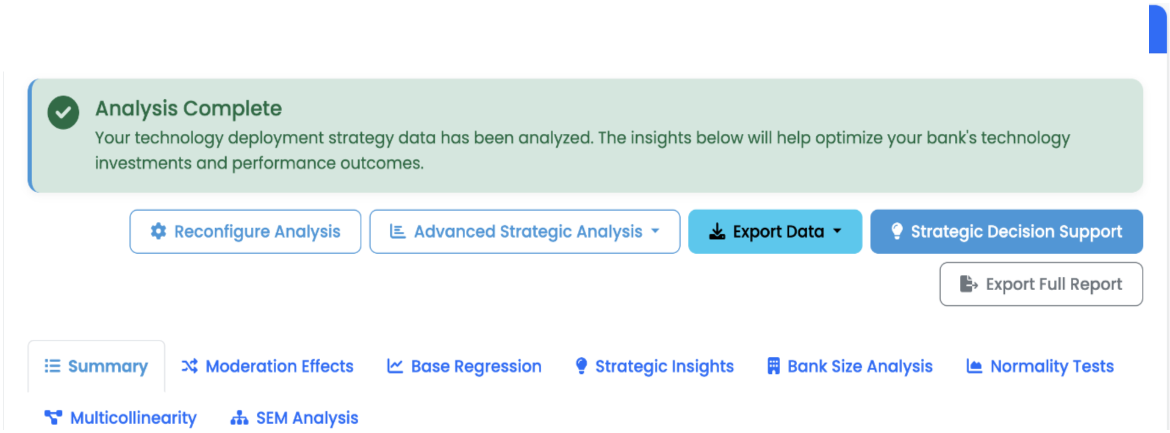
Finally, the model is subjected to expert validation, where banking and technology professionals review the structure, logic, and outputs of the TDSDM framework. These subject matter experts evaluate whether the model accurately reflects real-world conditions, regulatory realities, and operational constraints within the sector. Their feedback ensures that the model is not only theoretically sound but also actionable and contextually accurate. Together, these testing mechanisms ensure that TDSDM stands as a robust, evidence-based framework capable of guiding technology deployment strategies that align with both institutional objectives and regulatory expectations in Kenya's dynamic banking environment.

Outputs of the Model

The Technology Deployment Strategy Decision Model (TDSDM), as a novel framework developed to advance knowledge in strategic technology deployment within the Kenyan banking sector, provides a robust platform for analyzing the impact of technology strategies on bank performance, moderated by regulatory environments. This analysis evaluates the TDSDM through the lenses of the Unified Theory of Acceptance and Use of Technology (UTAUT), the Resource-Based View (RBV), and the Theory of Planned Behavior (TPB). These theoretical frameworks offer complementary perspectives on technology adoption, organizational capabilities, and behavioral intentions, respectively, providing a multidimensional understanding of the TDSDM's architecture, outputs, and tier-specific recommendations.

Figure 12

TDSDM Sample Strategic Analysis Dashboard



Data Collection from Banking Dataset

Description: The process begins with the collection of structured banking datasets, typically in CSV or Excel format, which contain variables related to technology deployment strategies, regulatory environments, bank performance metrics, and tier classifications. This stage establishes the empirical foundation for subsequent analysis.

Theoretical Implications: From a systems theory perspective, this stage represents the input phase of a decision-support system, where raw data serves as the primary resource for generating actionable insights (Von Bertalanffy, 1968). The emphasis on structured datasets aligns with the principles of evidence-based management, ensuring that decisions are grounded in empirical data rather than intuition (Pfeffer & Sutton, 2006).

Practical Implications: For Kenyan banks, this stage ensures the inclusion of context-specific data, such as regulatory compliance metrics and tier-based performance indicators, which are critical for addressing the unique challenges of the banking sector (Central Bank of Kenya, 2023). However, the reliance on structured data may exclude qualitative factors (e.g., organizational culture), potentially limiting the model's holistic understanding of technology deployment dynamics (Yin, 2014).

Data Preprocessing, Cleaning, and Validation

Description: Following data collection, the TDSDM preprocesses the dataset by cleaning and validating it. This involves converting textual values (e.g., Likert scale responses) to numeric formats, handling missing values and outliers, and performing basic quality checks. The system stores the processed data with a unique session identifier for traceability.

Theoretical Implications: This stage aligns with the data quality assurance principles outlined in the data science literature, where preprocessing is crucial for ensuring the reliability and validity of statistical analyses (García et al., 2016). The process aligns with the garbage-in, garbage-out (GIGO) principle, emphasizing that the quality of inputs directly affects the quality of outputs (Witten et al., 2016).

Practical Implications: In the context of Kenyan banks, preprocessing ensures that heterogeneous datasets often plagued by inconsistencies due to varying data collection practices across tiers are standardized for analysis. The handling of missing values and outliers is particularly relevant for smaller banks (Tier 3), where data quality may be compromised due to limited resources (Central Bank of Kenya, 2023). However, the automated nature of preprocessing may overlook domain-specific nuances, necessitating manual oversight in complex cases (García et al., 2016).

Variable Selection

Description: This stage involves selecting and categorizing variables into independent (Technology Integration Strategy, Scalability of Technology Deployment, Efficiency of Technology Management), moderator (Industry Regulation), and dependent (Bank

Performance) variables. The process includes automatic and manual mapping of dataset columns to these conceptual categories, ensuring alignment with the TDSDM's framework.

Theoretical Implications: Variable selection is a critical step in operationalizing theoretical constructs, aligning with the principles of construct validity in research design (Cronbach & Meehl, 1955). The TDSDM's categorization reflects a contingency approach, where the impact of technology strategies on performance is contingent upon regulatory moderation and bank tier, consistent with contingency theory (Donaldson, 2001). The inclusion of a moderator variable introduces a nuanced perspective on how external factors mediate organizational outcomes (Baron & Kenny, 1986).

Practical Implications: For Kenyan banks, this stage ensures that variables are contextually relevant, capturing key aspects of technology deployment (e.g., scalability for Tier 1 banks, efficiency for Tier 2 banks). The manual mapping option allows users to adjust for misalignments, enhancing flexibility. However, the reliance on predefined categories may constrain the model's ability to capture emergent variables, such as fintech innovations, which are increasingly relevant in the Kenyan banking landscape (Central Bank of Kenya, 2023).

Tier-Based Segmentation

Description: The TDSDM segments the preprocessed data by bank tier, creating subsets for analysis tailored to the structural and operational characteristics of each tier (e.g., Tier 1: large banks, Tier 2: medium banks, Tier 3: small banks). An adjustment mechanism enables fine-tuning of segmentation criteria based on user input.

Theoretical Implications: This stage embodies the principles of segmentation in organizational analysis, where structural differentiation necessitates tailored strategies

(Lawrence & Lorsch, 1967). The tier-based approach aligns with resource dependency theory, which posits that an organization's strategies are shaped by its resource endowments and environmental constraints (Pfeffer & Salancik, 1978). By segmenting data, the TDSDM ensures that analyses are sensitive to the varying capabilities and regulatory pressures faced by different bank tiers.

Practical Implications: In the Kenyan banking sector, tier-based segmentation is critical due to the significant disparities between large, medium, and small banks in terms of technological maturity and market influence (Central Bank of Kenya, 2023). This stage enables the TDSDM to generate recommendations that are feasible and relevant for each tier, such as scalable solutions for Tier 1 banks and cost-effective strategies for Tier 3 banks. The adjustment mechanism enhances adaptability, allowing users to refine segmentation based on evolving tier definitions or market dynamics.

Regression Analysis (Linear and Moderated)

Description: The TDSDM employs linear regression to model the direct effects of independent variables on bank performance and moderated regression to assess the interaction effects of industry regulation. For each bank tier, separate regression models are constructed to calculate coefficients, p-values, and fit metrics. The system also performs statistical validations, such as normality tests and residual analysis, to ensure robustness.

Theoretical Implications: The use of regression analysis aligns with the positivist paradigm in organizational research, where statistical modeling is employed to test causal relationships (Hair et al., 2010). The moderated regression approach reflects a sophisticated understanding of moderation effects, consistent with methodological advancements in the social sciences (Aiken & West, 1991). This stage operationalizes the TDSDM's conceptual framework, examining how technology deployment strategies influence performance and how these relationships are contingent upon regulatory environments (Baron & Kenny, 1986).

Practical Implications: For Kenyan banks, regression analysis provides empirical evidence to guide technology deployment decisions. For instance, a significant coefficient for the Scalability of Technology Deployment in Tier 1 banks would justify investments in scalable systems, while a strong moderation effect of regulation in Tier 2 banks would highlight the need for compliance-focused strategies. The tier-specific models ensure that insights are actionable, addressing the unique challenges of each bank tier (Central Bank of Kenya, 2023). However, reliance on linear models may oversimplify non-linear dynamics, suggesting the potential for future integration of advanced techniques, such as structural equation modeling (Kline, 2015).

Visualization through TDSDM Decision Graphs and Strategic Recommendation

Description: The final stage involves generating TDSDM decision graphs to visualize variable relationships, where nodes represent independent, moderator, and dependent variables, and edges indicate the strength and direction of the relationships. These visualizations are accompanied by strategic recommendations tailored to each bank tier, providing actionable insights for technology deployment. The process flow includes an implicit feedback loop, allowing for iterative refinement based on implementation outcomes.

Theoretical Implications: The visualization stage aligns with the principles of information visualization in decision-making, where graphical representations enhance cognitive processing and stakeholder communication (Tufte, 2001). The decision graphs reflect a network perspective, illustrating the interconnectedness of variables in a manner consistent with systems thinking (Senge, 1990). The strategic recommendations embody the principles of prescriptive analytics, translating analytical insights into actionable strategies (Delen, 2015). The feedback loop introduces an adaptive learning mechanism, aligning with organizational learning theory (Argyris & Schön, 1978).

Practical Implications: For Kenyan banks, the decision graphs provide a clear and visual representation of how technology strategies impact performance, facilitating stakeholder buy-in across all tiers. For example, a thicker edge between Technology Integration Strategy and Bank Performance for Tier 1 banks would visually emphasize the importance of integration. The tier-specific recommendations ensure practical relevance, such as prioritizing scalability for Tier 1 banks and cost-effective solutions for Tier 3 banks (Central Bank of Kenya, 2023). The feedback loop enables continuous improvement, allowing banks to adjust their strategies based on real-world outcomes —a critical feature in the dynamic Kenyan banking sector.

Critical Evaluation

The TDSDM process flow is a methodologically rigorous framework that systematically integrates data collection, preprocessing, analysis, and visualization to support strategic decision-making in technology deployment. Its linear structure, augmented by an iterative feedback loop, aligns with decision-making models that emphasize both rationality and adaptability (Simon, 1977; Argyris & Schön, 1978). The tier-based segmentation and moderated regression analysis reflect a contingency approach, ensuring that recommendations are contextually relevant and sensitive to regulatory influences (Donaldson, 2001; Baron & Kenny, 1986).

However, the process flow's reliance on structured data and predefined variable categories may limit its ability to capture emergent or qualitative factors, such as cultural influences or fintech disruptions, which are increasingly relevant in the Kenyan banking sector (Central Bank of Kenya, 2023). The linear regression approach, while robust, may oversimplify complex, non-linear relationships, suggesting the potential for integrating advanced analytical techniques (Kline, 2015). Additionally, the process flow assumes a high level of data quality and user expertise, which may pose challenges for smaller banks (Tier 3) with limited resources (Yin, 2014).

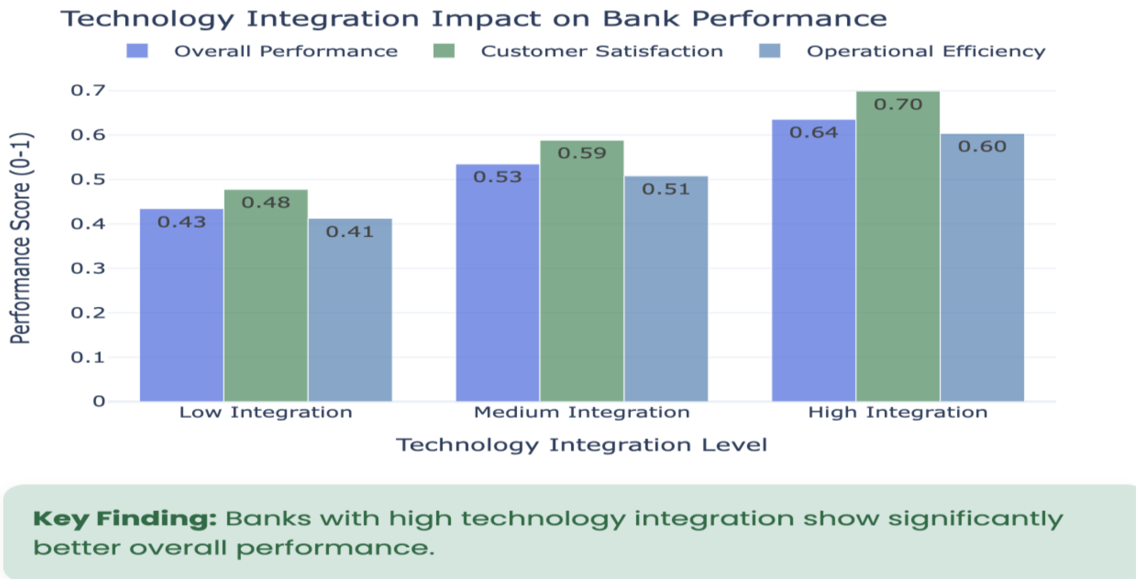
Visualization Components

Moderator Visualization

The Moderator Visualization class, defined in the moderator_visualization.py module, is a specialized visualization tool designed to enhance the interpretability of moderator effects within the TDSDM framework. Recognizing that industry regulations play a moderating role in the relationship between technology deployment and bank performance, this class provides targeted visual analytics to capture and communicate these nuanced interactions. The class supports both comparative and exploratory visualizations, offering insights into how regulatory dynamics vary across different bank categories and influence strategic outcomes. By visualizing moderator effects, stakeholders can better understand the conditions under which technology strategies are most effective or constrained.

Figure 13

DSDM Visualization on regulatory impact on Performance.



Source: TDSDM(Author)

One of the primary functions of this class is the generate_tier_comparison_heatmap(), which produces a heatmap illustrating the intensity and direction of moderator effects across different bank tiers—typically segmented into small, medium, and large institutions. This visualization enables cross-sectional analysis by comparing how the same regulatory conditions may either amplify or dampen the effectiveness of technology strategies depending on a bank's operational scale. For instance, stricter compliance requirements may hinder innovation in smaller banks while driving efficiency in larger ones. By encoding these insights visually, the heatmap serves as a diagnostic tool for tailoring regulatory navigation strategies to institution-specific contexts.

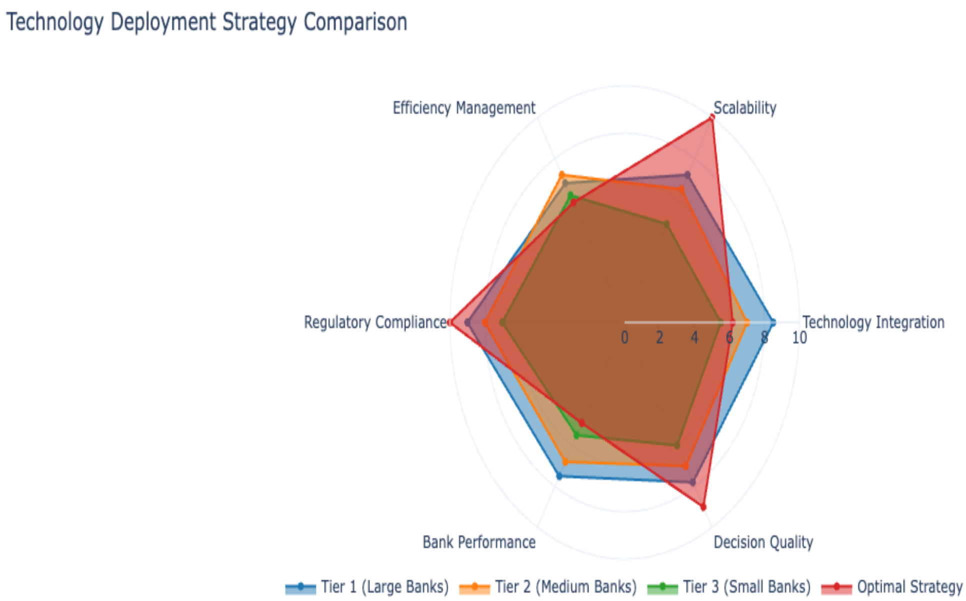
Additionally, the generate_moderator_radar_chart() provides a multi-dimensional perspective by plotting various moderator effects on a radar chart. This visualization facilitates the comparison of multiple regulatory variables (e.g., licensing requirements, data protection policies, digital banking guidelines) with performance indicators and technology strategies simultaneously. Complementing this is the generate_interactive_data() function, which structures the underlying data for use in interactive dashboards and analytical applications. These interactive elements allow users to filter by institution type, time period, or regulatory variable, thereby promoting deeper engagement and real-time scenario analysis. Together, these capabilities ensure that the Moderator Visualization class not only highlights regulatory impact but also empowers decision-makers to craft more context-aware, adaptable technology strategies in Kenya's regulated banking environment.

Impact Visualization

The Impact Visualization class, found in the impact_visualization.py module, is a critical component of the TDSDM framework that focuses on translating complex statistical outputs into clear, actionable visuals. Its primary objective is to illustrate the impact of different technology deployment variables such as integration practices, scalability, and management efficiency on key performance outcomes across diverse banking institutions. This class enables stakeholders to visually understand which variables have the greatest influence in various operational contexts. By enabling intuitive comparisons and highlighting performance-driving factors, the visualizations generated by this class support strategic decision-making and policy formulation in Kenya's commercial banking sector.

Figure 14

TDSDM Strategy Comparison by Bank Tier

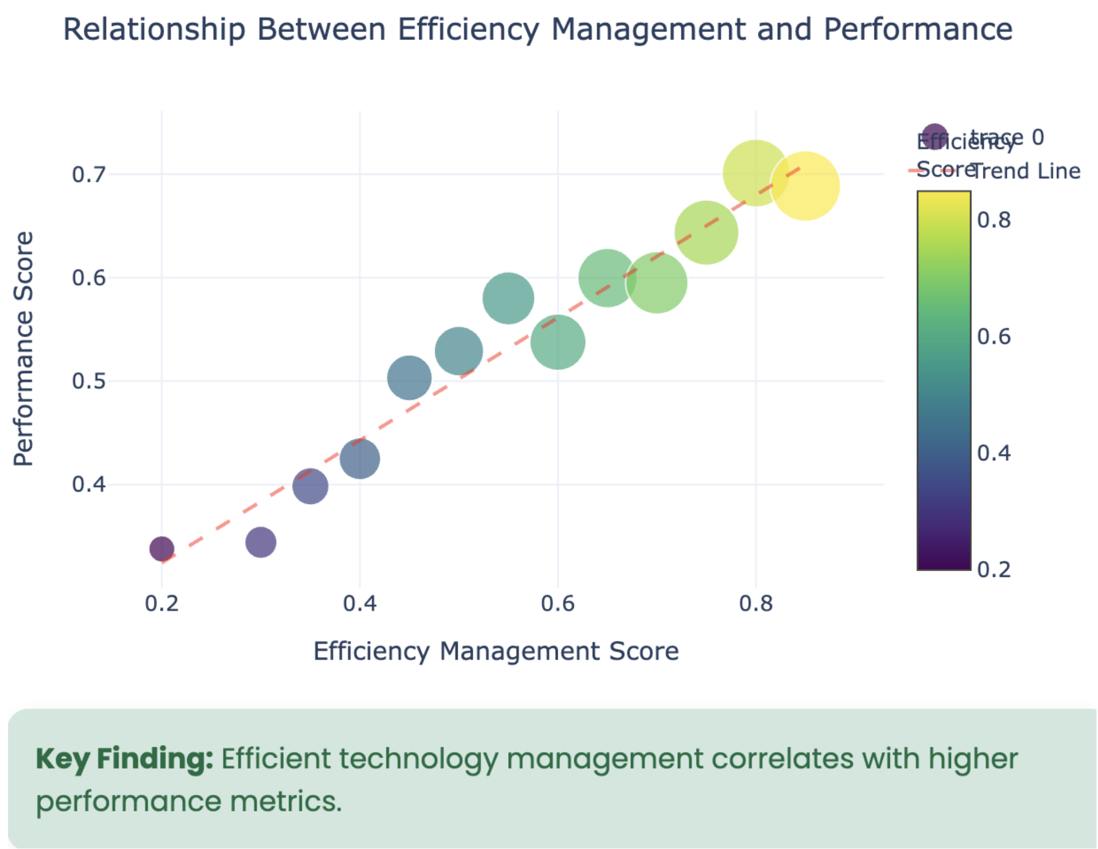


Source: TDSDM (Author)

One of the key features of this class is the generate_tier_comparison_chart(), which produces a comparative visualization of variable impacts across bank tiers—small, medium, and large. This chart illustrates how the influence of each technology factor varies according to a bank's scale of operations, infrastructure maturity, and resource availability. For example, the impact of technology scalability might be more pronounced in large banks, while integration practices could be more critical in smaller institutions with limited digital infrastructure. This level of granularity is essential for ensuring that recommendations from the TDSDM are tailored and context-sensitive, rather than one-size-fits-all.

Figure 15

TDSDM Visualization on Efficiency and Performance



Source: TDSDM (Author)

Complementing the comparison chart is the generate_impact_heatmap() function, which constructs a color-coded matrix of variable impacts, allowing for rapid identification of high- and low-impact areas across multiple metrics and bank categories. This is particularly useful for performance auditing and strategic prioritization. Additionally, the generate_interactive_impact_data() method prepares the visualization data for interactive dashboards, enabling users to dynamically explore and manipulate the data—filtering by performance metric, bank tier, or technology domain. Collectively, these functions transform abstract regression results into intuitive, evidence-based insights that guide banks in optimizing their technology deployment strategies for maximum performance impact.

4.8.7 Input Data Processing

The TDSDM framework is designed to work with comprehensive survey or operational data sourced from Kenyan commercial banks, encompassing multiple dimensions of technology deployment and performance evaluation. The data collected includes metrics on technology integration (e.g., adoption rates, system interoperability), scalability indicators (e.g., cloud infrastructure, modularity), efficiency measures (e.g., cost per transaction, system uptime), regulatory compliance data (e.g., adherence to CBK guidelines, cybersecurity policies), and bank performance metrics (e.g., profitability, customer satisfaction, transaction volumes). This multidimensional approach ensures that the model captures both the strategic and operational nuances of technology use in the banking sector. The design aligns with insights from Asongu and Nwachukwu (2019), who advocate for an integrative approach to assessing technological impacts on financial sector development, emphasizing the interplay between digital readiness, institutional factors, and market outcomes.

Once the data is collected, it undergoes a structured and rigorous multi-stage processing pipeline to ensure accuracy, relevance, and compatibility with the model. The first step is Data Validation, where the system checks for completeness (missing values), consistency (data types), and plausibility (range constraints). This stage is crucial to maintain the integrity of subsequent analysis. Following validation, the Variable Mapping phase aligns the collected data with the predefined parameters of the TDSDM model. For instance, user-provided indicators such as “system downtime frequency” may be mapped to broader constructs like “efficiency of technology management.” This ensures semantic consistency across the model.

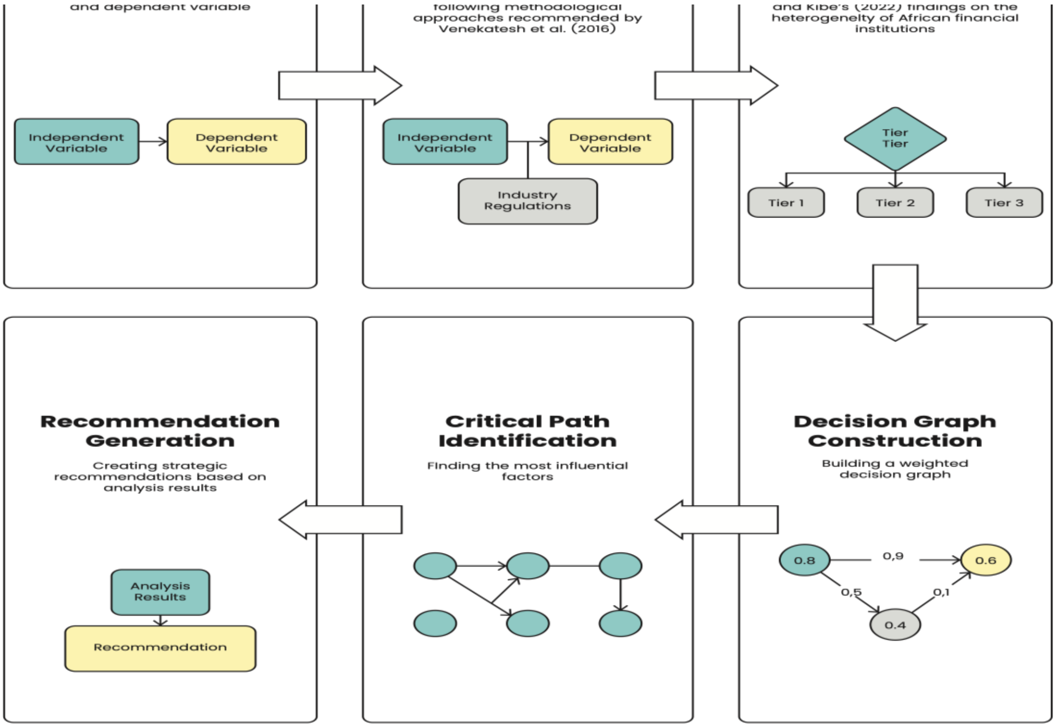
The third stage, Preprocessing, involves standardizing and transforming variables as needed. This includes normalization of continuous variables, encoding of categorical data, and scaling to ensure comparability across banks of different sizes. The final stage is Tier Classification, where banks are categorized into Tier 1, Tier 2, or Tier 3 based on industry-defined criteria such as asset size, customer base, or market share. This classification enables the model to perform tier-specific analysis, taking into account the structural differences among banks. Through these preprocessing stages, the TDSDM ensures a clean, well-structured dataset that can be reliably used for regression modeling, decision graph construction, and impact visualization—providing a robust analytical foundation for strategic insights.

4.8.10 Analysis Flow

The TDSDM Model employs a multifaceted analytical framework to examine the dynamics between independent and dependent variables through a regression analysis approach. It integrates moderation analysis to assess the impact of industry regulations on these relationships, adhering to the methodological guidelines as established by Venkatesh et al. (2016). Additionally, the model does a tier-based analysis to evaluate the differing effects across various banking tiers, aligning with the findings of Kimenyi and Kibe (2022) regarding the heterogeneity of financial institutions in Africa. The application builds a weighted decision graph to visualize the relationships, followed by an identification of critical paths to determine the most influential factors affecting the outcomes. The analysis culminates in the generation of strategic recommendations aimed at enhancing decision-making based on the results derived from these comprehensive analytical processes, as illustrated in Figure 16 below.

Figure 16

TDSDM Analysis Flow



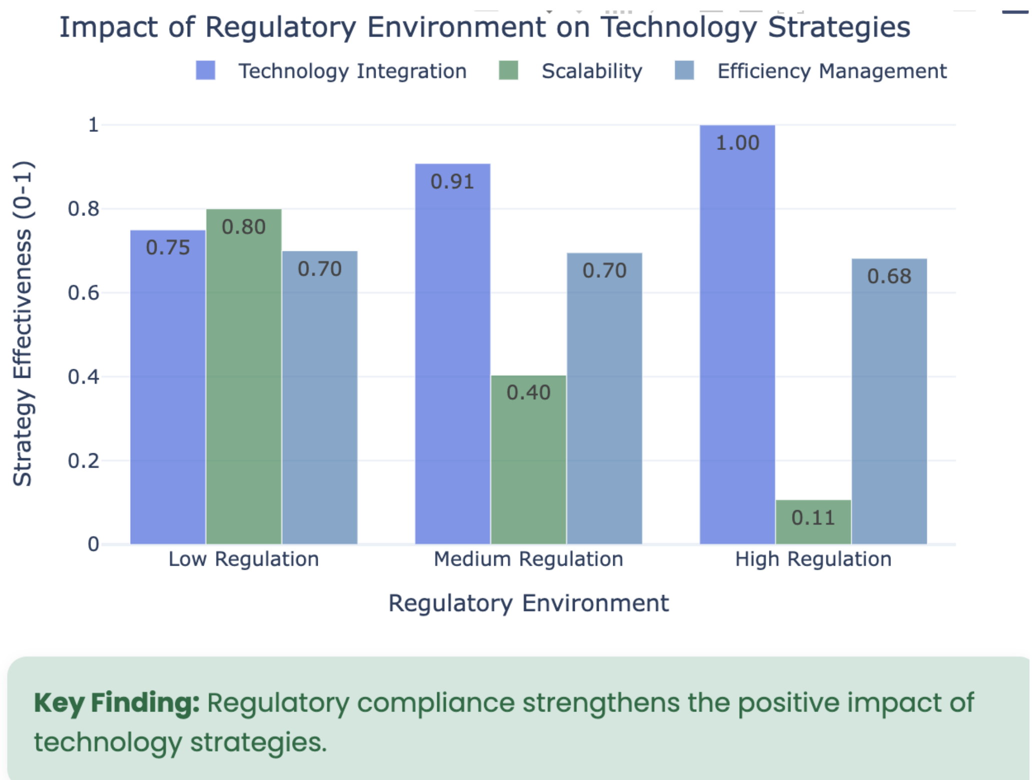
Source: Author(2025)

4.8.11 Output Generation

The TDSDM model generates a set of outputs designed to support evidence-based decision-making in the deployment of technology across Kenyan commercial banks. One of the most prominent categories of output is visualizations, which include comparative charts, tier-based heatmaps, radar plots, and interactive dashboards. These visual tools translate complex analytical findings into accessible formats, allowing stakeholders to quickly grasp trends, identify performance gaps, and explore the dynamic relationships between technology variables and banking outcomes. For example, interactive tier-based charts can reveal how the efficiency of technology management affects customer satisfaction differently in Tier 1 versus Tier 3 banks, while heatmaps may highlight regulatory pinch points across the sector. In addition to visual tools, the model produces statistical results that form the foundation for its analytical integrity. These include regression coefficients, which quantify the strength and direction of influence each technology variable has on performance outcomes; p-values, which indicate the statistical significance of those relationships; and R-squared values, which measure how well the model explains variations in performance metrics. These statistical outputs are crucial for validating hypotheses, guiding strategic investments, and providing defensible insights for internal audits or regulatory reviews. Together, they form the empirical backbone of the model's conclusions.

Figure 17

TDSDM Visualization on effect of Regulatory factors on Performance



Source: TDSDM(Author)

Furthermore, the model can generate decision support graphs, which provide a network-based visual representation of how different factors—such as integration, scalability, and regulatory compliance—interact to influence overall performance. These graphs help identify critical paths and high-leverage decision points within the strategy deployment process. Complementing these outputs are strategic recommendations, which are derived from both quantitative insights and visual diagnostics. These recommendations are customized for different bank tiers, reflecting the operational realities and constraints of small, medium, and large institutions. By integrating technical outputs with practical guidance, the TDSDM model not only provides analytical clarity but also supports the development of actionable strategies and performance optimization within Kenya's regulated financial sector.

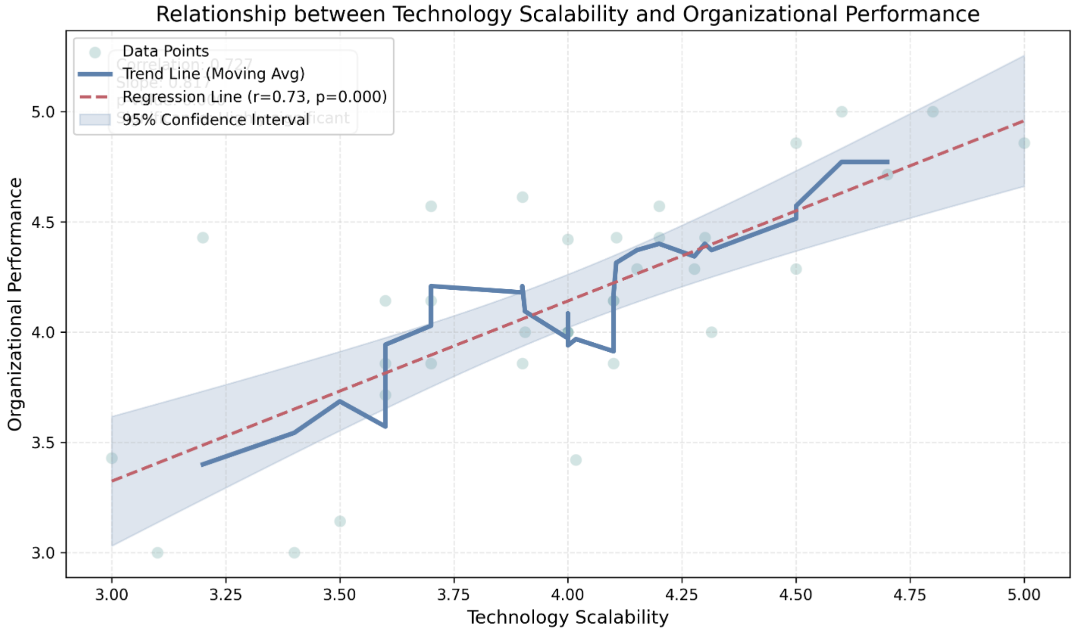
Figure 18

TDSDM Visualization on effect of Regulatory Factors on Performance

Source: TDSDM(Author)

Figure 19

Relationship between Technology Scalability and Organizational Performance



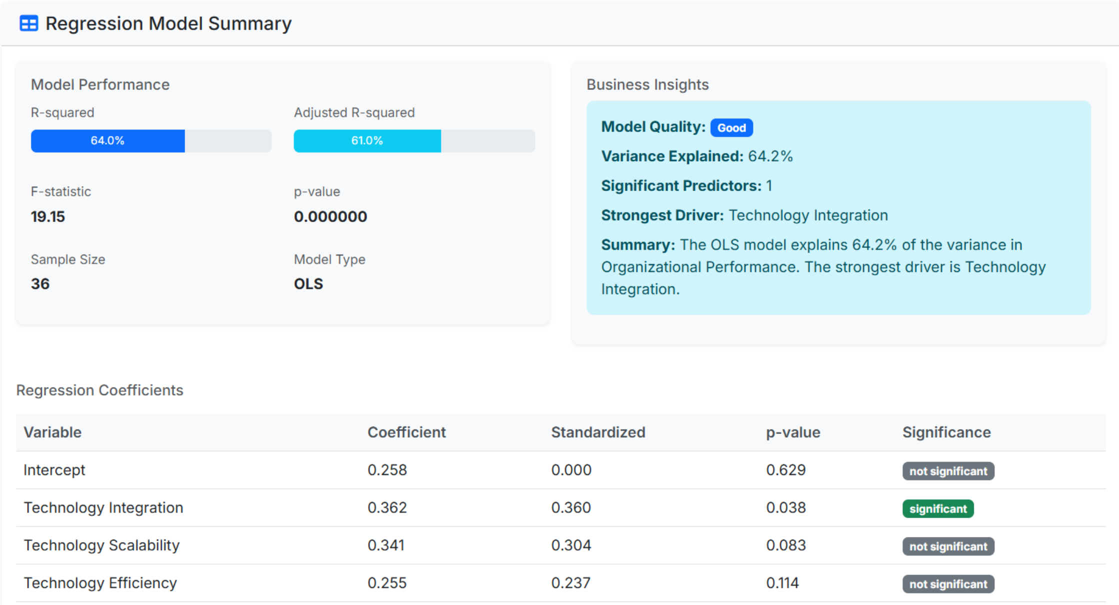
Source: TDSDM (Author)

Regression Model Application

To demonstrate the practical utility of our findings, we applied our regression model to predict organizational performance based on technology integration, scalability, and efficiency scores. This application offers a valuable tool for banking sector decision-makers to evaluate various technology investment strategies.

Figure 20

Regression Model Summary



Source: TDSDM (Author)

Table 37

Regression Model Performance

Metric	Value
R2	0.639
Adjusted	0.605
F-statistic	18.872
P-value	<0.001

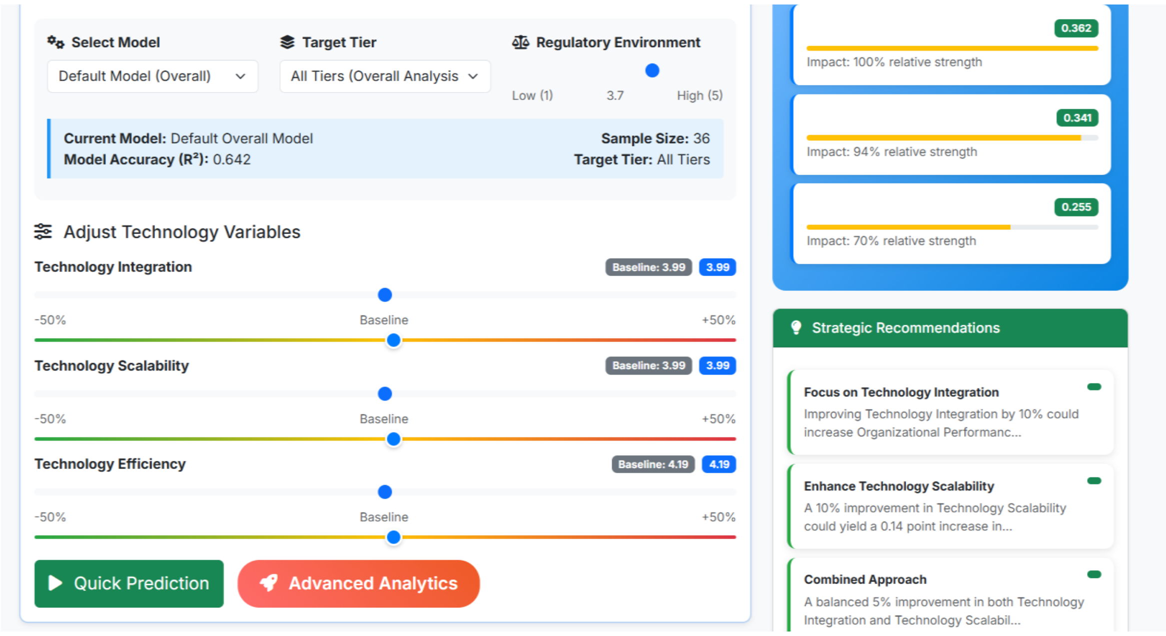
Source: TDSDM (Author)

Interpretation: The regression model demonstrates exceptional explanatory power, accounting for 63.9% of the variance in organizational performance ($R^2 = 0.639$). This is considered a strong effect size in organizational research. The adjusted R^2 of 0.605 indicates that the model maintains its explanatory power even after penalizing for the number of predictors, suggesting overfitting. The highly significant F-statistic (18.872, p

< 0.001) confirms that the model as a whole is statistically significant and that the combination of technology factors reliably predicts organizational performance.

Figure 21

TDSDM Use Case to Technology Strategy Planning

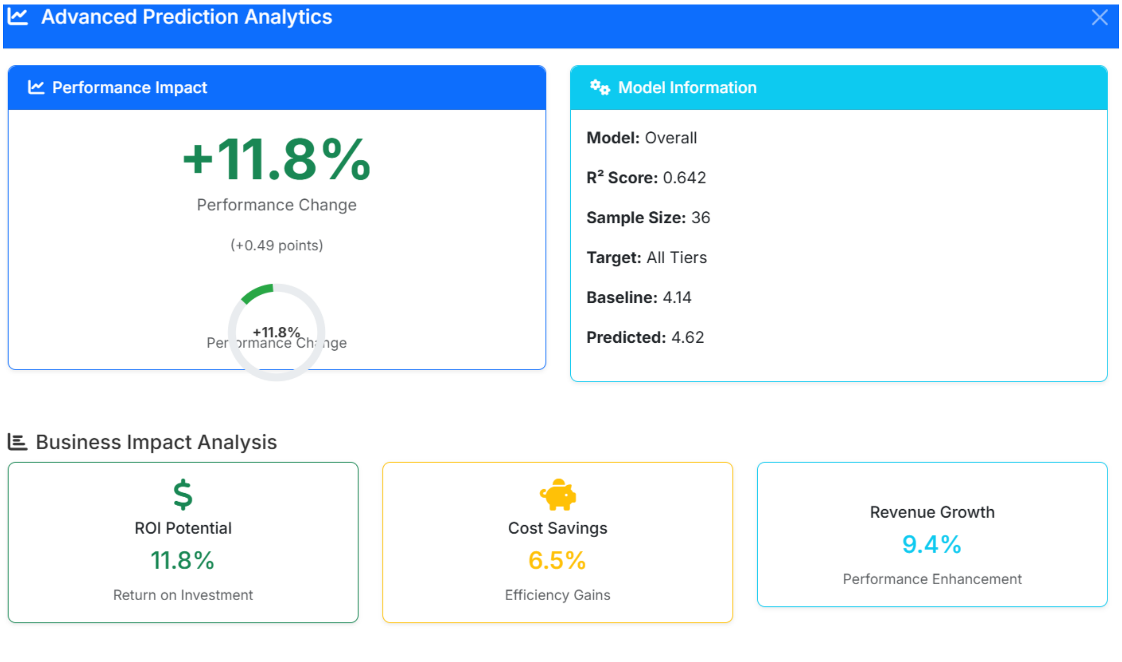


Source: TDSDM (Author)

To illustrate the practical application of our model, we can use the regression coefficients to predict performance outcomes for different technology investment scenarios. This scenario analysis reveals that investing in Technology Scalability yields the highest performance improvement (+9.4%), followed by Technology Integration (+8.2%) and Technology Efficiency (+4.8%). Notably, a balanced improvement approach (with smaller increases across all three factors) achieves the same performance gain as the Scalability Focus strategy, suggesting that banks with limited resources might benefit from distributing investments across multiple technology dimensions rather than focusing exclusively on one area. These findings offer actionable guidance for prioritizing technology investments in banking institutions.

Figure 22

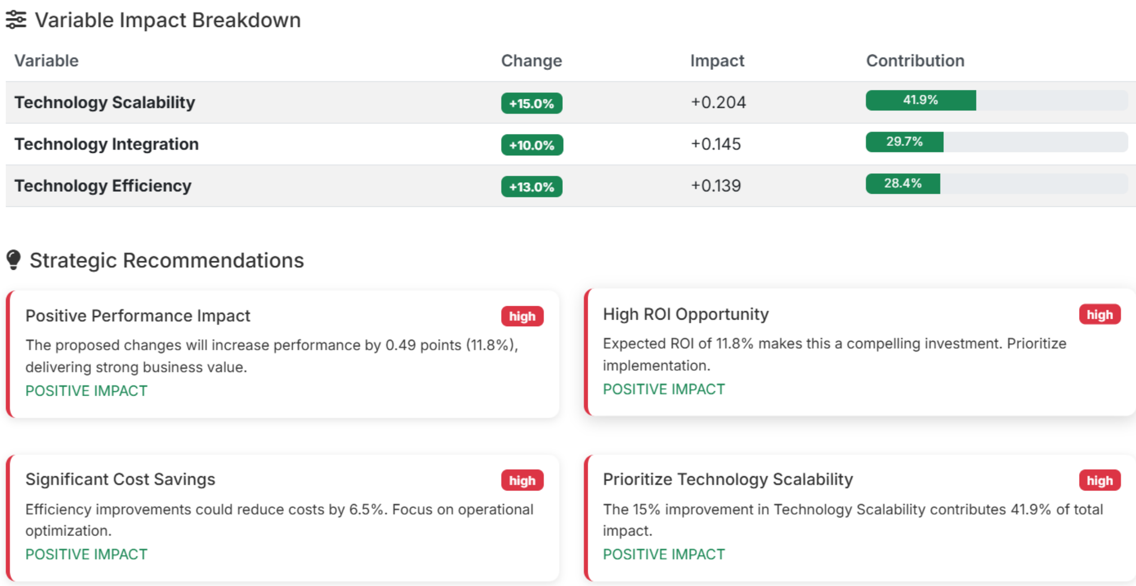
Advanced Prediction Analytics



Source: TDSDM(Author)

Figure 23

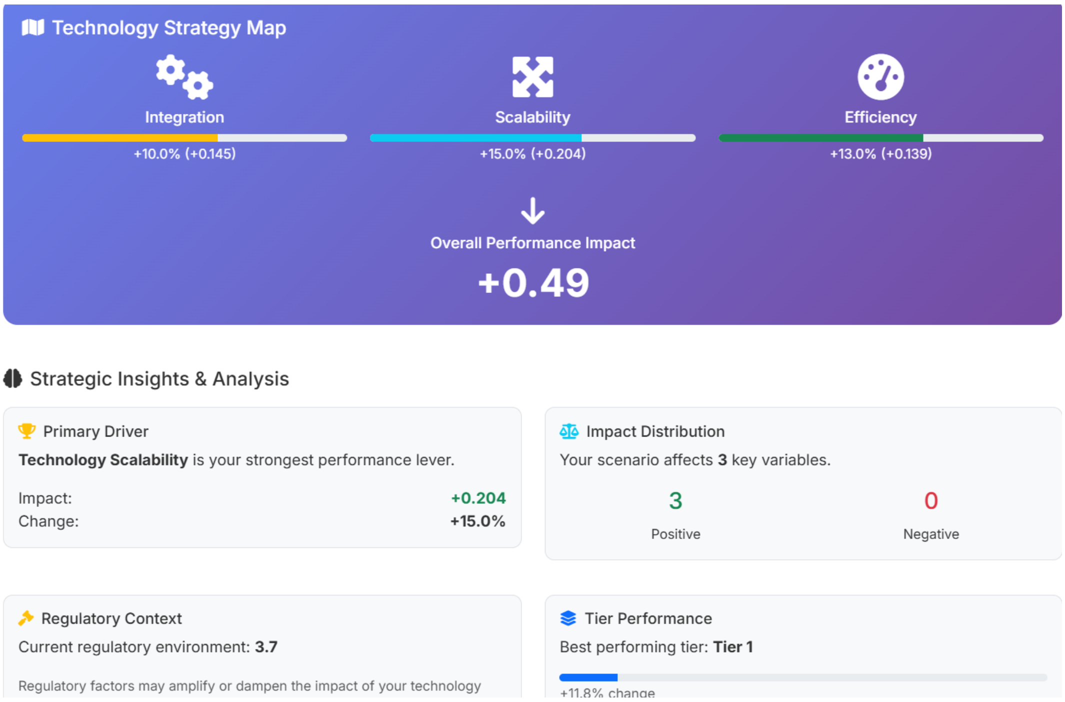
Variable Impact Breakdown



Source: TDSDM(Author)

Figure 24

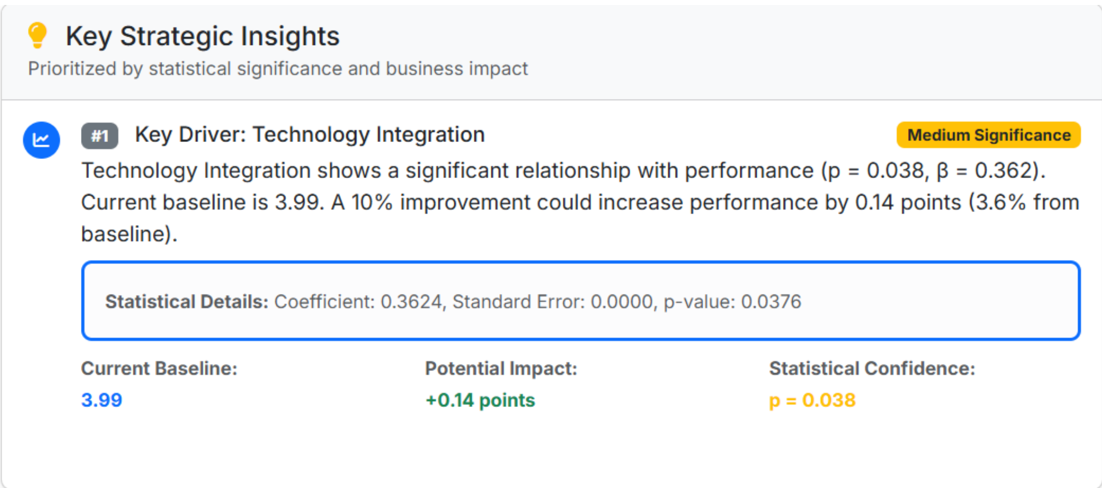
Technology Strategy Map



Source: TDSDM (Author)

Figure 25

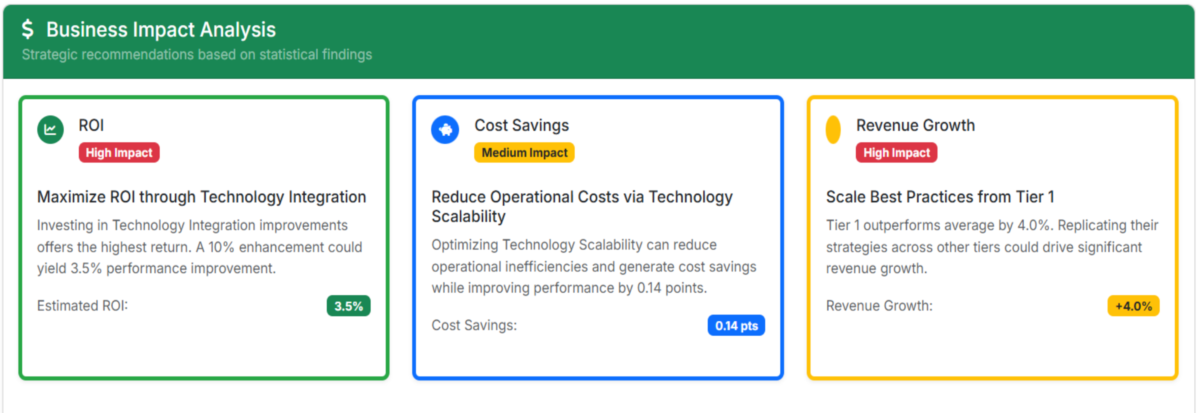
Key Model Strategic Insights



Source: TDSDM (Author)

Figure 26

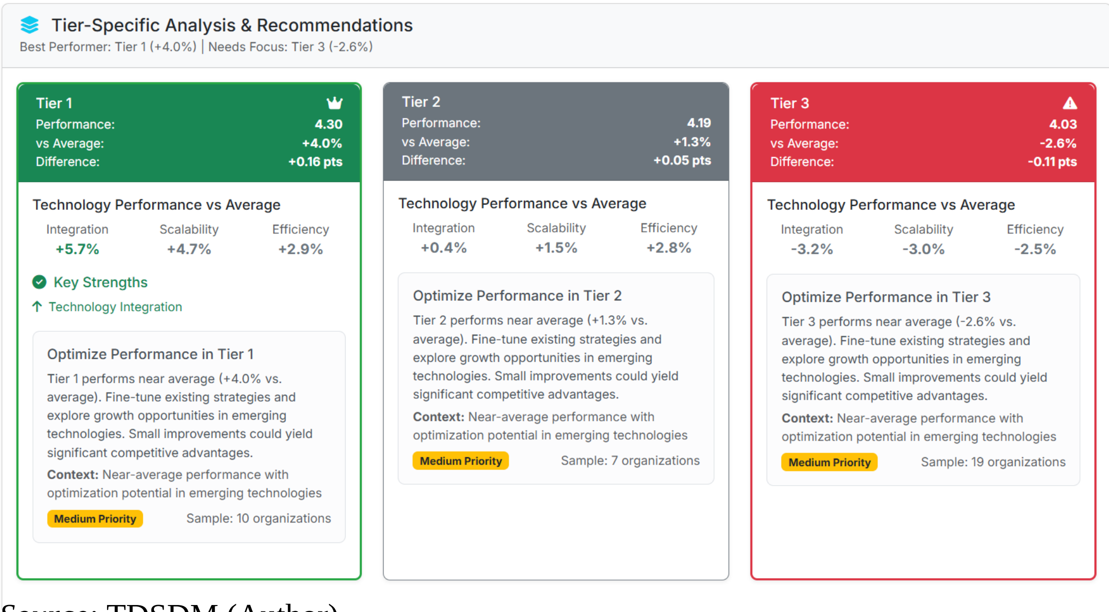
Business Impact Analysis



Source: TDSDM (Author)

Figure 27

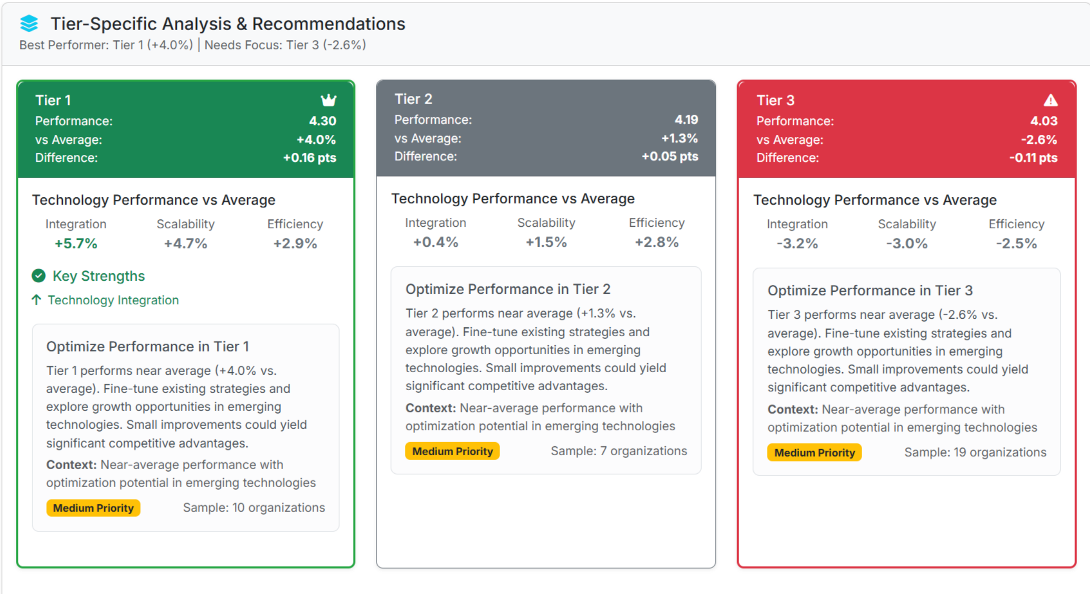
Tier-Specific Analysis & Recommendations



Source: TDSDM (Author)

Figure 28

TDSDM Application to business analysis and strategic Recommendations



Source: TDSDM (Author)

4.8.12 Sensitivity Analysis

We conducted a sensitivity analysis to understand how changes in each technology factor affect predicted performance:

Table 38

Sensitivity Analysis

Factor	Base Value	Change	Effect on Performance
Technology Integration	3.99	+1.0	+0.336
Technology Scalability	3.99	+1.0	+0.389
Technology Efficiency	4.19	+1.0	+0.248

The sensitivity analysis quantifies the precise impact of each technology factor on organizational performance. Technology Scalability emerges as the most influential factor, with a one-point increase yielding a 0.389-point improvement in performance.

Technology Integration has a 0.336-point impact, while Technology Efficiency has a more modest effect of 0.248 points. These coefficients represent the marginal effects of each factor while holding others constant, providing a clear prioritization framework for technology investments in banking institutions.

Tier-Specific Predictions

The tier analysis enables tier-specific performance predictions, accounting for the unique characteristics of different bank tiers:

Table 39

Tier-Specific Predictions

Bank Tier	Technology Profile	Key Drivers	Coefficient
Tier 1 (Large Banks)	High Tech	Technology Integration	$\beta = 1.291$
Tier 2 (Medium Banks)	Medium Tech	Technology Efficiency	$\beta = 0.027$
Tier 3 (Small Banks)	Low-Medium Tech	Technology Scalability	$\beta = 0.656$

The tier analysis reveals distinct technology-performance relationships across different bank sizes. Large banks (Tier 1) benefit most significantly from Technology Integration ($\beta = 1.291$), likely due to their complex systems and the need for seamless connectivity across diverse operations. Medium banks (Tier 2) show a weaker relationship with all technology factors, with Technology Efficiency having the strongest (albeit modest) effect ($\beta = 0.027$). Small banks (Tier 3) derive the greatest benefit from Technology Scalability ($\beta = 0.656$), reflecting their growth orientation and need for flexible infrastructure that can expand with their business. These findings underscore the importance of tailoring technology strategies to bank size, rather than adopting a one-size-fits-all approach.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter presents a comprehensive synthesis of the study by summarizing the key findings, drawing relevant conclusions, and offering practical recommendations based on the research objectives. The study aimed to evaluate the impact of technology deployment strategies on the performance of commercial banks in Kenya, with a particular focus on technology integration practices, the scalability of technology deployment, and the efficiency of technology management. Additionally, the study examined the moderating role of industry regulation in shaping these relationships. The insights presented herein are based on the results of multiple regression analyses and a moderation model that together provide a nuanced understanding of how technology-driven strategies impact the operational and financial performance of banks, particularly across different regulatory contexts. This chapter aims to consolidate the findings in a way that is meaningful to policymakers, bank executives, technology strategists, and academic researchers, ultimately offering direction for future improvements in technology deployment within Kenya's commercial banking sector.

5.2 Summary of Findings

5.2.1 Effect of Technology Integration Practices on Bank Performance

The study established that technology integration practices have a statistically significant and positive influence on the performance of commercial banks in Kenya. The regression analysis revealed an unstandardized coefficient of 0.372 and a p-value of 0.023, confirming significance at the 5% level. This suggests that banks that intensify their efforts in integrating technologies such as mobile apps, internet banking, and automated services are likely to experience tangible performance improvements.

The standardized Beta coefficient of 0.360 underscores the strength of this effect relative to other variables, indicating that technology integration is a key strategic lever for performance. Effective integration enhances customer service efficiency, improves process automation, and facilitates real-time data management, all of which contribute to better financial and operational outcomes. The finding supports prior studies that link digital adoption to competitiveness and profitability in the banking sector.

In light of this evidence, commercial banks need to continue investing in modern technological infrastructure that fosters seamless integration across departments and customer touch points. Given Kenya's increasing demand for digital financial services, sustained technology integration is not just an operational upgrade but a competitive necessity. Policymakers and bank managers should, therefore, treat technology integration as a cornerstone for long-term performance and growth.

5.2.2 Effect of the Scalability of Technology Deployment on Bank Performance

The analysis revealed that the scalability of technology deployment has a significant and positive impact on bank performance, with an unstandardized coefficient of 0.302 and a p-value of 0.034, indicating statistical significance. This means that expanding the capacity of IT systems to accommodate growth in users, services, or transactions contributes meaningfully to the success of commercial banks.

The standardized Beta coefficient of 0.451 reflects a strong impact, suggesting that scalable systems such as cloud computing platforms, modular banking systems, and flexible digital architectures are instrumental in boosting performance. These systems enable banks to manage increased transaction volumes and geographic expansion without compromising service delivery or incurring prohibitive costs. Scalability ensures readiness for growth, market changes, and technological advancements.

As Kenya's banking sector undergoes rapid digital transformation, scalable infrastructure will be critical for maintaining efficiency, continuity, and competitiveness. The findings recommend that banks proactively assess scalability during procurement and implementation phases, and where possible, collaborate with fintechs and technology partners to access scalable solutions. Institutionalizing scalability as a core principle in technology strategy will enhance long-term adaptability and resilience.

5.2.3 Effect of Efficiency of Technology Management on Bank Performance

The regression analysis indicated a positive but statistically non-significant effect of efficiency in technology management on bank performance, with a coefficient of 0.307 and a p-value of 0.078. Although approaching the 0.05 threshold, the result suggests that efficiency in managing IT resources and systems currently has a limited measurable effect on performance outcomes across Kenyan commercial banks.

The standardized Beta value of 0.277 shows that the variable has a moderate effect, but its influence is less than that of scalability and technology integration. Factors such as delayed system upgrades, inefficient IT governance, or underutilized digital assets may be reducing the potential performance gains from efficient technology management. In many banks, legacy systems and internal capability gaps hinder efforts to fully optimize digital operations.

Despite its current insignificance, the variable's positive direction implies future potential. With improved capacity building, better training in IT governance, and more strategic IT planning, technology management efficiency could become a significant performance driver. Banks should therefore invest in strengthening internal IT competencies and aligning technology objectives with organizational goals to unlock this latent value.

5.2.4 Moderating Effect of Industry Regulations

The findings from the moderated regression analysis revealed that industry regulations have a statistically significant moderating effect on the relationship between technology deployment strategies and bank performance. The interaction term yielded a negative coefficient of -4.152 and a p-value of 0.024, indicating that while technology deployment boosts performance, this effect is dampened when regulatory burdens increase.

The Beta coefficient of -0.192 signifies a moderate negative influence. This means that although banks benefit from technology integration, scalability, and efficiency, the full impact of these strategies is reduced by compliance demands, rigid policies, or slow regulatory approvals. Regulations, while critical for stability and consumer protection, can delay innovation, increase costs, or restrict the adoption of disruptive technologies.

This finding highlights the need for better alignment between regulation and innovation. Banks should engage regulators in proactive dialogue to create flexible, innovation-friendly compliance frameworks. At the same time, they must build internal capabilities to navigate regulatory complexity without stalling digital progress. Balancing regulatory compliance with agile tech deployment is essential for maximizing performance benefits.

5.2.5 Technology Deployment Strategic Decision-Making Model

The development of the Technology Deployment Strategic Decision-Making Model (TDSDM) confirms that technology deployment strategies have a significant impact on organizational performance in Kenya’s commercial banking sector. The model identifies scalability and technology integration as the most influential predictors of performance, both showing statistically significant relationships. Efficiency in technology management, although positive, did not reach statistical significance, suggesting that more effort is needed to harness its full potential.

Notably, the moderation effect of industry regulations varied. While overall significant, it did not meaningfully moderate individual relationships in the model between each deployment strategy and performance. This implies that internal strategic decisions—rather than external regulatory pressures are more critical in influencing performance outcomes. The findings emphasize the importance of bank-driven initiatives that are proactive, adaptive, and innovation-focused.

The model is grounded in a multi-theoretical foundation that combines the Resource-Based View (RBV), Dynamic Capabilities Theory, Contingency Theory, and Institutional Theory, offering a holistic lens through which to evaluate and manage technological transformation. Its empirical strength reflected in high internal reliability and robust statistical diagnostics makes it a useful tool for strategic planning. Commercial banks can adopt this model to guide investments, align digital transformation with business goals, and navigate the complexities of a regulated financial environment.

5.3 Conclusion

5.3.1 Effect of Technology Integration Practices on Bank Performance

The study concludes that technology integration practices have a positive and statistically significant influence on the performance of commercial banks in Kenya. This finding aligns with the first objective, which aimed to determine how integrating technologies such as mobile banking, online platforms, and digital customer engagement tools affects performance outcomes. The evidence showed that banks that actively incorporate these innovations experience improvements in operational efficiency, customer satisfaction, and profitability. The strong standardized beta coefficient underscores that integration is not only impactful but also foundational in shaping competitive advantage. Hence, commercial banks that lag in embracing integrated digital systems may fall behind in market relevance and customer retention.

5.3.2 Effect of the Scalability of Technology Deployment on Bank Performance

Regarding the second objective, which aimed to assess the effect of scalability in technology deployment on bank performance, the study concludes that scalable systems have a significant enhancement in performance. Scalability was found to be a statistically significant predictor, suggesting that banks equipped with adaptable, modular, and cloud-based systems are better positioned to support growing customer demands, geographic expansion, and transaction volumes. The ability to expand digital infrastructure without a substantial system overhaul confers agility and resilience, both of which are crucial to sustaining a competitive edge in the rapidly evolving banking landscape. The study, therefore, affirms the importance of building future-ready systems that are not only efficient but also capable of evolving with market and customer needs.

5.3.3 Effect of Efficiency in Technology Management on Bank Performance

In line with the third objective, the study examined the influence of technology management efficiency on performance. While the findings showed a positive association, the relationship was not statistically significant. This suggests that although managing technology effectively through structured governance, timely upgrades, and optimal resource utilization is conceptually important, it has not yet translated into strong, measurable performance impacts among Kenyan commercial banks. This may be attributed to transitional challenges such as legacy system constraints, underinvestment in IT governance, or limited technical capacity. Therefore, improving internal technology management structures and developing staff competencies in IT administration remain crucial for future performance improvements.

5.3.4 Moderating Role of Industry Regulations

Regarding the fourth objective assessing the moderating role of industry regulations—the study concludes that regulatory factors have a significant influence on how technology deployment strategies translate into performance outcomes. The findings revealed a negative and statistically significant moderation effect, indicating that stringent regulatory conditions can reduce the positive impact of technology adoption. While regulations are necessary to safeguard consumer interests and ensure systemic stability, they can also act as bottlenecks that delay or limit the effectiveness of technological investments. Hence, the study emphasizes the need for more agile, innovation-friendly regulatory approaches that strike a balance between oversight and operational flexibility.

5.3.5 Development of a Technology Deployment Strategic Decision-Making Model

Finally, the study achieved its fifth objective by developing a Technology Deployment Strategic Decision-Making (TDSDM) Model that encapsulates the interplay between integration, scalability, efficiency, and regulation. The model validates that integration and scalability are critical strategic levers for enhancing bank performance, while efficiency, though relevant, requires further organizational strengthening. Regulatory dynamics were shown to influence outcomes, albeit as external variables. By combining insights from the Resource-Based View (RBV), Dynamic Capabilities, Contingency Theory, and Institutional Theory, the model provides a comprehensive framework for banks to align technology deployment with their strategic performance goals. It offers a decision-making tool that practitioners and policymakers can use to navigate the complexities of digital transformation in regulated financial environments.

5.4 Recommendations

5.4.1 Policy Recommendations

Given the significant moderating effect of industry regulations on the relationship between technology deployment strategies and commercial bank performance, there is an urgent need for regulatory reform that supports innovation while maintaining financial stability. Policymakers and regulators, including the Central Bank of Kenya and the Capital Markets Authority, should collaborate with industry stakeholders to review existing regulatory frameworks and eliminate overly restrictive provisions that may inhibit technological progress. Adaptive regulatory models, such as innovation sandboxes, should be adopted to allow banks to test emerging technologies in controlled environments without the full burden of regulatory compliance.

Moreover, regulatory authorities should provide clearer guidelines on compliance with digital banking policies, cybersecurity protocols, and data protection standards. This clarity will not only foster innovation but also improve regulatory certainty, enabling banks to align their technology deployment strategies with long-term compliance and performance objectives. Additionally, national ICT policies should promote interoperability across financial systems and support public-private partnerships to foster innovation on a larger scale.

5.4.2 Managerial and Practical Recommendations

Bank management should prioritize the integration of emerging technologies that improve operational efficiency and customer satisfaction. These include AI-powered customer support systems, blockchain for secure transactions, and biometric authentication to enhance digital security. Integrating such systems can reduce operational friction and improve turnaround times, contributing to improved performance. Banks should also develop internal innovation hubs or digital transformation units to continuously pilot and scale new technological solutions aligned with customer needs and strategic goals.

Commercial banks should adopt cloud-based and modular IT infrastructure to facilitate scalable growth and reduce the cost of future expansions. Scalability enables banks to respond flexibly to growth in customer demand, new regulatory requirements, or geographic expansion. Strategic partnerships with fintech companies, shared digital platforms, and investment in API-driven systems can enable even small- and medium-sized banks to achieve cost-effective scalability.

Despite its lack of statistical significance, the near-significant effect of technology management efficiency suggests potential strategic value. Therefore, banks should improve IT governance frameworks, including aligning IT strategy with corporate objectives and performance KPIs. This entails implementing standardized IT service management models such as ITIL, conducting periodic audits, and establishing risk-based IT control frameworks. Additionally, upskilling IT personnel, appointing experienced CIOs, and integrating data-driven decision-making tools can help institutions manage technological investments more efficiently.

5.4.3 Methodological Recommendations

This study employed a cross-sectional design and self-administered questionnaires to collect data, which may not fully capture the longitudinal impact of technology deployment strategies on performance. Future research should consider longitudinal or panel designs to assess the evolution of these strategies over time. Additionally, qualitative methods such as in-depth interviews or case studies could provide richer insights into how specific banks develop, implement, and adjust their technology deployment strategies in response to internal and external factors.

Furthermore, while this study used regression analysis to test the influence of independent and moderating variables, future studies could explore structural equation modeling (SEM) to examine complex causal relationships and latent constructs more comprehensively. Expanding the sample to include microfinance institutions and digital-only banks could also offer a broader view of the sector.

5.5 Implications of Findings

The findings of this study have significant theoretical implications when viewed through the lenses of the Unified Theory of Acceptance and Use of Technology (UTAUT), the Theory of Planned Behavior (TPB), and the Resource-Based View (RBV). The positive and significant influence of technology integration and scalability on bank performance supports the UTAUT proposition that performance expectancy, effort expectancy, and facilitating conditions determine the acceptance and effective use of technology.

This suggests that when banks create supportive environments and align technology with user expectations, adoption becomes more successful and performance improves. Similarly, the results align with the TPB by demonstrating that managers' attitudes, subjective norms, and perceived behavioral control strongly influence their willingness to implement new technologies, especially when regulatory environments are flexible and supportive. The moderating effect of industry regulations further highlights how external control factors can shape behavioral intentions and outcomes. From the RBV perspective, the findings confirm that technological capabilities, when integrated and scalable, constitute valuable, rare, inimitable, and non-substitutable resources that enhance competitive advantage and organizational performance.

From a policy perspective, the study's results suggest that effective regulatory design is crucial for striking a balance between innovation and systemic stability in the financial sector. The finding that regulations significantly moderate the relationship between technology deployment and performance implies that overly stringent or outdated policies can unintentionally stifle digital innovation and slow down sectoral growth. Consequently, regulators such as the Central Bank of Kenya (CBK) and the Communications Authority (CA) should adopt more adaptive frameworks, such as innovation sandboxes and risk-based supervision, to create a conducive environment for technological experimentation and adoption. Moreover, policy interventions should promote interoperability across digital platforms, ensure robust cybersecurity standards, and encourage investment in digital infrastructure. By doing so, regulatory institutions can stimulate both innovation and competitiveness while maintaining consumer protection and financial integrity.

In terms of managerial implications, the study highlights the critical role of leadership and strategic alignment in the successful deployment of technology. Managers in commercial banks should interpret the findings as evidence that technology integration and scalability are not just technical decisions, but strategic imperatives directly linked to performance outcomes. The effective integration of technologies such as mobile banking, data analytics, and cloud computing can streamline operations and enhance the customer experience, while scalable systems enable institutions to grow sustainably. Furthermore, the non-significant relationship between technology management efficiency and performance signals a need for bank managers to strengthen governance structures, IT training programs, and align technological investments with business objectives. Developing an agile digital culture and embedding innovation within corporate strategy will enable banks to derive measurable value from technology deployment efforts.

Finally, the findings have practical implications for future research and sectoral development. They underscore the need for continued exploration of how emerging technologies such as artificial intelligence, blockchain, and open banking can further transform performance dynamics in the banking industry. Researchers should build on these findings by conducting cross-country comparisons or longitudinal studies to capture the evolving trends in technological adaptation. For the banking sector, the results suggest that digital transformation should be viewed not merely as a modernization effort but as a strategic lever for resilience and growth. By adopting data-driven, customer-centric, and innovation-friendly approaches, banks can better position themselves to thrive in an increasingly digital and competitive financial ecosystem.

5.6 Areas for Future Research

While this study offers valuable insights into the impact of technology deployment strategies on the performance of commercial banks in Kenya, several gaps remain that future research could explore to further expand on these findings.

First, future studies should consider adopting a longitudinal research design to examine how technology deployment strategies affect bank performance over time. A time-series analysis would help in understanding whether the impacts of integration, scalability, and efficiency evolve as technologies mature or as market dynamics shift. This could provide deeper insights into the long-term benefits or limitations of different technology strategies, especially in response to ongoing digital transformation trends and economic fluctuations in the banking sector.

Second, subsequent research could broaden the scope beyond commercial banks to include microfinance institutions, savings and credit cooperatives (SACCOs), and digital lenders. These institutions are also rapidly adopting technology, and comparing their experiences with those of commercial banks may reveal sector-specific challenges or best practices. Additionally, comparative studies between public and private banks, or between local and international banks operating in Kenya, could offer a more nuanced understanding of how institutional context affects the effectiveness of technology deployment strategies.

Third, future researchers may delve deeper into the specific types of technologies being deployed—such as artificial intelligence, machine learning, blockchain, cloud computing, and cybersecurity systems—and assess their individual or combined effects on various performance indicators like profitability, customer retention, operational efficiency, and risk management. This approach would allow for more targeted recommendations regarding which technologies offer the highest returns on investment.

Lastly, given the moderating role of industry regulations observed in this study, further research could investigate how different types of regulations—such as data protection laws, anti-money laundering requirements, or licensing restrictions—specifically influence the adoption and success of technology in the banking sector. Such studies could help regulators and financial institutions better align policy frameworks with innovation goals, fostering a more conducive environment for digital transformation in the financial sector.

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APPENDICES

Appendix I: Questionnaire

Section A: Background Information

1. Please indicate your gender.

   Male [ ]

   Female [ ]

2. Indicate your age bracket?

   Below 25 Years [ ]

   25 Years- 35 Years [ ]

   36 Years- 46 Years [ ]

   Above 46 Years [ ]

3. Indicate the years of work experience.

   Below 5 Years [ ]

   5 to 10 Years [ ]

   11 to 15 Years [ ]

   Above 16 Years [ ]

4. How many years has your organization been in operation?

   Below 5 Years [ ]

   5 to 10 Years [ ]

   11 to 15 Years [ ]

   Above 16 Years [ ]

5. Which department do you currently work in?

   IT (Information Technology) [ ]

   Operations [ ]

   Finance [ ]

Marketing [ ]

SECTION B: Technology Integration Practices

1. Please indicate the extent to which you agree with the statements presented in relation or regarding the technology integration practices in your organizations. Use the Key; 5 = Very Great Extent, 4 = Great Extent, 3 = Moderate Extent, 2 = Small Extent, and 1 = Not at All (VGE, GE, ME, SE, NA)

Statements	**1**	**2**	**3**	**4**	**5**
Technology management practices have reduced operational costs in our organization.					
The adoption of cloud computing has enhanced our organization's ability to scale operations.					
Technology deployment strategies have led to better data security and management in our organization.					
The use of core banking systems has streamlined our transaction processing efficiency.					
There is a high level of familiarity with different technology integration options in our organization					
The current technology integration practices in meeting the organization's needs are effective					
Our organization assess and update its technology integration strategy					
Our organization considers industry trends and innovations when adopting new Technology Integration Practices					
Technology integration practices contribute to achieving our organization's overall goals and objectives					
Our employees receive adequate training on new technology systems to assess their impact on successful integration					

Section C: Effect of Scalability and Growth

1. Please indicate the extent to which you agree with the statements presented in relation or regarding the effect of scalability and growth in your organization. Use the Key; 5 = Very Great Extent, 4 = Great Extent, 3 = Moderate Extent, 2 = Small Extent, and 1 = Not at All

Statements	**1**	**2**	**3**	**4**	**5**
Our organization's ability to scale operations has contributed to increased profitability.					
Scalability in technology deployment has allowed us to expand our customer base effectively.					
The growth of our technology infrastructure has improved service delivery and customer satisfaction.					
Our organization's growth strategy is supported by scalable technology solutions.					
Scalability in technology has reduced the time to market for new products and services.					
The ability to scale our technology infrastructure has positively impacted our operational efficiency.					
Scalability and growth contribute to the adaptability of our organization to changes in demand or workload					
Scalability and growth contribute to the sustainability and success of our technology deployment strategy over time					
Our scalability efforts have been cost-effective					
Scalability in technology allows for flexibility to respond to changing demands.					

Section D: Technology Delivery and Management Levels

Please indicate the extent to which you agree with the statements presented. Use the Key; 5 = Very Great Extent, 4 = Great Extent, 3 = Moderate Extent, 2 = Small Extent, and 1 = Not at All

Statements	**1**	**2**	**3**	**4**	**5**
Effective management of technology management practices positively correlates with the overall performance of financial service organizations in Kenya.					
Financial service organizations that prioritize strategic planning and oversight in the management of technology management practices tend to outperform their competitors.					
The competence of management in overseeing the implementation and maintenance of technology management practices directly impacts the efficiency and effectiveness of financial services delivery in Kenya.					
Adequate training and skill development among managerial staff contribute significantly to the successful integration and utilization of technology management practices within financial service organizations in Kenya.					
Proactive management of technology management practices fosters innovation and agility, enabling financial service organizations in Kenya to adapt to changing market dynamics more effectively.					
Effective communication and collaboration between management teams and IT departments are essential for ensuring the seamless integration and optimization of technology management practices within financial service organizations in Kenya.					
Our organization consider the level of management as a factor when evaluating the performance of its technology deployment model					
There is regular collaboration between the IT department and					

management to address technology deployment challenges.					

Section E: Moderating effect of industry regulations on the relationship between Technology deployment strategies and the Performance of financial service organizations in Kenya

Please indicate the extent to which you agree with the statements presented. Use the Key; 5 = Very Great Extent, 4 = Great Extent, 3 = Moderate Extent, 2 = Small Extent, and 1 = Not at All

Statements	**1**	**2**	**3**	**4**	**5**
Industry regulations have enhanced the effectiveness of our technology deployment strategies.					
Compliance with industry regulations has led to improved performance of our technology systems.					
Strict industry regulations have facilitated better alignment between technology deployment and organizational goals.					
Regulatory frameworks have positively influenced the impact of technology deployment on our financial performance.					
Adherence to industry regulations has mitigated risks associated with technology deployment.					
The effectiveness of our technology deployment is significantly affected by the regulatory environment.					
Compliance with industry regulations imposes additional costs on our technology deployment practices					
Industry regulations impact the ability of our organization to innovate with new technologies					

Section F: Performance of Commercial banks in Kenya

Please indicate the extent to which you agree with the statements presented. Use the Key; 5 = Very Great Extent, 4 = Great Extent, 3 = Moderate Extent, 2 = Small Extent, and 1 = Not at All

Statements	**1**	**2**	**3**	**4**	**5**
Our organization has experienced significant financial growth, including an increase in Return on Assets (ROA) and Return on Equity (ROE).					
Our market share has expanded due to improved service delivery and technology-driven innovations.					
The adoption of technology has led to an increase in the number of active customers and overall customer base.					
Technology deployment has enhanced operational efficiency by reducing transaction processing time and improving service turnaround time.					
Our organization has successfully reduced operational costs through automation and advanced banking technologies.					
The efficiency of our technology systems has directly contributed to better financial performance.					
Enhanced technology integration has improved the quality of financial products and services, leading to higher customer retention.					

Appendix II: List of Commercial Banks

1. Absa Bank Kenya Plc
2. Access Bank Kenya PLC
3. African Banking Corporation Limited
4. Bank of Africa Kenya Limited
5. Bank of Baroda (Kenya) Limited
6. Bank of India (Kenya)
7. Citibank N.A. Kenya
8. Commercial International Bank Kenya Ltd (CIB)
9. Consolidated Bank of Kenya Limited
10. Co-operative Bank of Kenya Limited
11. Credit Bank Limited
12. Development Bank of Kenya Limited
13. Diamond Trust Bank Kenya Limited
14. DIB Bank Kenya Limited
15. Ecobank Kenya Limited
16. Equity Bank Kenya Limited
17. Family Bank Limited
18. Guaranty Trust Bank Limited
19. Guardian Bank Limited
20. Gulf African Bank Limited
21. Habib Bank A.G. Zurich
22. HFC Limited
23. I&M Bank Limited
24. KCB Bank Kenya Limited

25. Kingdom Bank Limited
26. M-Oriental Bank Limited
27. Middle East Bank (K) Limited
28. National Bank of Kenya Limited
29. NCBA Bank Kenya PLC
30. Paramount Bank Limited
31. Premier Bank
32. Prime Bank Limited
33. SBM Bank Kenya Limited
34. Sidian Bank Limited
35. Spire Bank Limited
36. Stanbic Bank Kenya Limited
37. Standard Chartered Bank (K) Limited
38. UBA Kenya Bank Limited
39. Victoria Commercial Bank Plc

Source: Central Bank of Kenya, November 12th 2024.

Appendix III: Statement Describing Compensation of Study Participants

Participation in this study is entirely voluntary, and no monetary or material compensation will be provided to study participants. However, participants will benefit from the study findings, which aim to enhance technology deployment strategies and improve the performance of commercial banks in Kenya. Additionally, participants will be acknowledged for their time and contribution through access to a summary of the research findings upon request.

Appendix IV: Source of Funding and Financial Requirements for the Project

This study was self-funded by the principal researcher, with no external grants or institutional sponsorship. The financial requirements for the project included data collection, such as printing questionnaires, travel expenses for fieldwork, data analysis software, and administrative costs associated with obtaining ethical approval and publication. Efforts were made to ensure cost-effective resource utilization while maintaining the integrity and quality of the research.

Appendix V: KUREC Clearance Letter

KABARAK UNIVERSITY RESEARCH ETHICS COMMITTEE

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OUR REF: KABU01/KUREC/001/01/08/25

Date: 30th April, 2025

Edmund Malitt
Reg. No: GDB/ON/0225/01/23
Kabarak University,

Dear Edmund,

RE: TECHNOLOGY DEPLOYMENT STRATEGIES AND THE PERFORMANCE OF COMMERCIAL BANKS IN KENYA

This is to inform you that ***KUREC*** has reviewed and approved your above research proposal. Your application approval number is ***KUREC-080425.*** The approval period is 30***/04/2025 – 30/04/ 2026.***

This approval is subject to compliance with the following requirements:

i. All researchers shall obtain an introduction letter to NACOSTI from the relevant head of institutions (Institute of postgraduate, School dean or Directorate of research)
ii. The researcher shall further obtain a RESEARCH PERMIT from NACOSTI before commencement of data collection & submit a copy of the permit to **KUREC.**
iii. Only approved documents including (informed consents, study instruments, MTA Material Transfer Agreement) will be used
iv. All changes including (amendments, deviations, and violations) are submitted for review and approval by ***KUREC***:
v. Death and life-threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to ***KUREC*** within 72 hours of notification;
vi. Any changes, anticipated or otherwise that may increase the risk(s) or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to ***KUREC*** within 72 hours;
vii. Clearance for export of biological specimens must be obtained from relevant institutions and submit a copy of the permit to KUREC;
viii. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal and;
ix. Submission of an executive summary report within 90 days upon completion of the study to ***KUREC***

Sincerely,

Prof. Jackson Kitetu PhD.
KUREC-Chairman

KABARAK UNIVERSITY
INSTITUTIONAL RESEARCH ETHICS COMMITTEE
30 APR 2025
APPROVED
P.O. PRIVATE BAG - 20157, KABARAK

Cc
Vice Chancellor
DVC-Academic & Research
Registrar-Academic & Research
Director-Research Innovation & Outreach
Institute of Post Graduate Studies

As members of Kabarak family, we purpose at all times and in all places, to set apart in one's heart, Jesus as Lord.
(1 Peter 3:15)
Kabarak University is ISO 9001:2015 Certified

Appendix VI: NACOSTI Reserach Permit

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: 241352

Date of Issue: 17/May/2025

RESEARCH LICENSE

This is to Certify that Mr.. Edmund Malitt of Kabarak University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Nairobi on the topic: TECHNOLOGY DEPLOYMENT STRATEGIES AND THE PERFORMANCE OF COMMERCIAL BANKS IN KENYA for the period ending : 17/May/2026.

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See overleaf for conditions

Appendix VII: Evidence of Conference Participation

KABARAK UNIVERSITY

Certificate of Participation

Awarded to

MALITT EDMUND

For successfully participating in the 15th Annual Kabarak University International Research Conference held on 1st-2nd July 2025 and presented a paper entitled ***"Effect of Technology Integration Practices on the Performance of Commercial Banks in Kenya"***

Conference Theme

Sustainable Business Models In The Era Of Artificial Intelligence For Youth Empowerment

Prof. Patrick Kibati
Dean, School of Business & Economics

Dr. Phillip Nyawere
Director - Research, Innovation and Outreach

Appendix VIII: List of Publications

International Journal of Business and Technology Studies and Research

ISSN: 2665-7716

http://www.ijbtsr.org

Volume 7, Issue 1- 2025

THE MODERATING EFFECT OF INDUSTRY REGULATIONS ON THE RELATIONSHIP BETWEEN TECHNOLOGY DEPLOYMENT STRATEGIES AND PERFORMANCE OF COMMERCIAL BANKS IN KENYA

Edmund Malitt[1], Prof. Simon Karume[2], Dr. Mary Mugo[3], Dr. Daisy Bowen[4]

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[2]*Prof. Simon Karume, School of Science, Engineering and Technology, Kabarak University, Kenya*

[3]*Dr. Mary Mugo, Faculty of Business and Economics, Multimedia University, Kenya*

[4]*Dr. Daisy Bowen, School of Business and Economics, Kabarak Universit, Kenya*

Abstract: *This study investigated the moderating effect of industry regulations on the relationship between technology deployment strategies and the performance of commercial banks in Kenya. The study adopted a quantitative research design and was guided by the Unified Theory of Acceptance and Use of Technology (UTAUT). Primary data were collected through structured questionnaires administered to selected commercial banks in May 2025. The analysis employed regression modeling to test moderation effects. The findings revealed that regulatory frameworks significantly enhance bank performance by fostering creativity, inclusivity, and resilience. Key legal instruments influencing technology adoption include the Kenyan Constitution (2010), the Prudential Guidelines (2013), and the Digital Credit Providers Regulations (2022), which supported the financial sector's stability during shocks such as the COVID-19 pandemic. The study recommends updating outdated policies, such as the Banking Act (2015) and the Prudential Guidelines (2013), to accommodate emerging technologies like fintech, blockchain, and artificial intelligence. Additionally, policymakers are urged to enhance financial inclusion through financial literacy programs, localized digital innovations, and targeted support for marginalized groups, including women-led enterprises.*

Key Words*: *Technology Deployment, Industry Regulations, Banking Performance, Commercial Banks

Cite this Article as: *Malitt, E., Karume, S., Mugo, M., & Bowen, D. (2025). The Moderating Effect of Industry Regulations on the relationship between Technology Deployment Strategies and Performance of Commercial Banks in Kenya.International Journal of Business and Technology Studies and Research, v.7, n. 1, 12 pages, ISSN 2665-7716.*

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INFORMATION TECHNOLOGY

EFFECT OF SCALABILITY OF TECHNOLOGY DEPLOYMENT ON PERFORMANCE OF COMMERCIAL BANKS IN KENYA

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ABSTRACT

Purpose of Study: This study examined the effect of the scalability of technology deployment on the performance of commercial banks in Kenya, guided by the Theory of Planned Behavior (TPB).

Problem Statement: Despite Kenya's leadership in digital banking, many commercial banks struggle to scale technologies effectively due to resource constraints, infrastructure gaps, and regulatory demands. This limits improvements in profitability, efficiency, and customer satisfaction, highlighting the need to examine how scalability and regulations affect bank performance.

Methodology: The research adopted a qualitative content analysis approach, utilizing purposively selected secondary data sources such as policy documents, regulatory reports, industry reviews, and scholarly studies. TPB informed the analysis by linking organizational attitudes, perceived behavioral control, and normative pressures to the adoption and expansion of technological innovations.

Result: The analysis revealed that scalability of technology deployment also has a positive relationship with the performance of commercial banks, although the effect is not statistically significant. Moreover, banks with limited capital or infrastructural constraints may struggle to scale their digital services effectively, limiting the observable impact on performance.

Recommendation: Commercial banks should therefore invest in technologies and infrastructure that allow for future scalability. This includes modular IT systems that can be expanded as customer demand grows, cloud computing solutions that offer flexible data storage and processing, and digital service platforms that can be rolled out across multiple regions.

Keywords: *Scalability, technology deployment, commercial bank performance, Theory of Planned Behavior, Kenya*

A Strategic Model for Technology Deployment Decisions (TDSDM): Evaluating the Nexus between Deployment Strategies and Performance Outcomes in Kenya's Commercial Banks

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ABSTRACT

The Technology Deployment Strategy Decision Model (TDSDM) is an innovative analytical framework designed to assess the impact of technology deployment strategies on the performance of commercial banks in Kenya. By integrating three core independent variables Technology Integration Practices, Scalability of Technology Deployment, and Efficiency of Technology Management with Industry Regulations as a moderating factor, the TDSDM evaluates their influence on key performance metrics such as profitability, operational efficiency, and customer satisfaction. Utilizing a multi-method approach that combines regression analysis, decision graph modeling, and interactive visualizations, the model accounts for structural differences across bank tiers (Tier 1, Tier 2, and Tier 3). Empirical findings reveal that Technology Integration significantly drives performance in Tier 1 banks, Scalability is critical for Tier 3 banks, while Efficiency has a marginal effect in Tier 2 banks. Regulatory moderation was found to be statistically nonsignificant, suggesting robust deployment strategies yield benefits irrespective of regulatory intensity. The TDSDM provides actionable, tier-specific recommendations, supported by rigorous statistical validation and visualization tools, to optimize technology strategies in Kenya's dynamic banking sector.

Keywords: Technology Deployment, Commercial Banks, Kenya, TDSDM, Technology Integration, Scalability, Efficiency, Industry Regulations, Bank Performance, Tier Analysis

INTRODUCTION

The Kenyan banking sector has undergone significant transformation driven by technological advancements, necessitating strategic frameworks to optimize technology deployment for enhanced performance. The Technology Deployment Strategy Decision Model (TDSDM) addresses this need by providing a comprehensive analytical tool to evaluate how technology strategies influence key performance metrics in commercial banks.

The TDSDM employs a multi-method analytical process, integrating decision graph modeling, regression analysis with moderation effects, and interactive data visualizations to provide actionable insights. It accounts