Int Journal of Social Sciences Management and Entrepreneurship 8(3): 136-149 *2024*

ISSN 2411-7323

www.sagepublishers.com

INTERNET OF THINGS AND QUALITY OF SERVICES OF MOBILE NETWORK OPERATORS IN NAIROBI CITY COUNTY, KENYA

[1] Wanga Isaac Tunya, [2] Dr. Mose Thomas (PhD),

[1] Master of Science Degree in ICT Management, Jomo Kenyatta University of Agriculture and Technology

[2] Lecturer, Jomo Kenyatta University of Agriculture and Technology

ABSTRACT

. The general objective of the study was to assess the influence of internet of things on quality of services of mobile network operators in Nairobi City County, Kenya. Specifically, the study sought to establish the effect of Commercial IoT on quality of services of mobile network operators in Nairobi City County, Kenya and to establish the influence of Infrastructure IoT on quality of services of mobile network operators in Nairobi City County, Kenya. This study used a descriptive research design. The study targeted management level employees at telecommunication companies in Kenya. Target populace comprised all 950 management level employees working with the telecommunication companies in Kenya. This involved all levels of management (senior, middle and low level management staff). The study used Krejcie and Morgan (1970) formula to arrive at the sample size. The study sample size was 282 employees, which represented 29.7% of the entire population. Primary data was used in this study. The study's primary data was obtained using semi-structured questionnaires. The researcher carried out a pilot study to ensure the data collection tool was reliable and valid. Quantitative and qualitative data were generated from the closed-ended and open-ended questions, respectively. Qualitative data was analyzed on thematic basis and the findings provided in a narrative form. Before the data was analyzed, the researcher ensured the data was checked for completeness, followed by data editing, data coding, data entry, and data cleaning. Inferential and descriptive statistics was employed for analysis of quantitative data with the assistance of Statistical Package for Social Sciences (SPSS version 25). Data analysis was done using descriptive statistics and inferential statistics. Inferential data analysis was conducted by use of Pearson correlation coefficient, and multiple regression analysis. The study results were presented in tables and figures. The study concludes that Commercial IoT has a positive and significant effect on quality of services of mobile network operators in Nairobi City County, Kenya. The study also concludes that Infrastructure IoT has a positive and significant effect on quality of services of mobile network operators in Nairobi City County, Kenya. Based on the study findings, the study recommends that the management of mobile network operators in Kenya should establish strategic partnerships with businesses and industries adopting IoT solutions.

Key Words: Internet of Things, Quality of Services, Mobile Network Operators, Commercial IoT, Infrastructure IoT

Background of the Study

The telecommunications industry serves as a fundamental pillar of modern economies, playing a crucial role in shaping the infrastructure and functionality of both developed and developing countries (Akoyo, Bula, & Wambua, 2022). In any country, the telecommunications sector is integral to economic development, social connectivity, and technological innovation. It provides the essential backbone for communication services, including voice, data, and multimedia, which are vital for business operations, government functions, and daily life (Boakye, & Olumide, 2021). By facilitating efficient communication and data exchange, the telecommunications industry supports various sectors, such as healthcare, education, finance, and transportation, enhancing overall societal well-being and economic productivity (Boru, & Nchaga, 2022). Despite the critical role of telecommunications, the quality of services provided by mobile network operators (MNOs) can significantly impact user satisfaction and overall economic performance. Quality of service (QoS) in the telecommunications context encompasses various aspects, including network coverage, data speed, call quality, and reliability. High-quality services are essential for ensuring seamless communication, fostering customer satisfaction, and maintaining the competitiveness of MNOs. The performance of MNOs directly affects user experience, business operations, and the ability of the sector to support digital transformation initiatives (Chinedu, & Eje, 2023).

The Internet of Things (IoT) refers to the network of interconnected physical devices, sensors, and systems that communicate and exchange data with each other through the internet or other communication networks. These devices, often embedded with sensors, software, and other technologies, collect and transmit data to central systems or other devices, enabling automated and intelligent interactions (Kabanda, & Njenga, 2024). The Internet of Things (IoT) encompasses a diverse range of applications and technologies that connect devices and systems to the internet, allowing them to collect, exchange, and act on data. These applications are typically categorized into: Commercial IoT and Infrastructure IoT. Commercial IoT focuses on the use of IoT technologies in business and commercial settings to enhance operational efficiency, optimize resource management, and improve customer experiences (Maina, 2023). This domain includes smart vending machines, connected point-of-sale systems, and inventory management solutions that track stock levels and automate reordering processes. Commercial IoT applications can help businesses streamline operations, reduce costs, and gain valuable insights into consumer behavior and operational performance. Infrastructure IoT involves the application of IoT technologies to manage and optimize critical infrastructure systems, such as transportation networks, utilities, and public services (Mashat, Abourokbah, & Salam, 2024). Examples include smart grid systems that monitor and manage electrical power distribution, smart water management systems that detect leaks and optimize water usage, and intelligent transportation systems that improve traffic flow and reduce congestion. Infrastructure IoT aims to enhance the efficiency, reliability, and sustainability of public services and infrastructure (Malongo, 2020).

Statement of the Problem

The telecommunications industry in Kenya plays a vital role in driving economic growth, enhancing social connectivity, and supporting digital transformation across various sectors. As a key enabler of communication and information exchange, the industry has contributed significantly to the country's Gross Domestic Product (GDP), facilitated financial inclusion through mobile money platforms like M-Pesa, and supported innovations in sectors such as agriculture, health, and education (Communications Authority of Kenya, 2022). With the growing demand for digital services, the telecommunications sector is increasingly becoming a cornerstone of Kenya's socio-economic development. Mobile network operators (MNOs), in particular, have been at the forefront of expanding access to voice and data services, thereby enhancing connectivity and empowering citizens and businesses alike. As Kenya moves toward becoming a digital economy in line with its Vision 2030 and the Digital Economy Blueprint, the quality of services provided by MNOs remains a critical determinant of the sector's overall performance and impact (Ministry of ICT, Innovation and Youth Affairs, 2019).

Despite the critical role of mobile network operators in driving digital transformation, there has been a notable decline in the quality of services provided by MNOs in Nairobi City County, Kenya. Issues such as network congestion, slow data speeds, frequent call drops, and inconsistent network coverage have been increasingly reported by consumers. According to the Communications Authority of Kenya (CA), the overall quality of service (QoS) ratings for MNOs have been below the required standards in recent years. For instance, a QoS report by the CA indicated that, in 2023, the average call drop rate across major MNOs was 3.5%, exceeding the acceptable threshold of 2% (Communications Authority of Kenya, 2023). Additionally, customer satisfaction surveys have shown that more than 40% of mobile subscribers in Nairobi City County expressed dissatisfaction with the reliability and speed of internet services, citing significant delays during peak hours and limited coverage in some areas (Ipsos, 2023). Such declines in service quality not only affect user experience but also pose a risk to the operators' market share and overall competitiveness in a rapidly evolving digital landscape.

The Internet of Things (IoT) presents a significant opportunity for improving the quality of services offered by mobile network operators. IoT involves the interconnection of various devices and sensors, allowing for real-time data collection, analysis, and communication. For MNOs, the adoption of IoT technologies can enhance network optimization and resource management, enabling more efficient handling of network traffic and reducing instances of congestion (ITU, 2021). IoT-driven solutions, such as smart network management systems, can dynamically allocate network resources based on real-time demand, ensuring optimal performance and consistent service delivery (Cisco, 2022). Moreover, IoT can help in proactive network maintenance and fault detection, minimizing service interruptions and enhancing reliability (Ericsson, 2023). However, while IoT offers substantial potential to improve the quality of services, the extent of its impact remains underexplored in the context of Kenya's telecommunications sector, particularly in urban centers like Nairobi, where the demand for high-quality services is rapidly increasing. This study, therefore, sought to assess the influence of IoT on the quality of services provided by mobile network operators in Nairobi City County, Kenya

Objectives of the Study

This study was guided by the following specific objectives

i. To establish the effect of Commercial IoT on quality of services of mobile network operators in Nairobi City County, Kenya
ii. To establish the influence of Infrastructure IoT on quality of services of mobile network operators in Nairobi City County, Kenya

LITERATURE REVIEW

Theoretical Framework

Resource-Based View

The Resource-Based View (RBV) theory founded by Barney (1991) is a strategic management framework that focuses on the internal resources and capabilities of a firm as sources of competitive advantage. At its core, RBV posits that a firm's unique bundle of resources and capabilities can enable it to achieve sustainable competitive advantage and superior performance in the marketplace. Unlike traditional strategic management approaches that primarily focus on external factors such as market dynamics and industry structure, RBV emphasizes the importance of internal factors in determining a firm's success (Uwizeyimana & Mulyungi, 2020). RBV theory entails identifying and leveraging a firm's distinctive resources and capabilities to create value and achieve strategic objectives. Resources can include tangible assets such as physical infrastructure, financial capital, and technology, as well as intangible assets such as human capital, intellectual property, organizational culture, and reputation. These resources are considered valuable if they enable the firm to exploit opportunities or neutralize threats in the external environment. Capabilities, on the other hand, refer to the firm's ability to effectively deploy and utilize its resources to perform specific activities and achieve desired outcomes (Chinedu & Eje, 2023).

The Resource-Based View (RBV) theory of strategic management is built upon several foundational assumptions that shape its approach to analyzing firm performance and competitive advantage. One key assumption of RBV is that firms are heterogeneous in terms of the resources and capabilities they possess. This means that each firm has a unique bundle of resources—both tangible and intangible—that is valuable, rare, difficult to imitate, and non-substitutable (VRIN). RBV posits that these distinctive resources and capabilities are the primary sources of sustained competitive advantage and superior performance (Mutua & Muthimi, 2020). Another assumption of RBV is that firms are rational and profit-maximizing actors that seek to exploit their resources and capabilities to create value for stakeholders. RBV theory also assumes that resources are not static, but can be developed, accumulated, and leveraged over time to enhance a firm's competitive position. This implies that firms can invest in building and renewing their resource base, as well as developing dynamic capabilities that enable them to adapt and respond effectively to changes in the external environment. Additionally, RBV assumes that markets are imperfect and that firms can earn economic rents by possessing unique resources and capabilities that are not fully captured by market prices. These rents can arise from factors such as brand reputation, customer loyalty, and proprietary technology (Lentoimaga, Mulongo & Omboto, 2021).

Despite its strengths, RBV theory has faced several critiques over the years. One criticism is that RBV may be tautological or circular in its reasoning, as the concept of valuable, rare, inimitable, and non-substitutable resources (VRIN) is somewhat subjective and difficult to operationalize empirically. Critics argue that firms may achieve competitive advantage through factors other than resources and capabilities, such as market positioning or network effects. Additionally, RBV has been criticized for its limited focus on external factors and industry dynamics, such as changes in customer preferences, technological innovation, and competitive rivalry (Boru & Nchaga, 2022). Some scholars argue that RBV may overlook the importance of these external factors in shaping a firm's competitive position and performance. Moreover, RBV theory has been criticized for its lack of prescriptive guidance on how firms can identify and develop valuable resources and capabilities. While RBV provides a useful framework for understanding the sources of competitive advantage, it offers limited practical guidance on how firms can systematically analyze their resource base and make strategic decisions to enhance their competitive position. Critics also point out that RBV may be less relevant in industries characterized by rapid technological change and disruptive innovation, where traditional sources of competitive advantage may be short-lived (Uwizeyimana & Mulyungi, 2020). This theory was relevant in establishing the effect of Commercial IoT on quality of services of mobile network operators in Nairobi City County, Kenya.

Systems Theory

Systems Theory developed by Ludwig von Bertalanffy (1964) is a broad and interdisciplinary framework that seeks to understand and analyze the relationships and interactions between components within complex systems. It originated in the natural sciences but has since been applied to various fields including biology, psychology, sociology, and management. At its core, Systems Theory views systems as composed of interconnected elements that work together to achieve a collective goal or function. These elements can range from biological organisms to organizations, ecosystems, or even societies (Kabanda & Njenga, 2024). Central to Systems Theory is the idea of holism, which emphasizes that the whole system is greater than the sum of its parts. This perspective encourages studying the system as a unified entity rather than focusing solely on individual components in isolation. Systems Theory also emphasizes the importance of understanding feedback loops and interactions within the system. Feedback mechanisms can be positive (reinforcing) or negative (balancing), influencing how the system responds to internal or external changes (Yauri, 2021).

Another key concept within Systems Theory is the idea of boundaries and subsystems. Systems are often delineated by boundaries that define what is included within the system and what lies outside of it. Within larger systems, subsystems can exist, each with its own internal structure and dynamics. These subsystems interact with each other and with the larger system, contributing to the overall behavior and functioning of the system as a whole. Systems Theory also addresses the notion of emergence, where the properties and behaviors of the system as a whole cannot be fully understood or predicted by examining its individual components alone. Instead, emergent properties arise from the interactions and relationships between components, leading to novel phenomena that are not evident at lower levels of analysis (Karugani & Ochiri, 2020).

One fundamental assumption is holism, which posits that systems must be studied as integrated wholes rather than mere collections of parts. This holistic perspective emphasizes the interconnectedness and interdependence of system components, suggesting that understanding how these components interact is crucial for comprehending the system's behavior and dynamics. This assumption underscores the idea that the whole system exhibits properties and behaviors that are emergent and cannot be reduced solely to the sum of its individual parts (Wanjiru & Yusf, 2022). Another assumption of Systems Theory is that systems exhibit self-regulation and self-organization. This implies that systems possess mechanisms that enable them to maintain stability and adapt to changes in their environment. Feedback loops play a critical role here, where systems receive information about their own performance and adjust their behavior accordingly. Systems are viewed as dynamic entities capable of evolving and adapting over time, guided by internal processes that promote stability or facilitate change as needed (Otwal, Midida & Aliata, 2021).

Critiques of Systems Theory often focus on its complexity and the challenges associated with applying it in practice. One critique is that the holistic approach can sometimes oversimplify the intricate relationships and interactions within systems. In attempting to view systems as unified wholes, there is a risk of overlooking important nuances and variability among different system components or subsystems. This oversimplification may lead to inaccurate predictions or inadequate solutions when addressing real-world problems that involve diverse and multifaceted systems (Kabanda & Njenga, 2024). Additionally, Systems Theory has been criticized for its abstract nature and the difficulty of operationalizing its concepts in specific contexts. While the framework provides a useful lens for understanding general principles of systems dynamics, translating these principles into actionable strategies or policies can be challenging. Critics argue that Systems Theory's emphasis on general principles may not always provide practical guidance for addressing unique and complex real-world issues that require context-specific analysis and interventions (Yauri, 2021). This theory was relevant in establishing the influence of Infrastructure IoT on quality of services of mobile network operators in Nairobi City County, Kenya.

Conceptual Framework

A conceptual framework is an assumed model that aids in the identification of study concepts as well as their interactions with one another (Mugenda & Mugenda, 2019). In this study, the independent variables were Commercial IoT, and Infrastructure IoT while the dependent variable was quality of services of mobile network operators in Nairobi City County, Kenya.

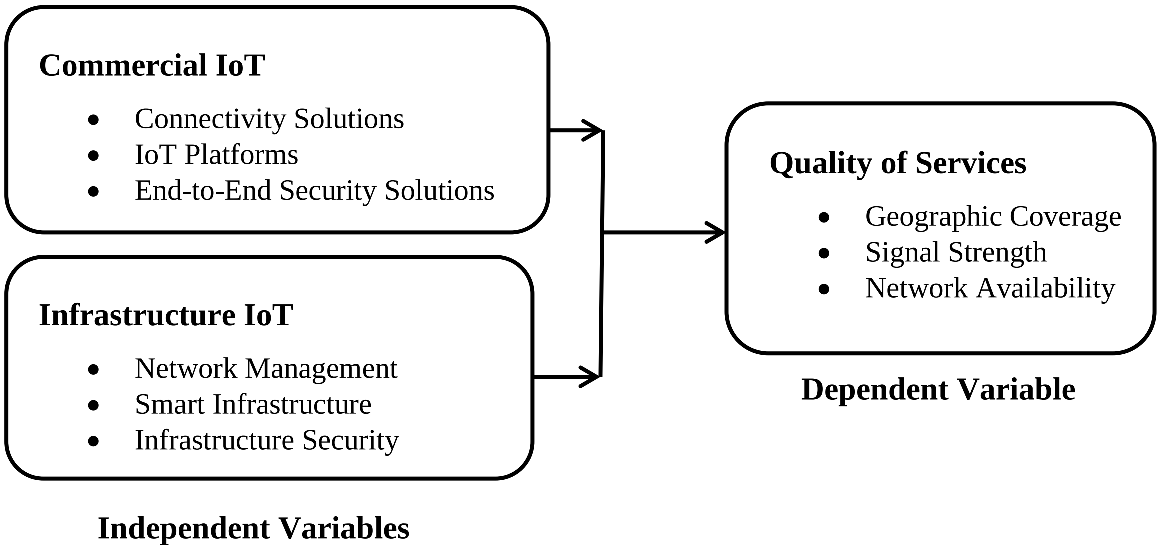

Figure 2. 1: Conceptual Framework

Commercial IoT

Commercial IoT (Internet of Things) refers to the application of IoT technology in business and industrial settings to improve operational efficiency, enhance productivity, and drive innovation. Commercial IoT is concerned with deploying connected devices and systems in various business environments to streamline processes, gather actionable data, and support strategic decision-making (Chinedu & Eje, 2023). Connectivity solutions are the backbone of the IoT ecosystem, enabling devices to communicate with each other and with central systems. These solutions encompass a variety of technologies and protocols, including Wi-Fi, Bluetooth, cellular networks (such as 4G and 5G), and Low Power Wide Area Networks (LPWAN) like LoRaWAN and NB-IoT. Each connectivity option has its own strengths and is chosen based on factors like range, data transfer rates, power consumption, and deployment scale. For example, Wi-Fi is commonly used for high-bandwidth applications within homes and offices, while LPWAN technologies are ideal for connecting devices over long distances with minimal power requirements. Effective connectivity solutions ensure reliable data transmission, enable seamless integration of IoT devices, and support scalable deployments across various environments (Mutua & Muthimi, 2020).

IoT platforms serve as the central hub for managing and orchestrating IoT devices and data. These platforms provide the infrastructure needed to collect, store, and analyze data generated by IoT devices, as well as tools for device management and application development. They offer functionalities such as real-time data processing, analytics, and visualization, which help businesses gain insights and make data-driven decisions. Major IoT platforms often include features for device provisioning, remote monitoring, and software updates, facilitating the management of large-scale IoT deployments. By providing a unified interface for interacting with diverse devices and data sources, IoT platforms simplify the development and integration of IoT solutions, making them essential for leveraging the full potential of IoT technologies (Lentoimaga, Mulongo & Omboto, 2021).

End-to-end security solutions are critical for protecting the integrity and confidentiality of data within IoT systems. These solutions encompass a range of security measures designed to safeguard devices, networks, and data from unauthorized access, breaches, and other cyber threats. Key components include encryption for data transmission and storage, secure authentication protocols to ensure that only authorized devices and users can access the system, and regular software updates to address vulnerabilities. Additionally, end-to-end security involves monitoring and responding to security incidents to prevent or mitigate potential attacks. Given the increasing complexity and scale of IoT deployments, robust security measures are essential for maintaining trust, ensuring compliance with regulations, and protecting sensitive information from emerging threats (Boru & Nchaga, 2022).

Infrastructure IoT

Infrastructure IoT (Internet of Things) refers to the application of IoT technology to the management, monitoring, and optimization of critical infrastructure systems. These systems include physical and organizational structures essential for the functioning of cities and large-scale operations, such as transportation networks, utilities, and public services (Karugani & Ochiri, 2020). Network management in the context of IoT refers to the processes and tools used to oversee and optimize the connectivity and performance of networked devices and systems. Effective network management ensures that IoT devices communicate efficiently, data flows seamlessly, and potential issues are addressed proactively. This involves monitoring network traffic, managing bandwidth, and ensuring reliable connectivity across various types of networks, including local area networks (LANs), wide area networks (WANs), and cellular networks. Tools for network management typically include network monitoring systems, configuration management, and diagnostic tools that help identify and resolve connectivity issues, optimize performance, and maintain network security. In IoT environments, where a large number of devices generate substantial data traffic, robust network management is crucial for maintaining the integrity and reliability of network operations, ensuring that data is transmitted without interruptions and that the network adapts to changing demands (Wanjiru & Yusf, 2022).

Smart infrastructure refers to the integration of advanced technologies and IoT solutions into physical infrastructure to enhance its efficiency, functionality, and sustainability. This includes deploying sensors, actuators, and data analytics to monitor and manage infrastructure systems such as transportation networks, energy grids, and buildings. For instance, smart transportation systems use real-time data to optimize traffic flow and reduce congestion, while smart grids use sensors to monitor energy consumption and improve grid reliability. Smart infrastructure also encompasses intelligent building management systems that control lighting, heating, and cooling based on occupancy and usage patterns. The goal of smart infrastructure is to create more responsive, adaptive, and efficient systems that improve overall quality of life, reduce operational costs, and support sustainable development by leveraging data-driven insights and automation (Otwal, Midida & Aliata, 2021).

Infrastructure security in the context of IoT involves protecting critical infrastructure systems from cyber threats and ensuring their resilience against attacks. This encompasses a range of strategies and technologies designed to safeguard data, devices, and communication networks from unauthorized access, manipulation, and other security risks. Key aspects of infrastructure security include implementing robust access controls, encrypting data in transit and at rest, and employing intrusion detection and prevention systems to monitor and respond to potential threats. Additionally, infrastructure security involves regular updates and patch management to address vulnerabilities and ensure that security measures evolve with emerging threats. Given the increasing complexity and connectivity of modern infrastructure systems, ensuring comprehensive security is essential for maintaining operational continuity, protecting sensitive information, and safeguarding public safety (Kabanda & Njenga, 2024).

Empirical Review

Commercial IoT and quality of services

Uwizeyimana and Mulyungi (2020) conducted a study on the influence of commercial IoT on provision of services in public institutions in Rwanda. The research adopted descriptive survey design and a total of 86 questionnaires were distributed to respondents. The study found that there was a strong significant relationship between commercial IoT and provision of services. The study concluded that commercial IoT has substantially contributed to the success of provision of services in public institutions in Rwanda.

Chinedu and Eje (2023) assessed on the impact of commercial IoT in manufacturing management. The research design is a survey. The population of this study consisted of all 141 staff of Camanov Ltd. Port Harcourt. Since the population is not large, the researcher conducted a census of all, and 126 staff completed a structured questionnaire. The study found that commercial IoT has a significant impact on organizational efficiency in Camanov Ltd. The study concluded that commercial IoT significantly contributes organizational efficiency in Camanov Ltd.

Mutua and Muthimi (2020) examined on commercial IoT and performance of Kenya Railways Corporation, Kenya. The study adopted a descriptive research design. The target population consisted of 250 employees of Kenya Railways based at the Headquarters in Nairobi. Stratified random sampling technique was used to select a sample of 75 respondents. The study found that commercial IoT influenced influence the performance of the corporation. The study concluded that commercial IoT influenced the performance of KRC to a great extent.

Lentoimaga, Mulongo and Omboto (2021) researched on commercial IoT and employee performance in the banking sector in Kenya: a survey of selected commercial banks in North Rift, Kenya. A descriptive survey design was used. The target population was 283 employees involved in the use of technology from selected commercial banks in the North Rift. Stratified random sampling and purposive sampling techniques were used to select a sample of 170 employees. The study found that commercial IoT improve employee performance. The study concluded that commercial IoT affects employee performance.

Boru and Nchaga (2022) investigated on commercial IoT and organizational performance in the communication authority of Kenya. A descriptive research design was adopted for this study. The researcher's target population was 78 managers and 160 non managerial staff. The study found that commercial IoT has a positive significant influence on organization performance in the communication authority of Kenya. The study concluded that commercial IoT is statistically significant in explaining organization performance in the communication authority of Kenya.

Infrastructure IoT and quality of services

Kabanda and Njenga (2024) investigated on the effect of infrastructure IoT on competitive edge in the Rwandan Telecommunication Landscape: A Case of MTN Rwandacell PLC. The research design that the study utilized is descriptive survey research. The target population for this study comprised 187 participants who are currently employed as staff at MTN Rwanda. A sample of 128 was determined using Slovin's Formula. The study found that there is a positive relationship between infrastructure IoT and competitive edge. The study concluded that infrastructure IoT has an impact on competitive edge in the Rwandan Telecommunication Landscape.

Yauri (2021) examined on the impact of infrastructure IoT on organizational performance of Nigerian Immigration Service, Kebbi State Command. The primary data was collected through the use of questionnaires. The population used for this research comprises of the entire personnel of NIS Kebbi State Command (465) while Krejcie and Morgan table was used to select the sample size of 214 personnel for the purpose of this study. The study found that there is a positive relationship between infrastructure IoT and organizational performance. The study concluded that infrastructure IoT has significant effect on organizational performance.

Karugani and Ochiri (2020) researched on the effect of infrastructure IoT on organizational performance: a case of Nairobi County, Kenya. Quantitative research design and a survey strategy were used. The research employed purposive sampling to select 87 employees in Nairobi County Government to participate in the research. The study found that infrastructure IoT improves organizational performance. The study concluded that infrastructure IoT enhances organizational performance.

Wanjiru and Yusf (2022) conducted a study on infrastructure IoT and the performance of the county government of Nyandarua, Kenya. A correlational research design was employed in this study. The target population was 119 employees. The study found that infrastructure IoT significantly influenced the performance of the county government of Nyandarua. The study concluded that infrastructure IoT has a significant association with performance of the county government of Nyandarua.

Otwal, Midida and Aliata (2021) assessed on the effect of infrastructure IoT on performance of county government of Migori, Kenya. The study adopted a correlation research design. Census sampling was embraced. The target population was 50. The study found that infrastructure IoT has a positive relationship with organizational performance. The study concluded that infrastructure IoT has a positive and significant effect on organizational performance of County government of Migori.

RESEARCH METHODOLOGY

This study used a descriptive research design. This study focused on the telecommunication companies in Kenya. According to the communication authority in Kenya there are 5 registered telecommunication companies and they include; Safaricom PLC, Airtel, Telkom Kenya, Finserve, and Jamii Telecommunications. The study targeted management level employees at telecommunication companies in Kenya. Target populace comprised all 950 management level employees working with the telecommunication companies in Kenya. This involved all levels of management (senior, middle and low level management staff).The study used Krejcie and Morgan (1970) formula to arrive at the sample size of 282 respondents. Stratified random sampling was applied to get the respondents. Primary data was used in this study obtained using semi-structured questionnaires

The pretesting sample was made of 28 respondents, representing 10% of the sample size. The results from the pilot test were not used in the main study. In addition, the respondents used in the pilot test were excluded from the final study. Quantitative and qualitative data were generated from the closed-ended and open-ended questions, respectively. Qualitative data was analysed on thematic basis and the findings provided in a narrative form. Inferential and descriptive statistics were employed for analysis of quantitative data with the assistance of Statistical Package for Social Sciences (SPSS version 25).

PRESENTATION, ANALYSIS AND INTERPRETATION OF DATA

The researcher sampled 282 respondents who were each administered with the questionnaires. From the 282 questionnaires 262 were completely filled and returned hence a response rate of 92.9%. The response rate was considered as suitable for making inferences from the data collected. As indicated by Metsamuuronen (2019), a response rate that is above fifty percent is considered adequate for data analysis and reporting while a response rate that is above 70% is classified as excellent. Hence, the response rate of this study was within the acceptable limits for drawing conclusions and making recommendations.

Descriptive Statistics

Commercial IoT and Quality of Services

The second specific objective of the study was to establish the effect of Commercial IoT on quality of services of mobile network operators in Nairobi City County, Kenya. The respondents were requested to indicate their level of agreement on the statements relating to Commercial IoT and quality of services of mobile network operators in Nairobi City County, Kenya. The results were as shown in Table 1

From the results, the respondents agreed that the connectivity solutions they use offer reliable network performance with minimal downtime (M-3.902, SD= 0.897). In addition, the respondents agreed that the connectivity solutions provide scale effectively to accommodate increasing data and device volumes (M=3.884, SD= 0.731). Further, the respondents agreed that their connectivity solutions integrate smoothly with existing IT infrastructure and systems (M=3.843, SD= 0.763). The respondents also agreed that the IoT platform they use effectively manages and organizes data from multiple sources (M=3.816, SD=0.641). In addition, the respondents agreed that the user interface of their IoT platform is intuitive and user-friendly (M=3.736, SD= 0.675).

The respondents agreed that their IoT platform integrates well with other software applications and hardware systems (M=3.721, SD=0.866). The respondents also agreed that their end-to-end security solutions effectively protect data from unauthorized access and breaches (M=3.688, SD=0.741). In addition, the respondents agreed that the security solutions in place offer robust threat detection and response capabilities (M=3.644, SD=0.888).

Table 1: Commercial IoT and Quality of Services

	Mean	**Std. Dev.**
The connectivity solutions I use offer reliable network performance with minimal downtime.	3.902	0.897
The connectivity solutions provide scale effectively to accommodate increasing data and device volumes.	3.884	0.731
Our connectivity solutions integrate smoothly with existing IT infrastructure and systems.	3.843	0.763
The IoT platform we use effectively manages and organizes data from multiple sources.	3.816	0.641
The user interface of our IoT platform is intuitive and user-friendly.	3.736	0.675
Our IoT platform integrates well with other software applications and hardware systems.	3.721	0.866
Our end-to-end security solutions effectively protect data from unauthorized access and breaches.	3.688	0.741
The security solutions in place offer robust threat detection and response capabilities.	3.644	0.888
Aggregate	**3.779**	**0.775**

Infrastructure IoT and Quality of Services

The fourth specific objective of the study was to establish the influence of Infrastructure IoT on quality of services of mobile network operators in Nairobi City County, Kenya. The respondents were requested to indicate their level of agreement on various statements relating to Infrastructure IoT and quality of services of mobile network operators in Nairobi City County, Kenya. The results were as presented in Table 2.

From the results, the respondents agreed that IoT solutions improve the overall performance and reliability of their network management systems (M=3.931, SD= 0.891). In addition, the respondents agreed that their IoT-based network management tools provide real-time monitoring and diagnostics of network performance (M=3.855, SD= 0.857). Further, the respondents agreed that IoT technologies assist in optimizing network traffic to ensure efficient data flow and minimize congestion (M=3.720, SD= 0.714). The respondents also agreed that IoT integration significantly enhances the operational efficiency of their smart infrastructure systems (M=3.685, SD= 0.677). Further, the respondents agreed that smart infrastructure solutions effectively utilize data to optimize performance and decision-making (M=3.678, SD= 0.656).

The respondents agreed that IoT technologies improve their ability to manage and allocate resources, such as energy and water, in smart infrastructure (M=3.658, SD=0.759). In addition, the respondents agreed that their IoT-based infrastructure security systems provide effective detection and response to potential threats (M=3.649, SD=0.898). Further, the respondents agreed that IoT security measures ensure that data collected from infrastructure systems is protected against unauthorized access and breaches (M=3.622, SD=0.779).

Table 2: Infrastructure IoT and Quality of Services

	Mean	**Std. Dev**
IoT solutions improve the overall performance and reliability of our network management systems.	3.931	0.891
Our IoT-based network management tools provide real-time monitoring and diagnostics of network performance.	3.855	0.857
IoT technologies assist in optimizing network traffic to ensure efficient data flow and minimize congestion.	3.720	0.714
IoT integration significantly enhances the operational efficiency of our smart infrastructure systems.	3.685	0.677
Smart infrastructure solutions effectively utilize data to optimize performance and decision-making.	3.678	0.656
IoT technologies improve our ability to manage and allocate resources, such as energy and water, in smart infrastructure	3.658	0.759
Our IoT-based infrastructure security systems provide effective detection and response to potential threats.	3.649	0.898
IoT security measures ensure that data collected from infrastructure systems is protected against unauthorized access and breaches.	3.622	0.779
Aggregate	**3.725**	**0.779**

Quality of Services

The respondents were requested to indicate their level of agreement on various statements relating to quality of services of mobile network operators in Nairobi City County, Kenya. The results were as presented in Table 3.

From the results, the respondents agreed that the geographic coverage provided by their network meets their needs for both urban and rural areas (M=3.882, SD=0.876). In addition, the respondents agreed that they can access network services reliably in the majority of the areas where they live and work (M=3.876, SD=0.897). Further, the respondents agreed that there are minimal gaps in geographic coverage that affect the usability of network services (M=3.872, SD=0.784). The respondents also agreed that the signal strength in their area is consistently strong and reliable throughout the day (M=3.869, SD=0.698). The respondents agreed that they experience strong and stable signal strength both indoors and outdoors (M=3.854, SD=0.653). In addition, the respondents agreed that signal strength is minimally affected by physical obstacles or environmental conditions (M=3.765, SD=0.789). The respondents also agreed that the network service is available and operational without significant interruptions (M=3.742, SD=0.783). Further, the respondents agreed that the frequency of network downtime is low and does not impact their ability to use the service (M=3.722, SD=0.687).

Table 3: Quality of Services

	Mean	**Std. Dev.**
The geographic coverage provided by our network meets our needs for both urban and rural areas.	3.882	0.876
I can access network services reliably in the majority of the areas where I live and work.	3.876	0.897
There are minimal gaps in geographic coverage that affect the usability of network services.	3.872	0.784
The signal strength in my area is consistently strong and reliable throughout the day.	3.869	0.698
I experience strong and stable signal strength both indoors and outdoors.	3.854	0.653
Signal strength is minimally affected by physical obstacles or environmental conditions.	3.765	0.789
The network service is available and operational without significant interruptions.	3.742	0.783
The frequency of network downtime is low and does not impact my ability to use the service.	3.722	0.687
Aggregate	**3.823**	**0.771**

Correlation Analysis

The present study used Pearson correlation analysis to determine the strength of association between independent variables (Commercial IoT, and Infrastructure IoT) and the dependent variable (quality of services of mobile network operators in Nairobi City County, Kenya)..

Table 4: Correlation Coefficients

		Quality of Services	**Commercial IoT**	**Infrastructure IoT**
Quality of Services	Pearson Correlation	1		
	Sig.(2-tailed)			
	N	262		
Commercial IoT	Pearson Correlation	.827**	1	
	Sig. (2-tailed)	.003		
	N	262	262	
Infrastructure IoT	Pearson Correlation	.895**	.119	1
	Sig. (2-tailed)	.000	.067	
	N	262	262	262

The results revealed that there is a very strong relationship between Commercial IoT and quality of services of mobile network operators in Nairobi City County, Kenya ($r = 0.827$, p value =0.003). The relationship was significant since the p value 0.003 was less than 0.05 (significant level). The findings conform to the findings of Uwizeyimana and Mulyungi (2020) that there is a very strong relationship between Commercial IoT and quality of services.

The results also revealed that there was a very strong relationship between Infrastructure IoT and quality of services of mobile network operators in Nairobi City County, Kenya ($r = 0.895$, p value =0.000). The relationship was significant since the p value 0.000 was less than 0.05 (significant level). The findings are in line with the results of Kabanda and Njenga (2024) who revealed that there is a very strong relationship between Infrastructure IoT and quality of services.

Regression Analysis

Regression Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	**(Constant)**	0.202	0.055		3.673	0.003
	Commercial IoT	0.481	0.123	0.480	3.911	0.003
	Infrastructure IoT	0.425	0.107	0.424	3.972	0.001

a Dependent Variable: project performance in KURA, Nairobi County, Kenya

The regression model was as follows:

$$\mathbf{Y = 0.202 + 0.481X_1 + 0.425X_2}$$

The results also revealed that Commercial IoT has significant effect quality of services of mobile network operators in Nairobi City County, Kenya, $\beta1=0.481$, p value= 0.003). The relationship was considered significant since the p value 0.003 was less than the significant level of 0.05. The findings conform to the findings of Uwizeyimana and Mulyungi (2020) that there is a very strong relationship between Commercial IoT and quality of services.

In addition, the results revealed that Infrastructure IoT has significant effect on quality of services of mobile network operators in Nairobi City County, Kenya $\beta1=0.425$, p value= 0.001). The relationship was considered significant since the p value 0.001 was less than the significant level of 0.05. The findings are in line with the results of Kabanda and Njenga (2024) who revealed that there is a very strong relationship between Infrastructure IoT and quality of services.

Conclusions

The study concludes that Commercial IoT has a positive and significant effect on quality of services of mobile network operators in Nairobi City County, Kenya. Findings revealed that connectivity solutions, IoT platforms and end-to-end security solutions influence quality of services of mobile network operators in Nairobi City County, Kenya.

The study also concludes that Infrastructure IoT has a positive and significant effect on quality of services of mobile network operators in Nairobi City County, Kenya. Findings revealed that network management, smart infrastructure and infrastructure security influences quality of services of mobile network operators in Nairobi City County, Kenya.

Recommendations

The study recommends that the management of mobile network operators in Kenya should establish strategic partnerships with businesses and industries adopting IoT solutions. By collaborating with key commercial players, such as smart infrastructure developers and logistics companies, network operators can gain insights into specific IoT demands and tailor their services to meet these needs effectively.

The study also recommends that the management of mobile network operators in Kenya should integrate advanced monitoring and management systems into their infrastructure. By deploying IoT sensors and smart management tools across their network infrastructure such as base stations, data centers, and network equipment operators can achieve real-time monitoring and predictive maintenance.

Suggestions for Further Studies

This study was limited to the influence of internet of things on quality of services of mobile network operators in Nairobi City County, Kenya hence the study findings cannot be generalized to quality of service in other organizations in Kenya. The study therefore suggests further studies on the influence of internet of things on quality of services in other organizations in Kenya. This study suggests further research on other factors affecting quality of services of mobile network operators in Nairobi City County, Kenya.

References

Akoyo, S. I, Bula, H. O & Wambua, P. P. (2022). Effect of internet of things on performance of chartered universities in Kenya. *International Journal of Economics, Commerce and Management*, *10*(10), 218-232.

Boru, R. D & Nchaga, A. M. (2022). Commercial IoT and organizational performance in the communication authority of Kenya. *International Research Journal of Business and Strategic Management, 4*(2), 91-98.

Chinedu, U. N & Eje, B. (2023). The impact of commercial IoT in manufacturing management. *Engineering*, *15*(9), 533-559.

Cisco. (2022). Smart Network Management for IoT. Cisco Systems Inc.

Communications Authority of Kenya. (2022). Annual Report 2021-2022. Nairobi, Kenya.

Communications Authority of Kenya. (2023). Quality of Service Report. Nairobi, Kenya.

Cooper, D. R. & Schindler, P. S. (2019). *Qualitative research: business research methods*, Boston, MA: McGraw-Hill.

Cooper, D. R., & Schindler, P. S. (2019). *Business Research Methods (Twelfth ed.).* Boston: Irwin McGraw Hill International.

Creswell, R. (2019). Research design: *qualitative*, *quantitative, and mixed methods approaches*. USA: Sage Publications.

Cronbach, L. J. (2019). *My Current Thoughts on Coefficient Alpha and Successor Procedures.* Washington, D: Educational and Psychological Measurement.

Cronbach, L. J. (2019). *Test Validation. In R. L. Thorndike (Ed).Educational Measurement (2nd Ed.)* Washington, DC: American Council on Education.

Crowther, D. & Lancaster, G. (2018). *Research Methods: A Concise Introduction to Research in Management and Business Consultancy*. New York: Butterworth-Heinemann.

Ericsson. (2023). The Role of IoT in Enhancing Network Reliability. Ericsson Inc.

Grant, R. (2019). Contemporary Strategy Analysis, *(4 Ed). Blackwell Publishers*

Ipsos. (2023). Telecom Customer Satisfaction Survey Report. Nairobi, Kenya.

ITU. (2021). The Impact of IoT on Telecommunication Networks. International Telecommunication Union.

Kabanda, A & Njenga, G. S. (2024). Effect of infrastructure IoT on competitive edge in the Rwandan Telecommunication Landscape: A Case of MTN Rwandacell PLC. *International Journal of Strategic Management, 3*(2), 14-32.

Kariuki, A. K. (2021). *Impact of internet of things on organizational performance: case of population services Kenya*. Retrieved From, http://erepository.uonbi.ac.ke/bitstream/handle/.

Karugani, W. P & Ochiri, G. (2020). Effect of infrastructure IoT on organizational performance: a case of Nairobi County, Kenya. *International Journal of Economics, Commerce and Management, 5*(6), 604-611.

Kitime, O & Lymo, B. J. (2020). Role of internet of things in improving organizational efficiency: a case of Arusha Urban Water Supply and Sanitation Authority. *Olva Academy – School of Researchers, 2*(3), 1-40.

Kothari, C. R. (2019). Research methodology: Methods and techniques. New Age International

Lentoimaga, F, Mulongo, L. S & Omboto, P. I. (2021). Commercial IoT and employee performance in the banking sector in Kenya: a survey of selected commercial banks in North Rift, Kenya. *International Journal of Economics, Commerce and Management, 5*(9), 588-606.

Lütfi, S., (2020) Validity and reliability in quantitative research. *Business and management studies. An International Journal, European Leadership University*

Maina, J. (2023). *Adoption of Internet of Things in Enhancing Knowledge Management in University Libraries: A Case Study of Catholic University of Eastern Africa, Kenya*. Retrieved from http://41.89.31.5/handle/123456789/1610

Malongo, I. K. (2020). *Internet of things and performance of selected public hospitals in Kenya*. Retrieved From, https://ir-library.ku.ac.ke/server/api/core/bitstreams/.

Mashat, R. M, Abourokbah, S. H & Salam, M. A. (2024). *Impact of internet of things adoption on organizational performance: a mediating analysis of supply chain integration, performance, and competitive advantage*. Retrieved From, file:///C:/Users/user/Downloads/sustainability.

Ministry of ICT, Innovation and Youth Affairs. (2019). Digital Economy Blueprint. Government of Kenya.

Mugenda A. &Mugenda O. (2019).Research Methods: Quantitative & Qualitative approaches.

Mutua, J. N, Muthimi, J. (2020). Commercial IoT and performance of Kenya Railways Corporation, Kenya. *The Strategic Journal of Business & Change Management, 6*(2), 2471–2482

Muyobo, D. K., Muketha, G. M. & Wechuli, A. N. (2023). *Revolutionizing Kenyan Healthcare Consultancy: Exploring IoT Innovations and other Enabling Technologies– A Case Study*. Retrieved from https://repository.mut.ac.ke/xmlui/handle/123456789/6431

Ogidiaka, E, Odion, P & Irhebhude, M. E. (2023). Adoption of internet of things (iot) among organizations in Lagos State, Nigeria. *The Journal of Computer Science and its Applications, 24*(2), 94-110.

Otwal, W, Midida, P & Aliata, V. L. (2021). Effect of infrastructure IoT on performance of county government of Migori, Kenya. *International Journal of Management and Economics Invention, 1*(1), 2235-2238.

Sekaran, U., & Bougie, R., (2019). *Research methods for business:* A skill building approach (5th ed.). Chichester, West Sussex:

Uwizeyimana, E & Mulyungi, P. (2020). Influence of commercial IoT on provision of services in public institutions in Rwanda. *International Journal of Innovative Research & Development, 9*(3), 141-145.

Wanjiru, W. A & Yusuf, M. (2022). Infrastructure IoT and the performance of the county government of Nyandarua, Kenya. *Social Sciences & Humanities Open 3*(2022), 57-68.

Yauri, A. R. (2021). The impact of infrastructure IoT on organizational performance of Nigerian Immigration Service, Kebbi State Command. *Equity Journal of Science and Technology, 8*(1), 89-94.