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Assessing Challenges in the Adoption of Digital Technologies for Automated Billing Systems by SMES In Lusaka District

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Abstract

This study assessed the challenges in the adoption of digital technologies for automated billing systems among ICT Small and Medium Enterprises (SMEs) in Lusaka District, Zambia. The purpose of the study was to examine the extent of digital technology adoption, evaluate its influence on SME competitiveness, and identify key barriers affecting its effective implementation. Specifically, the study sought to: assess the types of digital tools adopted by SMEs, examine the influence of digital technology adoption on competitiveness, and identify challenges affecting adoption among ICT SMEs. The study was guided by the Technology–Organization–Environment (TOE) framework and adopted a pragmatic paradigm using a concurrent mixed-methods design. A total of 101 participants were sampled from a population of 135 SME decision-makers, comprising 81 questionnaire respondents and 20 interview participants. Quantitative data were analyzed using SPSS, while qualitative data were analyzed thematically using NVivo, with triangulation enhancing the validity of the findings. The analysis and interpretation of results revealed that digital technology adoption significantly improves SME performance and competitiveness. Key benefits included improved communication (26%), enhanced operational efficiency (22%), and cost reduction (20%). Competitiveness outcomes were most evident in improved service delivery speed and quality (34.5%), followed by cost efficiency (23.4%) and market reach (16%). Overall, 64% of SMEs reported improved business performance after adopting digital technologies, demonstrating a strong positive relationship between digital adoption and organizational effectiveness. However, the study identified several critical challenges hindering adoption, including high costs of digital tools (58%), limited technical skills (16%), employee resistance (15%), and poor internet connectivity (11%). These barriers indicate that despite the clear benefits, SMEs face structural and capacity-related constraints that limit full digital integration.The significance of the study lies in its contribution to policy, practice, and academic knowledge. It provides empirical evidence to policymakers and stakeholders on the need to promote affordable digital solutions, strengthen ICT infrastructure, and enhance digital skills development among SMEs. Additionally, the study contributes to the existing body of knowledge on digital transformation in developing economies and offers a foundation for future research on technology adoption and SME competitiveness. The study concludes that while digital technologies, particularly automated billing systems, are critical drivers of SME competitiveness and sustainability, their successful adoption depends on addressing financial, technical, and infrastructural constraints.

1. Introduction and Background

Small and Medium Enterprises (SMEs) are widely recognized as key drivers of economic growth, employment creation, and innovation in developing economies such as Zambia (World Bank, 2020) .Within the Information and Communication Technology (ICT) sector, SMEs play an increasingly important role in supporting digital transformation and facilitating business modernization through the provision and use of technological solutions (Abdul & Francis, 2021) . The rapid advancement of digital technologies has significantly transformed how businesses operate, communicate, and compete, making tools such as cloud computing, digital payments, and automated systems essential for enhancing operational efficiency and expanding market reach (Sunday & Chinedu, 2018; Phiri & Mwale, 2025).

A growing body of research across global, regional, and local contexts indicates that the adoption of digital technologies improves business performance, operational efficiency, and competitiveness among SMEs. For instance, studies have shown that digital transformation enables firms to enhance customer engagement, streamline internal processes, and respond more effectively to market demands (Ardolino et al., 2018; Kahrović & Avdović, 2023). Similarly, research in developing economies highlights that SMEs adopting digital tools experience improved productivity, innovation, and business sustainability, although the level of adoption is often influenced by contextual challenges such as limited resources and infrastructure constraints (Prause, 2019; Achieng & Malaji, 2022) . In the Zambian context, studies by Mulenga and Phiri (2021) and Manda and Backhouse (2018) show that while ICT SMEs operate in a dynamic technological environment, the adoption of digital tools remains uneven and inconsistent.

Despite the well-documented benefits of digital technologies, existing research further indicates that many SMEs face significant barriers that hinder effective adoption. Key challenges identified in prior studies include high costs of digital tools, inadequate digital skills, limited access to infrastructure, and resistance to technological change (Kure et al., 2020; OECD, 2021; Chinomona, 2019). Additional evidence suggests that SMEs in resource-constrained environments tend to prioritize basic operational technologies over more advanced systems due to financial and technical limitations (Andras & Beata, 2023). While these studies provide valuable insights into digital technology adoption, they largely focus on general ICT usage and do not sufficiently address the adoption of automated billing systems, particularly within ICT SMEs in Lusaka District.

In Lusaka District, ICT SMEs operate in an increasingly competitive and technology-driven environment, yet the adoption and integration of digital technologies, especially automated billing systems, remain limited. Empirical evidence indicates that a significant proportion of SMEs continue to rely on manual or partially digital systems, resulting in inefficiencies in service delivery, weak customer engagement, and limited scalability (Pelekamoyo, 2023). Furthermore, low levels of digital literacy, high technology acquisition costs, and inadequate technical support continue to constrain the effective utilization of available digital solutions (Phiri & Mwale, 2025).

The problem addressed in this study is that the slow and uneven adoption of digital technologies, particularly automated billing systems, among ICT SMEs in Lusaka District is undermining their competitiveness, operational efficiency, and overall business performance. This gap between the availability of digital technologies and their effective utilization limits the ability of SMEs to innovate, respond to market demands, and sustain growth in an increasingly digital economy (Pelekamoyo, 2023; Phiri & Mwale, 2025) .

Therefore, this study intended to assess the extent to which digital technologies are adopted among ICT SMEs in Lusaka District, examine their influence on business competitiveness, and identify the key challenges affecting their effective implementation. Addressing these issues, study contributes to a better understanding of digital transformation in SMEs and provides evidence-based insights for policymakers, practitioners, and researchers seeking to enhance SME competitiveness and sustainability in Zambia.

Small and Medium Enterprises (SMEs) are widely recognized as vital contributors to economic growth, employment creation, and innovation, particularly in developing countries like Zambia. In recent years, the rapid advancement of digital technologies has revolutionized how businesses operate, communicate, and compete in the marketplace (Phiri and Mwale,2025). Digital tools such as cloud computing, e-commerce platforms, mobile applications, digital marketing, and customer relationship management systems have become essential in enhancing business efficiency, service delivery, and market reach (Sunday and Chinedu,2018).

In Zambia, particularly in urban areas like Lusaka District, the ICT sector is growing steadily, providing both opportunities and challenges for SMEs. Despite the potential benefits of digital technology adoption including improved productivity, enhanced customer engagement, reduced operational costs, and access to global markets many SMEs struggle to fully integrate and utilize these tools (Pelekamoyo,2023). Factors such as limited access to capital, digital literacy, inadequate infrastructure, and resistance to change often hinder the adoption process. The competitiveness of SMEs is increasingly being influenced by their ability to adapt to technological changes. In the ICT sector, where innovation and speed are crucial, businesses that fail to adopt digital solutions risk falling behind more agile competitors. Therefore, understanding how digital technology adoption impacts SME competitiveness is critical for business sustainability and economic development (Prause,2019).

1.2 Statement of the Problem

Despite the increasing availability of digital tools such as cloud computing, automated billing systems, digital marketing platforms, and e commerce solutions, many small and medium sized enterprises (SMEs) in Lusaka District and Zambia more broadly continue to operate below their digital potential. Although comprehensive district-level SME tech adoption data are limited, national digital usage statistics show that only about 33 % of the Zambian population (7.29 million people) were internet users by late 2025, indicating a relatively low overall digital penetration environment in which SMEs operate (DataReportal, 2026). This broader digital landscape suggests that many businesses still struggle to harness digital infrastructure effectively, which can constrain SME digital adoption (Mwila & Ngoyi, 2019). Research on ICT usage among SMEs in Zambia also shows uneven utilization of technology. A study of formal and informal SMEs in Lusaka found that while 38.2 % had incorporated basic ICT tools into operations, advanced digital applications such as web-based systems, e commerce, and online business platforms were used by only 17.6 % of firms, leaving a majority of SMEs with limited digital integration (Mwila & Ngoyi, 2019). This evidence supports claims that a substantial portion of SMEs either lack basic digital infrastructure or underutilize available digital tools (Chileshe, 2024). This digital gap translates into practical operational weaknesses. Anecdotal reports and market observations in Zambia indicate that a notable share of SMEs maintain manual customer records, have limited or no online presence, or do not use data analytics systematically for decision making, trends consistent with broader patterns of slow technology uptake among small firms in developing economies (Reddit, 2026). Moreover, broader African SME research finds that a large proportion of SMEs recognize the strategic importance of digital tools (e.g., more than 80 % view cloud computing as crucial for competitiveness), yet many still lag in adoption due to implementation challenges, including cost, skills, and infrastructure constraints (Chileshe, 2024). Internal constraints further reinforce this uneven adoption. Studies and local observations point to low digital literacy among staff, high technology acquisition and maintenance costs, and limited access to reliable internet and technical support as persistent barriers for SMEs (Chileshe, 2024; Mwale, 2024). These challenges reflect known patterns in the region where connectivity costs, unstable networks, and infrastructure gaps hinder broader technology integration. The core problem, therefore, is that slow and uneven adoption of digital technologies among ICT SMEs undermines their ability to innovate, increase market visibility, and respond effectively to customer and market demands. Evidence from similar developing-economy settings suggests that firms with weak digital integration tend to fall behind in competitiveness, market reach, and overall growth potential (Mwale, 2024; Chileshe, 2024).

2 Literature Review

2.1 Previous Studies

The adoption of digital technologies has reshaped how businesses operate worldwide. From the 1990s onward, firms began using information and communication technologies (ICTs) to digitise records, communicate with customers, and automate key functions like billing and inventory management (Restrepo Morales et al., 2024). Automated billing systems software platforms that generate invoices, manage payments, and track financial transactions emerged as an essential business tool because they reduce manual errors, speed up cash flows, and improve record accuracy compared to traditional paper-based billing (Restrepo Morales et al., 2024).

For large firms in developed economies, these technologies became mainstream in the early 2000s as part of broader enterprise resource planning (ERP) systems and cloud-based services. However, SMEs often adopted digital tools more slowly due to higher relative costs, limited technical expertise, and smaller operational scales that did not initially justify expensive digital systems (Oliveira & Martins, 2011).

In sub–Saharan Africa, the history of digital technology adoption broadly reflects these global trends but is shaped by regional challenges, such as

infrastructure deficits, high connectivity costs, and variable policy support for ICT development (Boateng, 2020). Early research focusing on ICT in African SMEs noted that while basic technologies such as mobile phones and simple accounting software were increasingly used, adoption of more advanced systems like automated billing lagged because many businesses lacked stable electricity, affordable internet, or trained staff to implement and sustain technology use (Boateng, 2020).

In Zambia, research into SME digital engagement began to appear in academic and development studies in the 2010s. These early studies documented those high costs of acquiring computers and software, limited internet access, and low levels of digital literacy were common barriers that prevented SMEs in urban centres like Lusaka from fully integrating digital systems into their operations (Mwila & Ngoyi, 2019). For example, in a study of formal and informal SMEs in Lusaka, researchers found that while over one third of businesses used basic ICT tools, only a small minority reported using digital financial systems as part of their core operations (Mwila & Ngoyi, 2019). This indicated a digital divide even within enterprises that were considered relatively progressive. These findings were reinforced by follow up studies that documented similar challenges. Research in the late 2010s and early 2020s highlighted those costs associated with software licenses, hardware maintenance, and reliable connectivity continued to pose barriers, especially for smaller enterprises with limited financial reserves (Chileshe, 2024). Where digital systems did exist, they were often used only for specific functions (e.g., record keeping or customer communication) rather than fully automating billing, inventory, or financial reporting.

The rise of cloud computing and Software as a Service (SaaS) in the mid-2010s offered a potential turning point by lowering upfront costs and making sophisticated tools more accessible. Cloud based automated billing systems, for instance, do not require large upfront investments because they are subscription based and hosted online. In theory, this model should make automation more attainable for SMEs (Restrepo Morales et al., 2024). However, in practice, adoption remains uneven in Zambia. Challenges such as the high cost of data, unreliable broadband, and insufficient training in digital skills have continued to limit uptake (Mwale, 2024).

Compounding these technical barriers are organizational and cultural factors. Research across developing countries has shown that resistance to change, lack of management commitment, and inadequate alignment between technology and business strategy can discourage SMEs from adopting digital tools even when they are aware of their benefits (Dimoso & Utonga, 2024). For example, SME leaders who are comfortable with manual processes may view automated billing systems as complex, unnecessary, or too disruptive relative to their immediate priorities even when digital solutions could improve efficiency and customer service.

Recent regional studies (2022–2025) further highlight that many SMEs recognise the strategic importance of digital technologies including billing, e commerce, and online payments but struggle to implement them due to persistent constraints, including infrastructure gaps, skills shortages, and limited access to technical support (Innovation Entrepreneurship Journal, 2024; Scielo Africa, 2022). These challenges are compounded by macro level issues, such as inconsistent digital policy frameworks and slow investment in national broadband infrastructure, which affect the cost and quality of internet services that SMEs rely on for cloud-based billing platforms (Scielo Africa, 2022).

Although formal surveys on automated billing adoption rates are limited, the historical pattern of digital adoption suggests that financial constraints, inadequate infrastructure, low digital literacy, and organisational barriers have consistently restricted SME uptake of automated billing systems. Without deliberate interventions such as training programs, cost subsidies, and improved digital infrastructure these historical barriers are likely to persist and continue to shape the experiences and performance of SMEs in Lusaka's evolving digital economy.

2.2 The extent to which these digital technologies are integrated into business operations

A study on Digital Technology Integration Among Eastern European Companies, Based on Digital Economy and Society Index by Andras and Beata (2023) The European Commission has paid special attention to the digital evolution of the European economy and society since the early 2000s. Beginning in 2014, the Digital Economy and Society Index (DESI) has served as a key instrument for monitoring and assessment. In 2021, the main DESI indicators were aligned with the Digital Agenda 2030 targets, which encompass four dimensions: human capital, connectivity, digital technology integration, and digital public services.

This article aims to examine the convergence among EU Member States in integrating digital technologies, which represent the third dimension of the DESI database. A σ-convergence analysis was conducted to assess whether disparities in digital technology integration across Member States have decreased over time. Additionally, β-convergence analysis was used to evaluate the pace at which less advanced countries are catching up with more developed ones. The findings indicate that neither σ-convergence nor β-convergence was confirmed. Eleven specific indicators related to digital technology integration were studied to identify critical areas requiring attention to ensure widespread digital inclusion across the EU. This research specifically focuses on the Member States that joined the EU during the Eastern enlargements. These countries typically perform below the EU average on individual indicators, and the β-convergence analysis reveals that their average catch-up rate is not promising.

Notably, the research focuses primarily on macro-level convergence metrics (σ- and β-convergence) without exploring the underlying causes behind the persistent digital integration disparities among Eastern EU Member States. It does not sufficiently account for institutional, economic, cultural, or policy-related factors that may influence the pace of digital adoption.

Nakmahmud etal (2023) Digital Technology Adoption in SMEs: What Technological, Environmental and Organizational Factors Influence in Emerging Countries. The research aimed to explore the technological, environmental, and organizational factors that influence digital technology adoption in the small and medium enterprise (SME) sector in developing countries. A conceptual framework is proposed that combines the Technology-Organization-Environment (TOE) framework and Diffusion of Innovation (DOI) theory to examine the determinants of digital technology adoption specifically, the applicability of information and communication technology (ICT) in SMEs.

Additionally, the study identifies the major barriers to implementing ICT in the SME sector. A purposive sample of 535 respondents was collected from higher- and middle-level managers of SME firms through a structured questionnaire. Data and hypotheses were analysed using partial least squares structural equation modelling (PLS-SEM).

The results show that relative advantage, complexity, observability, perceived cost, top management support, innovativeness of top management, competitive pressure, and government support are significant determinants of ICT adoption in SMEs. Conversely, compatibility, perceived trialability, and organizational readiness did not significantly influence ICT adoption.

Although the study identifies key determinants of ICT adoption, it does not delve deeply into why certain variables such as compatibility, trialability, and organizational readiness were not significant.

Naatu etal (2024) in a study on determinants of digital technology adoption in sub-Sahara Africa: Ghana, explored how perceived ease of use and perceived usefulness influence consumer attitudes and intentions to adopt digital technologies in Ghana. The study employed covariance-based structural equation modelling using a dataset of 204 respondents to evaluate the proposed model. The analysis was conducted using R (version 0.6–12).

The results confirm that both perceived ease of use and perceived usefulness are key predictors of the intention to adopt technology. Additionally, factors

such as attitude, subjective norms, and perceived behavioural control significantly influence adoption intentions. Notably, the findings reveal that perceived ease of use not only affects peer influence among consumers but also shapes their confidence in using the technology effectively.

Furthermore, unlike previous studies, this research indicates that while perceived behavioural control influences behavioural intention, it does not predict attitude within the Ghanaian context. The study recommends the development of user-centric technologies, the promotion of digital literacy, and the cultivation of a supportive digital culture to enhance technology adoption.

While the study provides valuable insights into how perceived ease of use and perceived usefulness influence consumer attitudes and intentions to adopt digital technologies in Ghana, it leaves several areas underexplored. Notably, the research focuses primarily on individual-level behavioural factors, without fully addressing external or contextual influences such as infrastructure quality, digital service accessibility, or socio-economic disparities that may significantly affect adoption

In Zambia, Tembo (2024) in a study on effects of management information systems on the growth of e-commerce in Zambia investigated the effects of Management Information Systems (MIS) on the growth of e-commerce in Zambia. With the exponential advancement of digital technologies globally, the adoption of MIS has become increasingly vital for businesses aiming to thrive in the digital marketplace. Through a comprehensive analysis of the Zambian e-commerce landscape, the research aimed to explore the impact of MIS implementation on various aspects of e-commerce growth in Lusaka.

Utilizing a mixed-methods approach combining qualitative insights from interviews with quantitative data analysis the study examined the extent of MIS adoption, the challenges encountered, and the strategies employed to maximize the benefits of MIS in driving e-commerce development. The findings reveal that MIS adoption in Zambia has led to improvements in customer engagement, operational efficiency, and service quality, ultimately enhancing the competitiveness and market positioning of e-commerce businesses.

However, the research also identified several challenges, including operational disruptions, data privacy concerns, and the need for continuous innovation to overcome technological and regulatory barriers. To address these issues, the study recommends the development of clear guidelines, interdisciplinary collaborations, and investments in advanced analytics capabilities. It also advocates for further longitudinal research to track trends over time. Moreover, the study emphasizes the importance of fostering a culture of innovation, strengthening industry–academia partnerships, and prioritizing cybersecurity measures in order to fully harness the potential of MIS for e-commerce growth in Zambia.

In as much as this study was extensive, it does not sufficiently explore the long-term sustainability and scalability of MIS adoption among small and medium-sized e-commerce enterprises. Most of the findings are contextually bound to Lusaka, leaving a gap in understanding how these systems perform in other regions with different infrastructural and technological constraints.

2.3 The influence of digital technology adoption on the competitiveness of ICT SMEs

In a study on the Impact of Digital Technologies on Business Performance in Serbia by Kahrović and Avdović (2023) whose main aim was to investigate the extent to which Serbian businesses adopt and utilize digital technologies as part of their digital business transformation process. The motivation behind the study was to examine the specific determinants of the digital economy, digital technologies, and digital business transformation.

The research was conducted from October 2020 to March 2021. A questionnaire was distributed to over 500 Serbian companies via email, resulting in 98 completed and valid responses. The key characteristics of the sample were presented to demonstrate its randomness and representativeness, and the choice of data analysis methods was explained accordingly.

The findings revealed that mobile technologies, social networks, and cloud computing were the most widely used digital tools among the sampled Serbian businesses. In contrast, the second tier of disruptive technologies was found to be minimally present. However, the role and importance of robotics and artificial intelligence are beginning to gain recognition in the Serbian business landscape. The study established a significant relationship between digital technology adoption and business performance, including correlations between specific technologies and performance indicators, as well as the intensity and statistical significance of their impact. It also showed that some key technologies exert a latent, indirect influence on performance, and explained the mechanisms through which this occurs. The analysis was strengthened by standardizing ordinal scale values to improve the accuracy of results.

In terms of the research gap, while the study offers useful insights into digital technology adoption and its impact on business performance, it lacks in-depth analysis of the organizational and environmental factors that influence this process. It does not fully explore how internal capabilities and external conditions affect the successful integration of digital technologies. A study on the examining information and communication technology (ICT) adoption in SMEs: A dynamic capabilities approach by Sunday and Chinedu (2018) argue that since the 1980s, a substantial number of theories have significantly contributed to the understanding of information and communication technology (ICT) adoption. However, many of these theories treat ICT adoption as a one-time event, focusing primarily on the factors influencing decision-making at a single point in time. They often overlook the fact that adoption is a dynamic process, potentially influenced by different factors at various stages. Therefore, the purpose of this paper is to examine the evolving nature of ICT adoption through the lens of dynamic capabilities.

This study employed a qualitative approach to gain in-depth insight into the dynamic and evolutionary process of emerging information and communication technology (EICT) adoption in UK small service-based SMEs. Unstructured and semi-structured interviews were conducted in two separate rounds with 26 participants, selected from the Crunch Online Database and the Luton Business Directory. The sample of 65 participants was drawn from an extended classification of professional service businesses proposed by Ramsey et al. (2008). Participants included managers, government agency representatives, SME consultants, and IT vendors. Purposive random sampling and snowball sampling methods were used.

The study developed a framework based on the concept of dynamic capabilities and found that applying this concept to examine EICT adoption reveals the recursive nature of the process. It also shows that the influencing factors vary across both single and multiple stages of adoption.

The identified research gap highlights limited research exploring how influencing factors evolve throughout the adoption journey, particularly in the context of emerging ICTs (EICTs) within small service-based SMEs. This gap highlights the need for frameworks that capture the recursive and adaptive nature of ICT adoption over time. Meanwhile, Ardolino etal (2018) argue in a study on the role of digital technologies for the service transformation of industrial companies that the role of digital technologies in service business transformation remains under-investigated. This paper contributes to filling this gap by exploring how the Internet of Things (IoT), cloud computing (CC), and predictive analytics (PA) facilitate service transformation in industrial companies. Using the Data–Information–Knowledge–Wisdom (DIKW) model, we examine how these technologies convert low-level entities such as data into information and knowledge to support manufacturers' service transformation. The study proposed a set of digital capabilities based on existing literature and findings from four case studies. We then discuss how these capabilities support the various service transformation trajectories of manufacturers. Our findings show that IoT is foundational to any service transformation and is particularly crucial for becoming an availability provider. PA is vital for transitioning to a performance provider profile. While CC provides scalability across all profiles, it is especially instrumental in

implementing an industrialiser strategy, leading to standardized, repeatable, and productized service offerings.

The research gap identified in this study is that digital technologies such as the Internet of Things (IoT), cloud computing (CC), and predictive analytics (PA) are increasingly acknowledged as enablers of service business transformation, there remains limited empirical research on how these specific technologies interact to support different transformation trajectories in industrial companies including the ICT SMEs.

In the context of Africa, Achieng and Malaji (2022) in a study on Digital transformation of small and medium enterprises in sub-Saharan Africa: A scoping review observes that the economic activities of Small and Medium Enterprises (SMEs) in sub-Saharan Africa (SSA) drive much of the region's economic growth and development. Despite their importance, SMEs are more likely to fail within their first two years of operation compared to larger enterprises. While digital transformation (DT) enhances organizational resilience, the adoption of DT among SMEs in SSA has been slow due to various impediments. The objective of this article is to explore how SMEs in the SSA context can develop comprehensive strategies for integrating digital technologies into their operations to build resilience.

Arksey and O'Malley's systematic scoping review (SR) framework is employed to identify and map relevant literature over a five-year period using clearly defined inclusion and exclusion criteria. A total of 44 articles were selected for in-depth analysis to address the research objective. The findings highlight economy-based, market-based, and sociotechnical contextual factors as key themes impeding the digital transformation of SMEs in the SSA region. Specifically, SMEs in SSA face numerous regional constraints, including limited access to profitable and value-added markets, which create significant operational barriers.

The researcher observes a research gap on this study as that while the importance of digital transformation (DT) in enhancing the resilience of SMEs in sub-Saharan Africa (SSA) is recognized, there remains a lack of comprehensive research on how SMEs in SSA can develop and implement context-specific digital integration strategies.

In Zambia, a study by Mulenga (2023) on the Impact of information communications technology on the postal sector: a case study of Zambia observes that has been a notable global decline in postal services offered by Designated Postal Operators (DPOs), and Zambia is no exception. The Zambia Postal Services Corporation (ZAMPOST), as the country's DPO, is experiencing a shift in the use of Information and Communication Technologies (ICTs), which is redefining its role in the postal sector. Despite this shift, the impact of ICT adoption on service delivery remains poorly understood. This study aimed to examine the current state of the postal sector in Zambia and how ICTs are being adopted by ZAMPOST to enhance service delivery. The study employed a mixed-methods approach, incorporating both qualitative and quantitative data. A total of 273 respondents were randomly selected and surveyed using both online platforms and hardcopy questionnaires. The collected data were analyzed using Microsoft Excel and SPSS. Additionally, various reports and documents related to the local postal sector were reviewed to provide insights into services that have adopted ICTs and those that remain manual.

A review of relevant literature revealed that the global postal sector is evolving to meet customer demands and improve service quality. Reforms in the sector have been driven by a range of social, cultural, political, economic, and technological factors. The traditional role of postal operators is being replaced by more technologically advanced functions. Moreover, the sector has experienced increased competition, with many new players particularly in courier services entering the market, which was once dominated by DPOs.

The study found that ZAMPOST, due to its extensive national network, is strategically positioned to expand its range of services beyond traditional postal functions. This expansion aligns with its mandate to provide basic postal services to all citizens under the Universal Service Obligation (USO).

Although global trends indicate a shift in the role of Designated Postal Operators (DPOs) through the adoption of Information and Communication Technologies (ICTs), there is limited empirical research specifically examining how this digital transformation is unfolding within the Zambian context. While ZAMPOST has begun integrating ICTs into its operations, the extent, effectiveness, and challenges of this adoption in enhancing service delivery remain underexplored.

2.4 Challenges affecting the adoption of digital technologies among ICT SMEs

Challenges of Industry 4.0 Technology Adoption for SMEs: The Case of Japan by Prause (2019) observes that In light of several national advanced manufacturing strategies such as Industry 4.0 in Germany and the Made in China 2025 initiative in China this study examines the challenges of Industry 4.0 adoption among Japanese small and medium-sized manufacturing firms. A technology adoption model for Industry 4.0 is developed and empirically tested using data from 38 manufacturing companies. The results indicate that market uncertainty is a significant driver of adoption in the short, medium, and long term. Relative competitive advantage influences adoption in the short term, while top management support is crucial in the long term. However, no significant support was found for the impact of advanced manufacturing complexity or market transparency on the adoption of Industry 4.0 solutions.

While this study identifies key drivers of Industry 4.0 adoption among Japanese SMEs such as market uncertainty, competitive advantage, and top management support it leaves unexplored the reasons why factors like advanced manufacturing complexity and market transparency show no significant influence.

Tom compliment further on this, Hamidatun and Sabariah (2018) carried out a research on innovation and technology adoption challenges: impact on SMES' company performance and observes that small and medium enterprises (SMES), though a vital component in driving a country's economic growth, have struggled to reach their full potential due to various challenges. in the SME masterplan 2012–2020, the government of Malaysia outlined six key challenges: human capital development, access to financing, market access, infrastructure, innovation and technology adoption, and the legal and regulatory environment. this study focused on one of these challenges of innovation and technology adoption and examines its impact on the performance of SMES in Malaysia.Data was collected through a survey conducted among Malaysian SME manufacturing companies, resulting in responses from 152 firms. the findings indicate a significant relationship between challenges related to innovation and technology adoption and overall company performance.

Meanwhile, a study by Amoako et al (2020) on the effect of internal integration on SMEs' performance: the role of external integration and ICT investigated the mediating role of external integration in the relationship between internal integration and the performance of small and medium enterprises (SMEs). Information and Communication Technology (ICT) was examined as a moderating variable in the relationships between internal and external integration, as well as between external integration and SME performance. A cross-sectional design was adopted, with questionnaires distributed to SME owners in the Abossey Okai business enclave to assess the key constructs in the study. Structural Equation Modeling (SEM) was employed to examine the relationships among the variables, based on 163 validated responses. Data analysis was conducted using Analysis of Moment

Structures (AMOS) and the Statistical Package for Social Sciences (SPSS).

The results indicate that external integration significantly mediates the relationship between internal integration and SME performance. Additionally, ICT demonstrated a positive moderating effect on both the relationship between internal and external integration and the relationship between external integration and SME performance. Arising from the above, aalthough studies have examined internal and external integration separately, limited research investigates how external integration mediates the relationship between internal integration and SME performance. Additionally, the moderating role of ICT in enhancing these integration links remains underexplored, particularly in informal and resource-constrained contexts like the Abossey Okai business enclave. Mwila and Ngoyi (2019) in a study on the use of ICT by SMEs in Zambia to access business information services and investments: barriers and drivers aimed to address key questions regarding the use of ICTs among SMEs by analysisng factors that either promote or hinder their recognition as essential tools for business development. Specifically, it examined the drivers that make ICTs valuable such as cost reduction and operational efficiency and the barriers that prevent their widespread adoption. The study involved a sample of 60 SMEs without formal business registration and 40 with formal registration, achieving response rates of 76.7% and 87.5%, respectively. The results revealed that ICTs play a critical role in both formal and informal business operations. Cost reduction and the ease of conducting business were identified as the primary drivers of ICT adoption. However, significant challenges included the high cost of ICT tools and services, as well as poor ICT infrastructure. The study also established a positive relationship between ICT investment and productivity, with 67.04% of respondents confirming improved performance following implementation.

The study recommends that the government fully implement the ICT framework outlined in the Seventh National Development Plan (7NDP). This includes investing in infrastructure development, reducing taxes on ICT-related goods, and promoting Public-Private Partnerships (PPPs) aimed at expanding and improving communication systems to support socio-economic development.

2.5 Theoretical frameworks

Technology-Organization-Environment (TOE) Framework

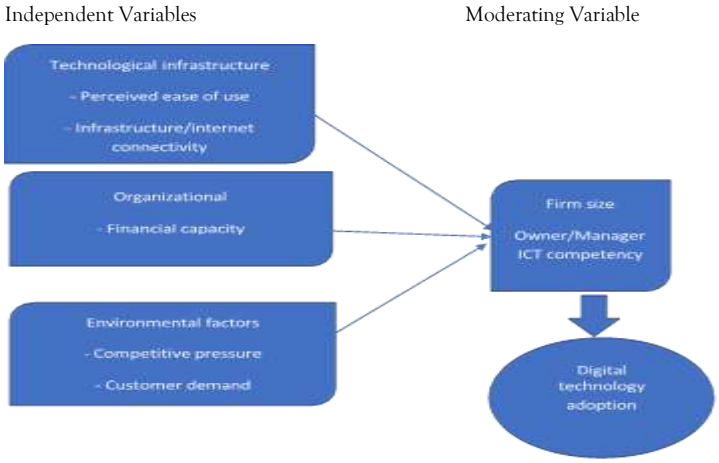
This study adopted the Technology-Organization-Environment (TOE) Framework, developed by Tornatzky and Fleischer in 1990, which provided a structured approach to understanding the factors that influenced an organization's decision to adopt and implement new technologies. The framework outlined three key dimensions that shaped the adoption process: the technological, organizational, and environmental contexts. These dimensions interacted to determine the readiness, capability, and motivation of a business to embrace digital transformation. The technological context referred to the range of digital tools and innovations available to the firm, both internally and externally. This included technologies that were already in use as well as emerging solutions potentially beneficial to the business. For ICT SMEs in Lusaka District, this involved digital solutions such as cloud computing, digital payment systems, online customer management platforms, and social media marketing tools. The perceived benefits, compatibility with existing systems, ease of use, and cost of these technologies played a critical role in whether they were adopted.

The organizational context related to the internal characteristics of the business, such as size, structure, available resources, employee skills, and management commitment. Many SMEs in Lusaka faced constraints such as limited financial capital, a lack of technical expertise, or inadequate strategic planning. However, firms with supportive leadership, an innovative culture, and access to skilled personnel were more likely to adopt and integrate digital technologies effectively.

The environmental context encompassed external forces that influenced adoption, including market competition, customer demands, government regulations, and the availability of technological infrastructure. In Lusaka District, ICT SMEs operated in a competitive environment where customers expected fast, reliable, and technology-enabled services. Additionally, national ICT policies, access to stable internet, and support from government or development agencies could either facilitate or hinder the digital adoption process.

The TOE framework was highly relevant to this study as it offered a comprehensive model for analyzing the various factors influencing digital technology adoption among ICT SMEs. It allowed for a contextual understanding of how different internal and external variables interacted to shape the digital transformation journey. This relevance was particularly important in a developing economy like Zambia, where digital adoption varied significantly across sectors and regions.

2.6 Conceptual Framework



Source: Own generated (2025)
Figure 1: Conceptual Framework

3 Research Methodology and Design

Guided by the pragmatic paradigm, the study adopted a concurrent (convergent) mixed-methods research design. Quantitative and qualitative data were collected simultaneously, analyzed independently, and then integrated during interpretation. This design was chosen because it provided a holistic view of digital technology adoption by capturing measurable outcomes alongside contextual explanations.

Quantitative data offered evidence of the extent to which SMEs adopted digital tools, the benefits realized, and their impact on performance indicators such as service delivery, market reach, customer engagement, and operational efficiency. Qualitative data, on the other hand, provided deeper insights into SME owners' perceptions, attitudes, challenges, and the specific strategies they employed to integrate technology into their operations. The concurrent mixed-methods approach enabled triangulation, enhancing the credibility, validity, and comprehensiveness of the findings. Furthermore, this design allowed the researcher to identify areas where quantitative trends and qualitative experiences converged or diverged, offering richer interpretations and actionable recommendations for both practice and policy.

The study was conducted in Lusaka District, the capital city and economic hub of Zambia. Lusaka was selected due to its high concentration of SMEs, particularly in the ICT sector, and its relatively advanced infrastructure, which supports higher levels of technology adoption. The district hosts a wide range of ICT SMEs, including software development companies, IT service providers, digital marketing agencies, and other technology-driven businesses.

Lusaka's competitive business environment, coupled with the presence of government and development organizations, provided a conducive setting to explore the factors influencing SME competitiveness. Conducting the study in Lusaka allowed the researcher to access businesses with varying degrees of digital adoption, providing insights into both early adopters and those still in transition. Moreover, the findings from Lusaka were expected to inform policies, support programs, and interventions for urban SMEs, contributing to the broader discourse on digital transformation in developing economies.

The target population comprised 135 owners, managers, and key decision-makers of selected ICT SMEs in Lusaka District. These individuals were considered the most relevant for the study because they were directly responsible for making technology adoption decisions and managing its integration within their organizations. The population included SMEs of various sizes and sub-sectors, ranging from software development and IT services to digital marketing and e-commerce businesses. These participants possessed first-hand knowledge of how digital tools influenced operational efficiency, customer service, market reach, and overall competitiveness.

The target population was appropriate because it ensured that data were collected from individuals with direct experience in adopting and utilizing digital technologies, thereby enhancing the relevance and accuracy of the findings. Furthermore, focusing on decision-makers enabled the study to capture strategic perspectives, including the rationale for adoption, challenges faced, and perceived benefits, which are crucial for understanding the dynamics of digital transformation in SMEs.

The study adopted a sample size of 101 participants, guided by the population of 135 ICT SME decision-makers. The sample was determined using Yamane's formula to ensure a statistically representative subset with a 5% margin of error:

$n = N / (1 + N(e)^2)$ Where:

(n) was the required sample size

(N) was the total population size

(e) was the desired margin of error expressed as a decimal $n = 135 / [1 + 135(0.05)^2]$

$n = 101$

Of the 101 participants, 81 responded to questionnaires (quantitative) and 20 participated in in-depth interviews (qualitative). This dual approach allowed for a balanced collection of quantitative data to measure adoption and performance trends, alongside qualitative insights to explore perceptions, challenges, and contextual dynamics of digital technology adoption.

For the qualitative component, 20 participants were purposefully selected from the 101 respondents to provide in-depth insights. These individuals were SME owners, managers, or key decision-makers with direct experience in adopting and integrating digital technologies, including automated billing systems, in their operations. Selection considered factors such as SME size, sub-sector (software, IT services, digital marketing, e-commerce), and level of digital adoption to ensure diversity of perspectives.

To determine the final qualitative sample size, the study applied the data saturation method, which involves continuing interviews until no new information or themes emerge (Guest, Bunce, & Johnson, 2020). During data collection, saturation was reached at 20 interviews, as subsequent interviews produced repetitive insights and no new emergent themes, confirming that the sample was sufficient to capture the breadth and depth of participants' experiences.

Using data saturation ensures that the qualitative findings are rich, comprehensive, and representative of the broader SME population in Lusaka District, while avoiding redundancy or unnecessary data collection. This approach aligns with best practices in qualitative research for enhancing credibility, dependability, and trustworthiness of findings (Fusch & Ness, 2015).

The study employed a combination of purposive and simple random sampling. Purposive sampling was used to select ICT SMEs in Lusaka District, ensuring that only businesses with direct experience in digital technology adoption were included. This method increased the relevance of the data collected by targeting participants who could provide meaningful insights into digital transformation.

Within the purposively selected SMEs, simple random sampling was applied to select individual respondents. This approach ensured that each participant had an equal chance of being included, minimizing selection bias and enhancing the generalizability of the findings to the wider population of ICT SMEs in Lusaka District. The combined sampling strategy thus balanced relevance and representativeness, providing both targeted and statistically robust data.

Data were collected using both primary and secondary sources. Primary data were obtained through structured questionnaires and semi-structured interviews, which included open- and closed-ended questions. The questionnaires captured quantitative measures of digital adoption, operational efficiency, market reach, customer engagement, and competitiveness. The interviews explored qualitative aspects, such as challenges, perceptions, experiences, and strategies for technology adoption.

Secondary data were obtained from academic literature, reports, government publications, and organizational documents relevant to ICT SMEs and digital transformation. These sources were used to complement primary data, provide background context, and validate the findings. The combination

of primary and secondary data enhanced the richness, reliability, and contextual depth of the study.

Quantitative data were analyzed using MS Excel and SPSS version 25, employing descriptive and inferential statistics. Descriptive statistics, including frequencies, percentages, means, and standard deviations, summarized respondents' characteristics and patterns of digital adoption. Inferential analysis was used to examine relationships between variables, including the influence of technological, organizational, and environmental factors on SME competitiveness. Findings were presented in tables, charts, and graphs for clarity.

Qualitative data were analyzed using thematic analysis and supported by NVivo software. The process involved familiarization with the data, coding, theme development, and interpretation. Themes were derived from recurring patterns, explanations, and participant perspectives. Only themes supported by multiple data sources and aligned with the study objectives were retained. Integration of qualitative and quantitative findings occurred during interpretation to allow triangulation, strengthen validity, and provide a comprehensive understanding of digital technology adoption in ICT SMEs.

4 Results and Findings

4.1 Response Rate and Data Reliability

4.1 To assess the types of digital tools adopted by SMEs into business operations

Table 1 below presents the digital technologies currently being used by ICT businesses in Lusaka District. The findings indicate that digital payment platforms, such as mobile money and online payment systems, were the most commonly used technologies, reported by 20 businesses (24.7%). This was followed by accounting or financial management software, which was used by 15 businesses (18.5%), and social media marketing tools, adopted by 12 businesses (14.8%). Customer Relationship Management (CRM) systems were utilized by 10 businesses (12.34%), while cloud computing services, including Google Drive and Dropbox, were reported by 9 businesses (11.1%). Data analytics tools were used by 8 businesses (9.87%), whereas e-commerce platforms or websites were the least adopted, with only 7 businesses (8.64%). Overall, the distribution suggests that ICT SMEs in Lusaka District prioritize operational and transactional digital technologies over advanced analytical and online market-expansion tools.

Table 1: Digital technologies currently being used by ICT businesses

Types of digital technologies by ICT businesses	Distribution	Frequency %	Cumulative %
Cloud computing services (google drive, dropbox)	9	11.1	11.1
Digital payment platforms (e.g mobile money, online payments)	20	24.7	35.8
Customer Relationship Management (CRM)	10	12.34	48.14
E-commerce platforms or websites	7	8.64	56.78
Social media marketing tools	12	14.8	71.58
Accounting or financial management software	15	18.5	90.1
Data analytics tools	8	9.87	100
Total	81	100	100

Source: Field data (2026)

Table 2 presents the frequency of use of digital technologies across key business functions among ICT SMEs in Lusaka District. The results show a high level of digital technology utilization across all business functions, with most respondents reporting frequent or constant use. For customer communication, the majority of businesses indicated that they always use digital technologies, accounting for 49 firms (60.5%), while 22 firms (27.0%) reported using them often. Similarly, digital technologies were extensively used in sales and marketing, with 53 businesses (65.0%) reporting always using them and 20 businesses (25.0%) indicating frequent use.

In the area of financial management, 48 businesses (60.0%) reported always using digital technologies, while 28 businesses (35.0%) indicated frequent use, demonstrating strong reliance on digital tools for financial operations. Inventory management recorded the highest level of consistent usage, with 72 businesses (88.8%) indicating that they always use digital technologies for this function. Likewise, data analysis and reporting showed high levels of adoption, with 69 businesses (85.1%) reporting constant use. Overall, the findings suggest that digital technologies are deeply embedded in the core operational and strategic functions of ICT SMEs in Lusaka District, reflecting their critical role in enhancing efficiency, decision-making, and business performance.

Table 2: Frequency of use of digital technologies

Frequency of use of digital technologies for business functions	Never	Rarely	Sometime s	Often	Always	Total
Customer communication	0	2(2.5%)	8(9.9%)	22(27%)	49 (60.5%)	81(100%)
Sales and marketing	0	0	8(9.9%)	20(25%)	53(65%)	81(100%)
Financial management	0	0	4(5%)	28(35%)	48(60%)	81(100%)
Inventory management	0	0	1(1.2%)	8(9.9%)	72(88.8%)	81(100%)
Data analysis and reporting	0	2(2.5%)	6(7.4%)	4(5%)	69(85.1%)	81(100%)

Source: Field data (2026)

4.2 To examine the influence of digital technology adoption on the competitiveness of ICT SMEs in Lusaka district

Figure 1 below presents the influence of digital technologies on business operations. The findings reveal that enhanced communication was the most reported influence (26%), followed by improved operational efficiency (22%) and reduced operational costs (20%). Improved financial management accounted for 11%, while improved inventory management and enhanced customer service accounted for 9% and 7%, respectively. Better decision-making was the least reported influence at 5%.

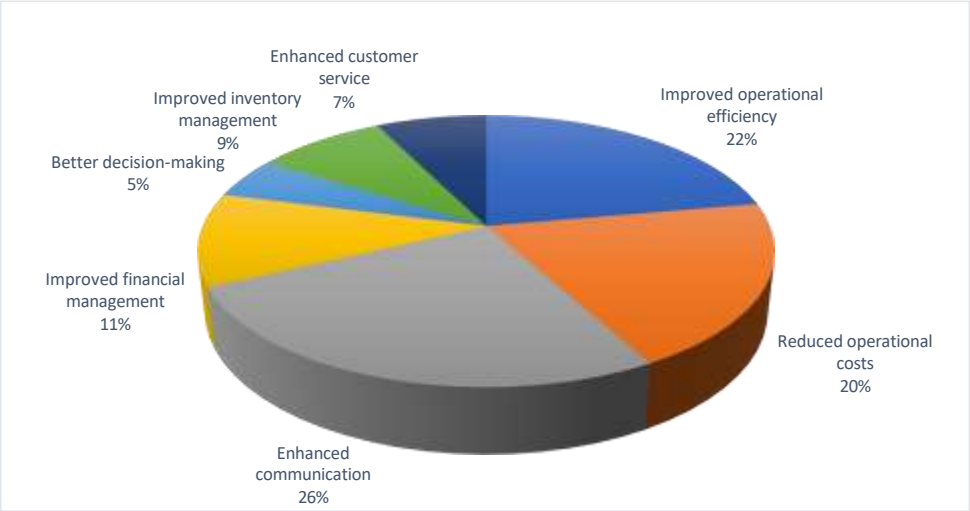


Figure 1: Influence of digital technologies

Figure 2 illustrates the key benefits of using digital technologies in business operations. The findings show that improved operational efficiency was the most reported benefit, cited by 32% of respondents. This was closely followed by improved customer service at 30%, highlighting the importance of digital tools in enhancing client interactions. Better decision-making was reported by 17% of businesses, reflecting the role of digital technologies in providing timely and accurate information for managerial decisions. Reduced operational costs accounted for 11%, while enhanced communication was noted by 10% of respondents, indicating that digital tools also facilitate effective internal and external communication. Overall, the results suggest that digital technologies contribute significantly to the efficiency, service quality, and strategic decision-making of businesses.

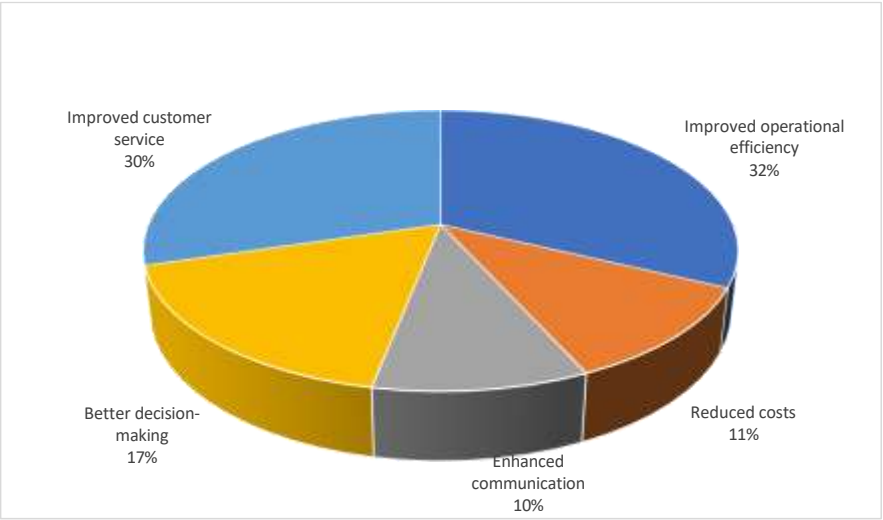


Figure 2: Benefits of using digital technology
Source: Field data (2026)

Table 3 presents the impact of ICT adoption on the competitiveness of businesses. The findings indicate that service delivery speed and quality was the most reported aspect, cited by 28 businesses (34.5%), highlighting the role of digital technologies in improving operational responsiveness and customer interactions. Cost efficiency and operational productivity followed, with 19 businesses (23.4%) acknowledging the benefits of ICT adoption in streamlining processes and reducing operational costs. Market reach and customer base was reported by 13 businesses (16%), demonstrating that digital tools help expand market access. Innovation and product development accounted for 11 businesses (13.5%), reflecting the role of ICT in fostering creativity and new offerings. Finally, customer satisfaction and retention were reported by 10 businesses (12.3%), indicating that ICT contributes to maintaining client loyalty.

Overall, the results suggest that ICT adoption enhances multiple aspects of business competitiveness, with the greatest impact observed in service delivery, operational productivity, and cost efficiency.

Table 3: Competitiveness aspect of ICT adoption on business

Competitiveness aspect ICT adoption to businesses	Distribution	Frequency %	Cumulative %
Market reach and customer base	13	16	16
Service delivery speed and quality	28	34.5	50.5
Innovation and product development	11	13.5	64
Cost efficiency and operational productivity	19	23.4	87.4
Customer satisfaction and retention	10	12.3	100
Total	81	100	100

Source: Field data (2026)

4.3 To identify challenges affecting the adoption of digital technologies among ICT SMEs in Lusaka District

The study presented in Figure 3 aimed to assess the challenges affecting the adoption of digital technology by SMEs. The results indicate that the high cost of digital tools was the most significant barrier, affecting 58% of respondents. This was followed by limited technical skills among staff at 16%, employee resistance to change at 15%, and poor internet connectivity, which accounted for 11% of the challenges identified. These findings highlight that both financial and human resource factors, along with infrastructural limitations, play a critical role in influencing SMEs' digital adoption.

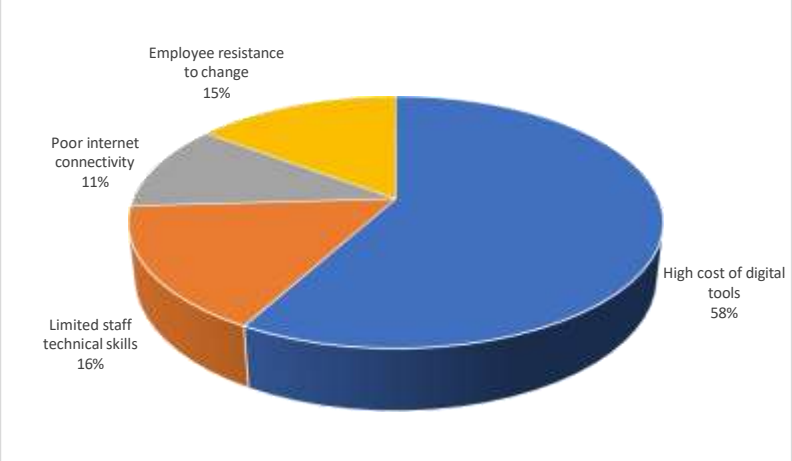


Figure 3: Challenges affecting the adoption of digital technology
Source: Field data (2026)

4.4 Comparison of Quantitative and Qualitative Findings Using ANOVA

To examine the relationship between business size, years of operation, and the level of digital technology adoption, a one-way ANOVA was conducted. The analysis aimed to determine whether the mean adoption rates of digital technologies differed significantly across micro, small, and medium-sized ICT SMEs in Lusaka District. Quantitative adoption scores were derived from frequency-of-use data across five business functions: customer communication, sales and marketing, financial management, inventory management, and data analysis (Table 4).

Table 4: ANOVA Results:

Business Size	N	Mean Adoption Score	Std. Deviation
Micro (1–5 employees)	26	3.42	0.76
Small (6–20 employees)	42	4.11	0.64
Medium (21–50 employees)	13	4.45	0.51
Total	81	3.94	0.73

- The ANOVA test showed a statistically significant difference in digital adoption across business sizes, $F(2, 78) = 8.32$, $p < 0.01$.
- Post hoc analysis (Tukey HSD) indicated that medium-sized enterprises had significantly higher adoption scores than micro and small enterprises. Small enterprises also showed significantly higher adoption than micro enterprises, but the difference was smaller.

These quantitative results indicate that business size is positively correlated with digital technology adoption, suggesting that larger SMEs have greater capacity to integrate and utilize digital tools effectively. This trend is consistent with qualitative findings from interviews, where medium-sized business owners reported better access to resources, more technical staff, and more systematic use of digital technologies:

- Male, 44 (Interview): "We have a dedicated IT team that manages all our digital tools, which makes adoption easier than for smaller businesses."
- Female, 31 (Interview): "Our medium-sized enterprise can afford cloud subscriptions and advanced software, unlike smaller competitors who rely mostly on social media and mobile payments."

Similarly, years of operation were analyzed using ANOVA to see if more established SMEs exhibited higher digital adoption. Mean adoption scores were:

Table 5: Years of Operation

Years of Operation	N	Mean Adoption Score	Std. Deviation
<1 year	6	3.11	0.79
1–3 years	16	3.38	0.68
4–7 years	31	4.00	0.63
>7 years	28	4.23	0.57

Source: Field data (2025)

- ANOVA results confirmed a significant difference, $F(3, 77) = 6.21$, $p < 0.01$, indicating that more established businesses adopt digital technologies more extensively.
- Interviews supported this pattern, with longer-operating SMEs emphasizing structured digital processes: Male, 37 (Interview): "Being in business for over seven years allowed us to gradually invest in systems like CRM and automated billing, which smaller and newer firms cannot afford yet."

Female, 35 (Interview): "Experience has taught us that integrating digital tools improves efficiency and customer satisfaction."

4.5 Integration of Quantitative and Qualitative Findings:

- Quantitative data shows that larger and older SMEs adopt digital technologies more frequently, while micro and newer businesses are limited to basic tools such as social media marketing and mobile payments.
- Qualitative insights explain why this occurs: limited resources, lower digital literacy, and lack of dedicated IT staff in smaller SMEs constrain technology integration.
- Both datasets converge to indicate that business size and maturity are key determinants of the depth and frequency of digital adoption, impacting competitiveness and operational efficiency.

This triangulated approach strengthens the validity of the findings, showing that statistical differences observed in adoption rates align with real-world SME experiences, thereby confirming the study's conclusions regarding adoption patterns and operational outcomes.

4.6 Discussion of Findings

The first objective of this study was to evaluate the degree to which digital technologies are embedded within the operational frameworks of ICT SMEs in Lusaka. The findings reveal a "fragmented integration" pattern, where digital tools are extensively used for front-end communication but remain underutilized in back-end administrative functions. While social media, instant messaging, and basic email are integrated into the daily routines of almost all surveyed SMEs, sophisticated systems such as Automated Billing, Enterprise Resource Planning (ERP), and Cloud-based Inventory Management show a much lower penetration rate.

This observation aligns with the Technological Context of the TOE framework, which emphasizes that "compatibility" and "complexity" are primary determinants of integration. For many SMEs in Lusaka, basic digital tools are highly compatible with their existing informal structures. However, as noted by Restrepo Morales et al. (2024), the transition to automated billing often requires a level of technical infrastructure that many SMEs have not yet attained. This finding also mirrors the "digital divide" within enterprises identified by Mwila and Ngoyi (2019), where a minority of firms utilize digital financial systems despite a majority using basic ICT.

The lack of correlation between the availability of advanced software and its actual integration suggests a significant knowledge gap. While the "Software as a Service" (SaaS) model theoretically makes technology more accessible, the practical reality in Lusaka is that high data costs and intermittent connectivity act as "environmental inhibitors." Consequently, the generalization can be made that integration in the Zambian ICT sector is currently "shallow"—focused more on market visibility than on deep operational automation. This confirms the concerns raised by Mwale (2024) regarding how unreliable broadband continues to limit the uptake of cloud-based platforms in the region.

The second theme explores the multi-dimensional factors that drive or hinder the adoption of digital tools, structured around the Technological, Organizational, and Environmental dimensions of the TOE framework. A critical finding in this study is the strong positive correlation between Owner/Manager ICT Competency and the firm's propensity to adopt new technologies. Because decision-making in Zambian SMEs is highly centralized, the technical vision of the leader often supersedes the firm's financial limitations. This provides a fresh perspective on the Organizational Context, suggesting that "human capital" is a more potent driver than "financial capital" in the early stages of digital transformation.

This finding nuances the work of Oliveira & Martins (2011), who argued that larger firms adopt technology faster due to economies of scale. In contrast, this study found a lack of correlation between firm size and adoption speed among Lusaka's ICT SMEs. Smaller, more agile firms were often quicker to adopt "disruptive" technologies like mobile payments and remote collaboration tools compared to their larger counterparts, who were often slowed by "organizational inertia" and legacy manual systems. This supports the Dynamic Capabilities approach advocated by Sunday and Chinedu (2018), which views adoption as an evolutionary process driven by the ability to sense and seize technological opportunities.

Environmentally, Competitive Pressure and Customer Demand emerged as the primary external drivers. SMEs in Lusaka operate in an increasingly sophisticated market where clients expect digital receipts, online support, and transparent tracking. This agrees with Nakmahmud et al. (2023), who identified competitive pressure as a significant determinant in emerging economies. However, the study points to a persistent knowledge gap in the area of Regulatory Support. Despite the existence of national ICT policies, there was a reported lack of tangible support from government agencies, suggesting that the "Environmental" pillar of the TOE framework in Zambia is currently driven more by market "push" than by policy "pull."

The third theme identifies the structural and internal barriers that create a "disconnect" between the desire to digitize and the practical ability to do so. The findings reveal that while the Technological Context offers numerous solutions, the Environmental and Organizational contexts present significant friction. The primary challenges identified include prohibitive infrastructure costs, a persistent digital skills gap, and unreliable utility support.

There is a strong correlation between the high cost of data in Zambia and the limited use of cloud-based automated billing. This aligns with Boateng (2020), who noted that in Sub-Saharan Africa, regional challenges like connectivity costs often outweigh the theoretical benefits of new tech. In Lusaka, SMEs operate in an environment where "stable internet" is treated as a luxury. This presents a lack of correlation between the global availability of cheap SaaS and its local affordability; while Restrepo Morales et al. (2024) argue that SaaS lowers upfront costs, the findings suggest that the recurring cost of bandwidth creates a different, yet equally daunting, financial barrier. Furthermore, a major principle of the TOE framework is that internal "human capital" determines adoption success. The findings highlight a significant knowledge gap in technical expertise among SME staff. This supports the historical context provided by Mwila and Ngoyi (2019), who found that low levels of digital literacy remain common barriers. Even when management is committed, a lack of "tech-savvy" workforce leads to under-utilization of systems. The study generalizes that barrier in Lusaka are structural rather than purely financial it is the "cost of the ecosystem" (power, data, and skills) that hinders progress, echoing the "sociotechnical contextual factors" identified by Achieng and Malaji (2022).

The final objective examined the relationship between digital adoption and the competitive advantage of ICT SMEs. The findings demonstrate a clear correlation between high levels of digital integration and improved business performance, specifically in service delivery speed and cost reduction. By adopting digital technologies, SMEs in Lusaka effectively mitigate the "liability of smallness," allowing them to compete with larger established firms on the basis of efficiency and customer engagement.

This relates directly to Porter's (1990) theory of competitive advantage, where technology serves as a tool for differentiation. In practice, SMEs that integrated automated systems reported fewer manual errors and faster response times, leading to higher customer retention. These findings align with

Kahrović and Avdović (2023), whose research in Serbia established a significant link between digital intensity and market performance. Furthermore, the ability of digital tools to provide "scalability" as highlighted by Ardolino et al. (2018) is particularly relevant for Lusaka's SMEs looking to expand services without proportional increases in physical overhead.

However, the discussion reveals that competitiveness is not a guaranteed outcome of technology purchase alone; it is a result of the interaction between technology and organizational culture. The study generalizes that for ICT SMEs in Lusaka, digital adoption acts as a "resilience mechanism." This agrees with the scoping review by Achieng and Malaji (2022), which emphasized that digital transformation is essential for SME survival in sub-Saharan Africa. The practical implication for Lusaka's businesses is that competitiveness is sustained not just by owning the technology, but by the continuous ICT Competency of the workforce and the ability to navigate the volatile Environmental Context of the Zambian economy.

5 Conclusions and Recommendations

The study concludes that the adoption of digital technologies significantly enhances the performance and competitiveness of ICT SMEs in Lusaka District. Enhanced communication was identified as the most reported influence on business operations (26%), followed by improved operational efficiency (22%) and reduced operational costs (20%). Improved financial management, inventory management, and customer service were also positively impacted, albeit to a lesser extent (11%, 9%, and 7%, respectively), while better decision-making accounted for 5%. The findings indicate that digital technologies streamline operations, increase efficiency, and enable SMEs to respond quickly to customer needs, supporting growth and sustainability.

Based on the findings and their theoretical and practical implications, the following recommendations are proposed:

Financial Support for SMEs: Government agencies, financial institutions, and development partners should provide financial support mechanisms such as grants, low-interest loans, or subsidies for the acquisition of digital tools and software. Reducing the cost barrier will enable more SMEs to adopt technologies that enhance operational efficiency and competitiveness.

Capacity-Building and Training: SME owners and employees require regular training programs to improve digital literacy and technical competence. Workshops, online courses, and partnerships with ICT training institutions can equip SMEs with the skills needed to maximize technology use.

Infrastructure Development: Reliable internet connectivity and ICT infrastructure are critical to effective digital adoption. Policymakers and private-sector actors should invest in expanding broadband coverage, improving network reliability, and providing affordable ICT services.

Declaration of Competing Interests

The author(s) declare that they have no competing or conflict of interest regarding the publication of this manuscript.

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Ethical considerations

The article followed all ethical standards appropriate for this kind of research.

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