

**SMART WATER STRATEGIES AND ORGANIZATIONAL
PERFORMANCE: A CASE OF NAIROBI WATER AND SEWERAGE
COMPANY IN NAIROBI CITY COUNTY, KENYA**

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D53/OL/CTY/22295/2022

**A RESEARCH PROJECT SUBMITTED TO THE SCHOOL OF BUSINESS,
ECONOMICS AND TOURISM IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF
BUSINESS ADMINISTRATION (STRATEGIC MANAGEMENT) OF
KENYATTA UNIVERSITY**

AUGUST 2025

DECLARATION

This project is my original work and has not been submitted for the conferment of a degree or award of a diploma in this or any other university: -

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This project has been submitted with my approval as University the Supervisor.

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DEDICATION

This study is dedicated to my entire family, including my wife, Esther Wanjiku, and our four daughters: Natasha, Natalia, Natania, and Natalie. They have consistently served as my wellsprings of inspiration and strength, offering moral, spiritual, and emotional support during the most daunting phases of this journey. I am deeply thankful to my father and mother, whose steadfast guidance has shaped me into who I am. To all of you, thank you for your enduring patience, unwavering support, and boundless love throughout this challenging journey of the past year.

ACKNOWLEDGEMENTS

I appreciated Dr. Janesther Karugu for her invaluable guidance, unwavering support, continuous advice, and constructive criticism of my work. It was through her mentorship that my ideas were transformed into reality. Furthermore, my appreciation went to the entire Kenyatta University community, particularly the esteemed faculty members, whose academic insights were instrumental in refining this proposal and equipping me with the requisite knowledge for this level of study. Lastly, I thanked God for giving this opportunity to me and for my good health throughout the writing process.

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ABBREVIATIONS AND ACRONYMS

AWWDA	Athi Water Works Development Agency
CBOs	Community-Based Organizations
CIDP	County Integrated Development Plan
EWASCO	Embu Water and Sanitation Company Limited
ICT	Information Communication Technology
MTM	Magnetic Tomography Method
NACOSTI	National Commission for Science, Technology and Innovation
NCWSC	Nairobi City Water and Sewerage Company
NGO	Non-governmental Organizations
RBV	Resource-Based View
SCT	Structural Contingency Theory
SDG	Sustainable Development Goals
SPSS	Statistical Package for Social Sciences
SUWASA	Sustainable Water and Sanitation in Africa
SWS	Smart Water System
USAID	United States Agency for International Development
WaSREB	Water Services Regulatory Board

OPERATIONAL DEFINITION OF TERMS

Customer Service	Customer service refers to the range of activities and support systems a water service provider offers to meet the needs, expectations, and satisfaction of its consumers. It encompasses responsiveness to complaints, timely resolution of service issues, provision of accurate billing information, accessibility of communication channels, and overall user experience throughout the service delivery process.
Effective Water Billing Token	An effective water billing token is a digital or electronic billing mechanism that enables customers to pay for water usage in a prepaid or real-time format. In smart water management systems, billing tokens are often used in prepaid water meters where users input a purchased token code to activate water flow, promoting transparency, accountability, and efficient revenue collection.
Innovation of water leak detection	Innovation of water leak detection refers to the application of advanced technologies and methods to identify, monitor, and manage water losses within the distribution network. These innovations may include smart sensors, acoustic monitoring, satellite imagery, and real-time data analytics that enable early detection of pipe bursts, hidden leaks, and unauthorized connections.
Performance	This is the ability of an organization to reach its goals and optimize results. In the context of this research, performance is based on three metrics and these are increased revenue, increased customer base, along with increased number of employees.

- Smart Water Strategy** This refers to the use of advanced technologies to collect, analyze, and manage water resource data. Smart water strategy, in the context of this research is made up of three components and these are storage capacity location, customer service effective water billing token, along with innovation of water leak detection.
- Storage Capacity Location** This the site where both potable water for consumption and non-potable water are stored for use. In the context of this study, storage capacity location is contextualized in two parameters and these are reservoirs/dams and tanks.
- Water Billing Token** This comprises of the cost per unit of water and a small management fee. In the context of this study, water billing token is contextualized in two metrics and these are volume charge and minimum bill.

ABSTRACT

The NCWSC was highly committed to ensuring effective water management. The company had achieved 80% of its strategic plan. However, it faced significant challenges between the years 2014/15 and 2018/19. In 2014/15, NCWSC produced 201.8 million cubic meters of water, while the amount sold was 124.7 million cubic meters. By 2018/19, both production and sales had declined to 180.1 million cubic meters and 114.5 million cubic meters, respectively. These declines were primarily attributed to climate change and erratic rainfall, partly due to the droughts experienced in 2016 and 2017. Additionally, Non-Revenue Water (NRW) losses due to physical leaks or inefficiencies stood at 36.4% in 2018/19, exceeding the sector's recommended maximum of 25%. This study aimed to assess how smart water strategies impacted the Nairobi Water & Sewerage Company's performance in Nairobi City County, Kenya. In this context, the study specifically aimed to; examine the influence of storage capacity location on the performance of Nairobi Water & Sewerage Company in Nairobi County Kenya; establish the influence of customer service effective water billing tokens on the performance of Nairobi Water & Sewerage Company in Nairobi County Kenya; explore the influence of innovation leakages on the performance of Nairobi Water & Sewerage Company in Nairobi County Kenya. The study was anchored on three key theories; resource-based view theory, structural contingency theory, and balanced scorecard concept. A descriptive research design was adopted. The target population was 94 participants within NCWSC's Nairobi operations and all the 94 respondents were selected as the sample using a census sampling technique. Data was collected using questionnaires. A pilot test was first conducted with nine respondents from NCWSC who were not part of the actual study to minimize bias. In order to calculate the coefficient that describes the correlation of an instrument, Cronbach's alpha test was applied. A tool's correlation coefficient must exceed 0.7 if it is to be considered reliable and as such, the study aimed to obtain a correlation coefficient of 0.8. The variables were analyzed using descriptive statistics - mean and standard deviation - and multiple linear regressions. The results were presented in tabular and graphical formats. The study achieved a response rate based on 94 questionnaires administered to managers and staff at Nairobi Water and Sewerage Company. The adjusted R-squared value indicated that organizational performance variation was influenced by innovation in water leak detection, customer service in water billing tokens, and storage capacity location. Regression analysis showed significant positive contributions from these factors, confirming their strong influence on organizational performance. The study examined the impact of smart water strategies on Nairobi Water & Sewerage Company's (NWSC) performance. Findings revealed that digital metering, automated distribution, and data-driven decisions enhance efficiency, revenue collection, and service delivery. Strategic storage facility placement minimizes supply disruptions, while smart billing improves transparency and payments. Innovations in leak detection reduce water losses and costs. The study recommends adopting advanced technologies, optimizing storage locations, enhancing billing systems, and investing in modern leak detection. Future research should explore AI, IoT, and policy impacts.

CHAPTER ONE: INTRODUCTION

1.1 Background

Urban water systems face increasing strain due to population increases, climate changes, aging infrastructure, and higher customer expectations (World Bank, 2019). Because of these issues, water providers globally are shifting from basic systems to smart water plans. These plans use digital tools, real-time data, and analysis to improve the entire water process. Countries such as Germany, the United States, and Australia have made progress in using these solutions, but many developing countries, like Kenya, are just starting (Amankwaa *et al.*, 2023). This study looks at how using specific smart water plans affects the Nairobi Water and Sewerage Company (NWSC). NWSC is key to providing reliable, affordable water services in Nairobi City County.

In the water sector, provider performance includes things such as operational efficiency, revenue, customer satisfaction, following regulations, and protecting the environment (Mutanu & Wanjohi, 2021). For providers like NWSC, performance is often about reducing water loss, ensuring a continuous supply, billing correctly, lowering operational losses, and quickly addressing customer issues. Studies show that using technology and new ideas can greatly improve these areas by automating tasks and reducing errors (Kang *et al.*, 2020). But, improvements in Kenya are uneven because of infrastructure limits, scarce resources, and slow adoption of smart systems.

One key part of smart water management is storage capacity and location, which affects water pressure, distribution, and supply. Well-placed storage tanks ensure water is delivered efficiently, reducing interruptions. Cities like Melbourne and Singapore use hydraulic modeling to place reservoirs smartly, which has improved system reliability and lowered energy costs (Farley & Trow, 2010). In Nairobi, poor storage often causes supply problems, especially in informal areas. Improving storage design and location

is needed for NWSC to meet growing water demands.

Another important aspect is customer service and billing systems, like digital or token-based options (Billing tokens let consumers pay for water using mobile phones or cards, improving revenue and accountability. Also, good customer service, with quick responses and clear communication, increases customer satisfaction and payment rates (World Bank, 2019). For NWSC, bad billing and slow responses have caused mistrust and lost revenue. Using smart meters and automated billing is important for upgrading the utility's customer service and ensuring correct billing.

Equally important is finding water leaks, which helps reduce water loss and improve sustainability. Tools like acoustic sensors and satellite images help find underground leaks accurately, reducing repair time and water loss. The International Water Association (2020) says that providers using leak detection systems can recover up to 30% of lost water each year. In Nairobi, leaks are a major cause of water loss, leading to financial and service problems. Despite the benefits of leak detection technologies, their use is limited, so assessment and investment are needed to reduce water losses.

Globally, SMART water strategies are being adopted to address the challenges of scarcity of water, inadequate infrastructure, and inefficient water management in developing nations. Countries like India and Brazil are exploring the use of SMART technologies to improve water distribution and management, with a focus on enhancing service delivery and reducing wastage (Singh, & Ahmed, 2021 India's Smart Cities.Mission was focused on implementing advanced water management solutions to support sustainable water resources and reduce non-revenue water, which includes water lost through leaks or unauthorized usage (Li et al., 2020).

In Africa, the adoption of SMART water strategies was essential in addressing the continent's significant water challenges, including scarcity, pollution, and inadequate infrastructure. The integration of SMART water technologies has been pioneered by countries such as South Africa and Ghana. For instance, in South Africa, the City of Cape Town implemented a comprehensive water management strategy that incorporated smart metering, water demand management, and real-time data monitoring to combat severe drought conditions and promote sustainable water use (Anghileri et al., 2024). The SMART water strategy in Cape Town included the deployment of advanced metering infrastructure (AMI), which provided detailed insights into water usage patterns and facilitated the detection of leaks and unauthorized consumption. By implementing this approach, water consumption was substantially reduced and a reliable water supply was ensured during droughts.

In an effort to address its water challenges, Kenya has implemented SMART water strategies, focusing particularly on improving the efficiency and reliability of water services (Mutanu & Wanjohi, 2021). As a result, Nairobi City Water and Sewerage Company (NCWSC) adopted a variety of technologies to improve its performance.

1.1.1 Organizational Performance

In organizational theory and management, Richard L. Daft defined performance as an entity's ability to achieve its objectives (Daft, 2012). Performance was also described as a dynamic process involving continuous assessment and adjustment to ensure that organizational objectives were met efficiently and effectively (Johnson, Kast, & Rosenzweig, 1963). Navimipour, Milani, and Hossenzadeh (2018) characterized performance as the degree to which a company effectively and efficiently accomplished its business objectives. As a crucial concept, performance enabled leaders to identify

key priorities and evaluate their success in achieving them (Molnar & Rogers, 2022). Building a thriving organization required operational excellence, and enhancing a company's capacity to meet its objectives was essential for maximizing shareholder returns. Consequently, organizational effectiveness served as a critical business tool for assessing success in attaining desired goals.

Evaluating organizational performance was a fundamental aspect of strategic management. Organizational leaders needed to understand how well their organization was functioning to determine whether strategic adjustments were necessary (Jundt, Shoss, & Huang, 2020). The balanced scorecard, a tool created to simplify corporate performance review, was first presented by Kaplan and Norton in 1996. It suggested that managers monitor a small number of critical metrics that together reflected four fundamental aspects: internal business operations, learning and development, customer happiness, and financial performance.

In this study, performance was assessed using metrics such as rate of change in revenue, employee turnover and change in customer share. The Kenyan government invested substantial funds in water supply projects, particularly in rural areas, with additional financing from external donor organizations and NGOs. As a result of the project, water access and distribution would be greatly improved, especially in arid and semi-arid regions and rural communities (Macharia, Mbassana, & Oduor, 2020).

Muiruri and Mutiso (2021) noted that despite the rise in water projects, many failed due to poor management and inadequate maintenance, leading to their collapse and an inability to improve water supply rates. The failure of these projects exacerbated water scarcity, adversely affecting the health, well-being, and development of communities.

This emphasized the urgent need to explore sustainable water project management strategies to ensure long-term benefits for public health and community growth.

1.1.2 Smart Water Strategies

Smart water strategies involve the use of advanced technologies to collect, analyze, and manage water resource data, digitally transforming the entire water cycle. These strategies offer technological solutions and enhance resource management (Aghaeifar, Strand, Puntervold, Austad & Sajjad, 2018). Technological solutions improve water management by streamlining operations at every stage, which results in reduced water consumption and lower costs. Consequently, water technology plays a vital role in addressing climate change by optimizing the use of this limited resource (Bwambale, Abagale, and Anornu, 2022).

According to Porter (2008), SMART strategies involve integrating advanced technologies, including smart meters, sensors, and real-time data analysis, to optimize processes and improve service delivery. In water management, these technologies enable precise tracking of water usage, leak detection, and the prediction of maintenance needs, ultimately improving the efficiency and effectiveness of water resource management. On the other hand, Drucker (1999) suggests that SMART strategies focus on clearly defining objectives and utilizing technology to monitor and achieve those goals. In the context of water management, this means setting specific targets for reducing water loss, enhancing water quality, and improving customer service, while leveraging technological tools to track progress and make data-driven decisions.

Water storage was essential for effective water management, acting as a buffer during times of scarcity and ensuring a steady supply for diverse needs (Klaassen, Bosveld,

and Dewater, 2019). It allowed the capture and retention of water from various sources such as rainfall, rivers, and aquifers. Boelter (2022) noted that water storage mitigated the effects of drought and helped prevent water shortages, while also supporting sustainable agriculture, hydropower, and ecosystem conservation. By regulating water flow, storage systems created a balance between supply and demand, ensuring consistent availability for agricultural, industrial, and domestic purposes, even when weather patterns were unpredictable.

Prepaid water metering systems provided financial flexibility, especially for lower-income users, by allowing payments in smaller, more frequent increments, preventing the debt accumulation that is common with post-paid arrangements (Hanjahanja and Omuto, 2018). Gunawardana (2021) added that these systems empowered users to monitor their usage and credits, providing time to top up before running out. Prepaid meters, equipped with processors and shut-off valves, offered additional advanced functionalities while reducing conflicts over unpaid bills, as water consumption was prepaid. A robust leakage strategy was also essential for optimizing water system performance. Smart technology allows accurate leak detection and repair within distribution networks, which reduces water consumption and improves system efficiency.

1.1.3 Nairobi Water & Sewerage Company in Nairobi City County Kenya.

The Nairobi Water and Sewerage Company (NWSC) is the main water provider for Nairobi City County, Kenya's capital and largest city. It was created in December 2003 as a private firm owned by the Nairobi City County Government. The goal was to make water services more efficient, accountable, and sustainable through a commercial, public-focused approach (Giudicianni *et al.*, 2020). NWSC aims to supply affordable,

safe, reliable, and environmentally sound water and sewage services to Nairobi residents, following the Water Act and national guidelines.

Nairobi's quickly growing population puts pressure on its water systems. The Nairobi County Integrated Development Plan (CIDP) for 2018–2022 estimated that the county would have 5.9 million people by 2022, up from 4.39 million in 2019 (Shuma, 2021). This growth makes it hard for NWSC to provide enough water and sewage services, especially in poorer areas. Water demand often goes beyond supply, causing rationing, illegal connections, lost water, and lower service quality. Because of these problems, there are questions about how technology and smart water plans can help the company do a better job.

NWSC works within a system where several regulatory and development groups work together and keep an eye on things. The Athi Water Works Development Agency (AWWDA), created under the Water Act 2016, builds large water and sewage systems in the Nairobi area. Once these are built, they are given to NWSC to run and maintain. Nationally, the Water Services Regulatory Board (WaSREB) regulates the industry, setting service standards and checking that water quality, customer service, billing, and infrastructure maintenance meet those standards. WaSREB also checks how well water service providers (WSPs) are doing with a yearly report that points out areas for improvement and suggests policy changes.

Besides regulatory oversight, NWSC works with community groups, NGOs, and donor projects to bring water and sewage services to underserved areas, like Kibera, Mathare, and Mukuru. This teamwork lets the company try out new ideas like water kiosks, prepaid meters, smart billing, and leak tracking (Hlalele, Ilunga, and Dinka, 2021). Still, there is not enough research on how much these smart plans have improved NWSC's

performance such as how well it covers its area, how accurate its billing is, how fast it answers customer issues, and how much it has lowered water loss.

Also, NWSC's work is shaped by limited resources, old infrastructure, irregular supply, and weak digital systems. While smart water technologies like SCADA systems, GIS mapping, and IoT metering are being tested, it is not clear how well they can be expanded, sustained, and how much they actually affect the company's main goals in Nairobi's specific environment (Mwaniki, 2019). More studies are needed to see how smart water plans like better storage, digital customer service, billing, and leak finding affect how well NWSC works.

1.2 Problem Statement

Securing sustainable and high-quality water sources, production, and storage; optimizing water transmission and ensuring equitable distribution; lowering non-revenue water; improving wastewater management; boosting revenue growth and customer loyalty; strengthening human resource management; improving financial stewardship; and developing brand equity alongside institutional capacity were the eight main themes of the NCWSC 2018–2022 strategic plan (Klosok-Bazan *et al.*, 2021). These focus areas aimed at ensuring the company's operational efficiency and sustainability while meeting growing demand for water and sewerage services in Nairobi. This strategic plan is in line with the desired vision 2030. The estimated cost to implement the strategic plan was Kshs 42 billion, in addition to the regular operations expenditure (Hanjahanja and Omuto 2018).

In an ideal scenario, NCWSC envisioned achieving sustainable and high-quality water sources capable of meeting Nairobi's growing demands. The company aimed to optimize its transmission system to equitably distribute water, minimize losses, and ensure

consistent supply (Xie & Zilberman, 2018). Reducing non-revenue water to the sector-recommended target of 25% was another critical goal, along with implementing robust wastewater management systems. The strategic plan also emphasized achieving significant revenue growth through improved billing and customer loyalty initiatives, ensuring prudent financial management, enhancing workforce efficiency, and strengthening the company's brand and institutional capacity (Pereira & Pinto, 2019). However, the actual situation deviated from these goals. Despite achieving 80% of its strategic plan, NCWSC faced significant challenges. Water production dropped from 201.8 million cubic meters (M3) in the financial year 2014/15 to 180.1 million M3 in 2018/19, primarily due to climate changes and erratic rainfall patterns, including prolonged droughts in 2016 and 2017.

A substantial amount of water was lost due to leaks, theft, and inefficiencies in the distribution system caused the non-revenue water (NRW) to be 36.4% in 2018/19. This is considerably higher than the recommended sector target of 25% (Zhou *et al.*, 2021). Additionally, water sales declined from 124.7 million M3 in 2014/15 to 114.5 million M3 in 2018/19, reflecting inefficiencies in both water production and distribution. The statistical trends highlight the challenges: water production decreased from 201.8 million M3 in 2014/15 to 180.1 million M3 in 2018/19, water sales fell from 124.7 million M3 in 2014/15 to 114.5 million M3 in 2018/19, and non-revenue water stood at 36.4% in 2018/19 against the recommended target of 25%.

The gap identified in this study was the discrepancy between the strategic goals set by NCWSC and the actual performance outcomes, particularly in water production, sales, and non-revenue water levels. The decline in water production and sales, coupled with high non-revenue water, highlighted inefficiencies and challenges in the existing water management practices (Zhou *et al.*, 2021). A number of studies have shown that smart

water technologies can improve water resource management. For instance, Gupta et al. (2020) found that smart technologies could significantly enhance water resource management and reduce water scarcity worldwide. However, these results might not have directly applied in the Kenyan context. A study by Shuma (2021) examined water management practices in Nairobi and determined that sufficient infrastructure is needed to deliver quality services, although the study focused primarily on service delivery.

Therefore, the study sought to determine the effectiveness of smart water approaches in ensuring better performance by the NWSC in Nairobi City County, Kenya (Hanjahanja & Omuto, 2018). By examining the application and impact of smart water technologies, this study aimed to identify practical solutions to bridge the gap between strategic goals and actual performance outcomes, ultimately improving water management and service delivery in Nairobi.

1.3 Objectives of the Study

1.3.1 General Objective

This study aimed to assess how smart water strategies impacted the Nairobi Water & Sewerage Company's performance in Nairobi City County, Kenya.

1.3.2 Specific Objectives

- i. To establish the effect of storage capacity location on the performance of Nairobi Water & Sewerage Company in Nairobi County Kenya.
- ii. To examine the effect of customer service effective water billing tokens on the performance of Nairobi Water & Sewerage Company in Nairobi County Kenya.

- iii. To explore the effect of innovation leakages on the performance of Nairobi Water & Sewerage Company in Nairobi County Kenya.

1.4 Research Questions

- i. In what way does location of storage capacity affect the Nairobi Water & Sewerage Company's performance in Nairobi City County, Kenya?
- ii. In what way does customer service efficiency in water billing tokens affect the Nairobi Water & Sewerage Company's performance in Nairobi City County, Kenya?
- iii. In what way does the innovation in water leak detection affect the Nairobi Water & Sewerage Company's performance in Nairobi City County, Kenya?

1.5 Significance

The results had a big impact on the NWSC in Nairobi City County, Kenya, because they showed how smart water strategies affect performance and how the company can overcome obstacles when putting them into practice. Water companies in Kenya and policymakers gained knowledge of the smart water management process, especially when designing policies to improve organizational performance. Following the recommendations, the appropriate policies were then developed aligned with implementation. As well as providing a literature resource regarding how smart water strategies influence water company performance, this study encouraged further study in the area through its proposition for future studies in this area.

1.6 Scope

This study was limited to examining the relationship between smart water strategies and organizational performance at the Nairobi Water and Sewerage Company (NWSC) in Nairobi City County, Kenya. Geographically, the study focused exclusively on NWSC, excluding other counties or water service providers, to allow for a detailed and context-specific analysis. Conceptually, the independent variable—smart water strategies—was explored through three key components: storage capacity location, customer service with effective water billing tokens, and innovation in water leak detection. These components were selected due to their increasing relevance in enhancing operational efficiency and service delivery within modern water utilities.

The dependent variable, organizational performance, was measured in terms of NWSC's service coverage, revenue generation, customer satisfaction, operational reliability, and responsiveness to service interruptions. Methodologically, the study adopted a descriptive research design targeting NWSC staff across key operational departments, as well as stakeholders from regulatory and community-based organizations. The temporal scope of the study covered the period between 2018 and 2023, enabling the researcher to capture recent developments and trends in the implementation of smart water strategies and their effects on organizational performance.

1.7 Limitations

Because respondents were reluctant to provide relevant information, the study could be limited. Respondents were given the assurance that any information they submitted would be treated in confidence in order to address this. Concerns about competition and confidentiality may also have made some managers reluctant to divulge sensitive

information about the adoption and application of response plans. Despite these obstacles, Kenyatta University and NACOSTI provided a letter and permit. These records offered guarantees of anonymity and attested to the fact that the material requested was for scholarly reasons. Furthermore, the study emphasized the ethical handling of data and adherence to research protocols to build trust and encourage full participation from respondents.

1.8 Organization of the Study

This study is organized into five comprehensive chapters, each addressing specific components of the research process. Chapter One presents the introduction and includes the following sub-sections: background of the study, statement of the problem, objectives of the study (general and specific), research questions, justification and significance of the study, scope of the study, limitations and delimitations, assumptions of the study, definition of key terms, and the organization of the study itself. Chapter Two provides a detailed review of related literature and is structured into the following sections: theoretical review (highlighting relevant theories), conceptual framework (depicting the relationship between variables), empirical review (reviewing previous studies organized by variables), summary of literature review, and identification of research gaps.

Chapter Three outlines the research methodology and includes the following sub-sections: research philosophy, research design, target population, sampling techniques and sample size, data collection instruments, pilot testing (validity and reliability of instruments), data collection procedures, data analysis techniques (including analytical models), diagnostic tests, and ethical considerations. Chapter Four presents the results and findings of the study, including descriptive statistics, inferential statistics, and interpretation of findings in relation to the study objectives. Chapter Five provides a

summary of the findings, conclusions, recommendations for policy and practice, and suggestions for further research. Each chapter builds upon the previous one to provide a coherent and rigorous investigation into how smart water strategies influence organizational performance at the Nairobi Water and Sewerage Company.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

As a result of this section, key theories have been introduced, research gaps have been identified, and a conceptual framework has been formed to illustrate the relationships between the variables in the study. The chapter also included an empirical review and critique of relevant studies, aiming to summarize how strategic management practices affected public health institutions' performance and address gaps in the existing research.

2.2 Theoretical Framework

Theories serving as the basis for the study were introduced in this section. Theories are developed to elucidate and expand understanding of a concept or phenomenon. Therefore, the theory of RBV, structural contingency theory, and the model of the balanced scorecard provided the main framework.

2.2.1 Resource-Based View Theory

Wernerfelt developed (RBV) in 1984. It is based on the idea that a firm gains its competitive advantage from unique internal resources and capabilities which have some value, are rare, cannot be imitated, and do not have any substitutes. As such, the resources, under this view, are capable of generating long-term success and differentiation. However, not all organizational resources contribute to strategic success. The primary objective of an organization is to acquire and control key valuable resources, whether by developing them internally or securing them externally, to enhance its competitive position.

There are various criticisms against the RBV theory. RBV theory is often criticized for lacking practical guidance for managers about how to identify, develop, and deploy

resources so as to achieve sustainable competitive advantage. The emphasis of this theory is on the importance of unique resources along with capabilities, but it does not provide specific steps or methodologies for managers to follow. This abstract nature makes it challenging for practitioners to apply the theory effectively in real-world situations. Critics argue that without clear operational guidelines, the RBV remains more of a conceptual framework than a practical tool for strategic management.

Businesses depend increasingly on external suppliers for parts, software, expertise, and sales in order to achieve sustainable competitive advantages. They can thus gain access to valuable resources and capabilities that would otherwise be unavailable to them (Langlois, 2010). This necessity aligns with the factors that influence firms' strategic responses, such as reduction in costs, new product or service introduction, focusing on the core competencies, and labor flexibility, all of which enhance the functioning of the organization. According to Barney (1991), sustainable competitive advantage has its source in resources that are valuable, rare, inimitable-which is a function of path-dependence, social complexity-and impossible to substitute. The theory focuses on firm history and culture as well as competencies as the core factors for successful results.

This theory was highly relevant to this study as it stipulated that the Nairobi Water & Sewerage Company employed strategic responses, provided the resources were available. The theory also illustrated that the social environment within which NWSC functioned did not remain stable. Poor performance resulted from the inability of the contingency variables to align with the structure. Resource-Based View (RBV) theory views storage capacity location as strategic assets that, when effectively harnessed, can enhance the Nairobi Water and Sewerage Company's operational effectiveness and overall organizational performance.

2.2.2 Structural Contingency Theory

Donaldson (1996) established the SCT framework. Structural contingency theory revolves around the view that for an organization to ensure continuous improvement and maintenance of performance, there is a need to fit its structure according to the contingency factors. According to the structural contingency theory, there does not exist any effective structure applicable to all organizations. According to Donaldson (1996), these factors including strategy, public accountability, size, tasks, uncertainty, parent organization, critical assets, along with technology. By customizing their organizational structures in response to these factors, firms can more effectively navigate their environments and enhance their performance outcomes.

Just like any other theory, this theory has various criticisms. One major criticism of Structural Contingency Theory is its overemphasis on the alignment between the structure of an organization and its external environment. The SCT theory posits that organizational effectiveness is contingent upon fitting the structure to the environment, but this focus may overlook the importance of internal factors such as organizational culture, leadership style, and employee dynamics. Critics argue that by concentrating primarily on environmental fit, the theory may neglect how internal organizational aspects also significantly influence performance and effectiveness.

The Structural Contingency Theory (SCT) was relevant to this research as it proposed that the most effective organizational structure aligned with its contingency factors. In the case of NWSC, strategic choices were essential, as the organization needed to adopt a new structure that accommodated evolving contingency factors to prevent performance decline caused by misalignment. The theory also demonstrated that the social environment in which NWSC operated did not remain stable. Poor performance resulted from the inability of contingency variables to align with the structure. The

process of transitioning from misalignment to alignment, known as adaptive change, was the core principle of Structural Contingency Theory. Therefore, the Structural Contingency Theory holds that aligning water storage capacity and its physical location with the operational environment and demand patterns enables Nairobi Water and Sewerage Company to achieve structural efficiency and optimize performance outcomes.

2.2.3 Balance Scorecard Model

A Balanced Scorecard, developed by Kaplan and Norton (1996), links strategy with day-to-day operations in an integrated performance management model. It offers a comprehensive perspective of the organization grounded in its business objectives. This concept asserts that Balanced Scorecard is an important tool for translating a firm's vision and strategy into actionable plans, facilitating clear communication of strategic intent and motivating performance toward established goals. As a management system, the Balanced Scorecard allows organizations clarify their vision as well as strategy, translating these elements to concrete actions that drive performance and results.

Despite its usefulness, there are various criticisms against the balance scorecard model. A major criticism of the Balanced Scorecard model is its emphasis on quantitative performance measures. While the model advocates for a balanced approach by including financial and non-financial metrics, critics argue that it may overemphasize numerical indicators at the expense of qualitative aspects. This focus on quantifiable data can lead to an incomplete understanding of organizational performance and may neglect important qualitative factors such as employee satisfaction, innovation, and organizational culture.

Epstein and Wisner (2018) note that a Balanced Scorecard serves as a strategic planning framework that organizations utilize in prioritizing their products, projects, along with

services; communicate any set targets and goals; as well as plan routine activities. This tool enables firms to monitor as well as assess the effectiveness of their organizational strategies, providing insights into their respective performance levels. Punniyamoorthy and Murali (2018) further explain that Balanced Scorecard functions as a structured report measuring managerial performance against key indicators of performance, demonstrating their contributions toward achieving established strategy and targets. Success is evaluated based on specified goals, enabling businesses to gauge their growth rate and compare themselves against competitors.

The Balanced Scorecard model was a performance-based framework that supported the variable of this study: performance. This model was relevant to the research as it emphasized how organizations could secure returns on investments and manage key risks associated with business operations. It assessed how effectively a company delivered value to its customers and measured customer satisfaction with its products or services. Additionally, the Balanced Scorecard outlined the necessary measures and objectives to enhance operational effectiveness. It also evaluated the organization's products or services to ensure they met customer standards while optimizing organizational capacity to achieve favorable results. Therefore, the Balanced Scorecard concept provides a comprehensive lens through which innovations in water leak detection can be evaluated, not only for their technical utility but also for their contribution to internal process improvements, customer satisfaction, and long-term organizational performance at Nairobi Water and Sewerage Company.

2.3 Empirical Review

Throughout this section, previous studies related to each objective are reviewed, highlighting relevant empirical literature. It was divided into three subsections, with the

first section covering the first objective, the second section addressing the second objective, and the third section focusing on the third objective, as outlined below.

2.3.1 Storage Capacity Location and Performance

Xie and Zilberman (2018) examined the link between water storage capacity and efficient water usage, exploring whether they function as substitutes or complements. Their findings suggest that improvements in efficiency can lead to increased demand for storage capacity under two conditions: when overall water demand rises, or when re-optimizing water inventory management increases the likelihood of exhausting storage capacity. They identified specific properties of demand for water and productivity that could facilitate these scenarios, illustrating potential complementarity through citing an example from the California State Water Project. Importantly, their performance analysis spanned the years 2015 to 2017.

Yu et al. (2021) proposed a new integrated approach to water storage, advocating for the recognition of water storage as a service rather than merely a physical facility. Their argument is not just based on the volume of water stored in dams or watersheds, but also on the ability of such dams or watersheds to provide specific services with a certain level of assurance at specified times and places. This study recommends developing and managing integrated storage systems to meet targeted service standards, thereby reducing the costs associated with developing new storage facilities and promoting sustainable benefits. However, qualitative data was primarily used in this study.

In a changing climate, Maas et al. (2017) looked into how allocation institutions affected the value obtained from water storage systems. These researchers measured the impact of these organizations on the total value produced by a reservoir system, in addition to the goals of reservoir management and storage capacity. The study

concentrated on the Colorado-Big Thompson system, which channels water stored from the Rocky Mountains, using a stochastic dynamic model for programming that takes into consideration fluctuation in water demand that is reliant on water and stochastic semiannual inflows. Their results indicated that allocation mechanisms that are rigid along with management objectives that are not efficient could reduce the value of stored water by up to 13%, comparable to predicted losses linked to climate change-induced inflow reductions.

Pereira and Pinto (2019) explored the integration of smart technologies in water storage management to enhance system performance. Their research emphasizes the implementation of real-time monitoring systems and advanced control strategies to optimize storage capacity. They found that incorporating smart management systems can significantly improve operational efficiency and reduce costs. By leveraging integrated monitoring and control technologies, water utilities can more effectively manage storage resources and respond to fluctuations in water demand and supply conditions.

Ribeiro & Silva (2020) explores the impact of smart water infrastructure on storage capacity and system reliability. The authors examine how technologies such as sensors and data analytics contribute to more effective management of water storage systems. The study highlights that smart infrastructure can optimize the use of storage resources, thereby enhancing system reliability and reducing the likelihood of supply disruptions. As a result of these findings, smart water infrastructure can improve water storage systems' overall performance.

Zhou et al. (2021) evaluates the performance of smart storage systems within urban water networks. It discusses the implementation of automated control systems and predictive analytics to optimize storage capacity and improve system performance. The

study indicates that smart storage solutions offer significant benefits in form of efficiency and reliability. It provides insights into how smart technologies can address the challenges of managing storage in urban water networks, including the benefits and limitations associated with their adoption.

2.3.2 Customer Service Effective Water Billing Tokens and Performance

Kenyan residents in Embu Municipality are not paying their water bills due to the following factors (Mwaniki, 2019). In this regard, the study was a descriptive study aimed at solving consumer water payment problems. The target population consisted of 8,836 residents who had been served by EWASCO in Embu County. Based on the Fischer method, 400 individuals were selected by stratified random sampling, and data was collected by administering structured questionnaires to respondents. From the findings, it was observed that the billing system did not deter water payment; the revenue collection system was efficient and had no negative implications. High costs of water, consumer behavior changes were the major causes of delayed payments. The study focused specifically on EWASCO in Embu County.

Hanjahanja and Omuto (2018) investigated whether prepaid water meters improve water service quality in Nakuru, Kenya with an emphasis on an early-phase project. The study examined the impact of prepayment on service delivery, specifically for impoverished urban people, and the function of microfinance in assisting water service providers. The researchers installed communal prepaid meters within a conventional network that is existent and collected data via interviews, field visits, as well as literature reviews. The findings indicated that prepaid metering led to notable improvements over conventional metering systems. A microfinance program had the potential to enhance access to water services through partnerships between financial institutions, water providers, and low-income consumers. However, the findings were

exclusive to Nakuru, Kenya.

Moussallem (2022) investigated the effect of water quality and service on subscriptions and fee collection in regions of Bireh and Sin el Fil. This research involved a detailed survey aimed at identifying the primary factors affecting customer satisfaction and billing behavior, particularly in light of changes in governmental operations in the water sector. Results indicated that respondents in Sin el Fil were generally more dissatisfied with water quality and supply compared to those in Bireh, despite being willing to pay more for improved services. Water supply was prioritized over quality as well as billing services in both regions. Nevertheless, the study primarily used secondary data to analyze its results. Several factors, including water cost, customer satisfaction, and water quality, influenced billing behavior.

2.3.3 Innovation of Water Leak Detection and Performance

As part of their study, Klosok-Bazan et al. (2021) assessed the management of leakage in small water supply systems using performance indicators. Their study involved a comprehensive analysis of various PIs necessary for evaluating different leakage reduction methods, adopting a step-by-step method to identify data that is most relevant for analysis of leakage management at the network level. The performance indicators proposed in the study aimed at enhancing efficiency of leakage management in the small water supply systems. The authors aligned their methodology with the Deming cycle, which involves a systematic process of planning activities, executing them according to the plan, checking the execution against the set objectives, and making improvements based on the analyses and lessons learned. The findings indicated that implementing a comprehensive and systematically strategy that is improved could significantly enhance effectiveness of leakage management systems. However, it is worth noting that this research relied on secondary data for its analysis.

In their study, Hlalele, Ilunga, and Dinka (2021) investigated how and why leaks occur in water distribution systems and their causes. Using several leak detection systems in individual water pipes, a program of leak detection and repairs was prescribed to address NRW. In addition to Sahara and SmartBall leak detection technologies, Piper and satellite technologies were also used. As part of the proactive measures, various technologies were also employed, including Magnetic Tomography Method (MTM) Gradient and Long Range Guided Ultrasonic Waves Technology, which measured the walls of the pipes and determined what repair was needed in order to stop leaks. Rand Water was able to locate and identify many leaks and repair them with various leak detection and repair technologies. As a result, Rand Water will be able to lower preventable non-revenue water. However, qualitative data was employed in the study. Barros et al. (2023) conducted an investigation into the impact of leakage on parameters of water quality within distribution networks, aiming to identify new sources of information to promote more sustainable water use.

During leak occurrences, the study examined the hydraulic behavior of water networks, which affected key water quality parameters, including water age and chlorine concentration, in a study. Water data could serve as a valuable resource for identifying leaks, potentially influencing the development of future detection systems, according to the authors. Moreover, the study introduced the application of graph theory to the water network, suggesting that analyzing the shortest path between leak location and respective reservoir could yield significant insights for improving detection methods. Despite these contributions, the research employed a cross-sectional design, which may limit the ability to observe changes over time and establish causal relationships.

In their study (2022), Murray et al. explored how advanced sensor technologies can be integrated into real-time leak detection to improve overall system performance. The

study examined how Internet of Things (IoT) sensors and machine learning algorithms can be used to increase the accuracy and timeliness of leak detection. The results indicated that smart sensors and data analytics significantly improved leakage detection rates and operational efficiency, leading to reduced water loss and better resource management. The research applied a mixed-method approach, combining both quantitative data and case studies. The current study will fill this research gap in methodology by applying descriptive research design.

Zhang et al. (2023) examined the role of predictive maintenance strategies in reducing leakage and improving system performance. This study utilized both quantitative analysis of performance metrics and qualitative assessments of maintenance practices. The research focused on the application of predictive analytics to anticipate potential leaks before they occur, using historical data and real-time monitoring. The study demonstrated that predictive maintenance could decrease downtime, extend the lifespan of infrastructure, and enhance overall system reliability.

Santos et al. (2022) explored the effect of smart water grids on leakage management and organizational performance. The study employed a comparative analysis of traditional and smart water grid systems to evaluate performance improvements. Using advanced metering infrastructure (AMI) and real-time data analytics, the study evaluated smart grid implementation. The findings highlighted that smart water grids facilitated more efficient leakage detection and management, leading to cost savings and improved service delivery.

2.4 Summary of Literature Reviewed and Research Gaps

Xie and Zilberman (2018) examined the relationship between the capacity of water storage and the efficiency of water use, finding that improved efficiency could increase storage demand or exhaust storage capacity. In this research performance was measured from the year 2015 to 2017. Performance will be measured from the year 2019 to 2023 in the current research. Yu et al. (2021) argued that the storage of water should be managed as a service, emphasizing the need for integrated systems to meet targeted service standards and reduce development costs. Quantitative data will be used in the current study, whereas qualitative data was used in their study.

Mwaniki (2019) analyzed factors influencing water bill payments in Embu County, finding that billing systems and consumer behavior impacted payment patterns. The study by Mwaniki (2019) focused on EWASCO in Embu County. The current study will focus on Nairobi Water.

Sewerage Company in Nairobi City County Kenya. On the other hand, Hanjahanja and Omuto (2018) evaluated the impact of prepaid water meters in Nakuru, Kenya, noting improvements in service delivery and potential for microfinance partnerships. Their research focused on Nakuru, Kenya. We will examine Nairobi Water & Sewerage Company in Nairobi City County, Kenya, for the purpose of this research.

Klosok-Bazan et al. (2021) assessed leakage management using performance indicators, suggesting systematic strategies to enhance effectiveness. Their study used secondary data. The current study will use primary data. Hlalele et al. (2021) examined various leak detection technologies and methods, demonstrating their role in reducing non-revenue water. The research employed qualitative data. The current study will utilize quantitative data. Barros et al. (2023) analyzed how leaks affect water quality

and proposed using graph theory for future detection systems. The research used a cross-sectional research design while the current study will apply descriptive research design.

Table 2.1: Summary of Literature Reviewed and Research Gap

Author	Study Focus	Findings	Gaps	Focus of the Current Study
Xie and Zilberman (2018)	Water storage vs water use efficiency: substitutes or complements	Relevant to choices among infrastructure investment, enhanced consumption efficiency, and conservation of other resources like energy	Performance measured from 2015 to 2017	Performance will be measured from 2019 to 2022
Yu, Rex, McCartney, Uhlenbrook, Gnechten, and Priscoli (2021)	Storing water: an integrated approach for resilient development	Integrated storage systems should deliver a targeted service standard	Study used qualitative data	Study will use quantitative data
Mwaniki (2019)	Factors influencing non-payment of water bills in Embu County, Kenya	Billing system negatively affected payment, revenue collection system was effective	Focused on EWASCO in Embu County	Study will focus on Nairobi Water & Sewerage Company in Nairobi County
Hanjahanja and Omuto (2018)	Impact of prepaid water meters on service delivery quality	Prepaid metering showed positive improvements over conventional metering	Case study in Nakuru, Kenya	Study will focus on Nairobi Water & Sewerage Company in Nairobi County
Moussallem (2022)	Influence of water quality and service on subscriptions and fee collection	Factors like water cost, satisfaction, and quality significantly affect billing behavior	Used secondary data	Study will use primary data

Klosok-Bazan, Boguniewicz-Zablocka, Suda, Łukasiewicz, and Anders (2021)	Leakage management in small water supplies using performance indicators	Concluded that a systematically improved strategy enhances system effectiveness	Used secondary data	Study will use primary data
Hlalele, Ilunga, and Dinka (2021)	Causes of leaks and leakage management in water distribution systems	Detected several leaks using various technologies and repair methods	Used qualitative data	Study will use quantitative data
Barros, Almeida, Zanfei, Meirelles, Luvizotto, and Brentan (2023)	Effect of leakages on water quality parameters in distribution networks	Water quality data can be useful for future detection systems	Used cross-sectional research design	Study will use descriptive research design

2.5 Conceptual Framework

A conceptual framework visually presents the relationship between key variables under investigation and guides the structure of the study. It helps in understanding how the independent variables influence the dependent variable by mapping out hypothesized connections. In this study, the key independent variables are: storage capacity location, customer service and effective water billing tokens, and innovation in water leak detection. These variables represent core components of smart water strategies adopted by Nairobi Water and Sewerage Company. The dependent variable is organizational performance, which refers to how effectively NWSC delivers water and sanitation services, manages operations, and satisfies customer needs. The framework outlines how each smart water strategy component is expected to contribute to or influence the company's overall performance outcomes. Figure 2.1 below illustrates the hypothesized relationship between the independent and dependent variables in this study.

Independent Variables

Dependent Variables

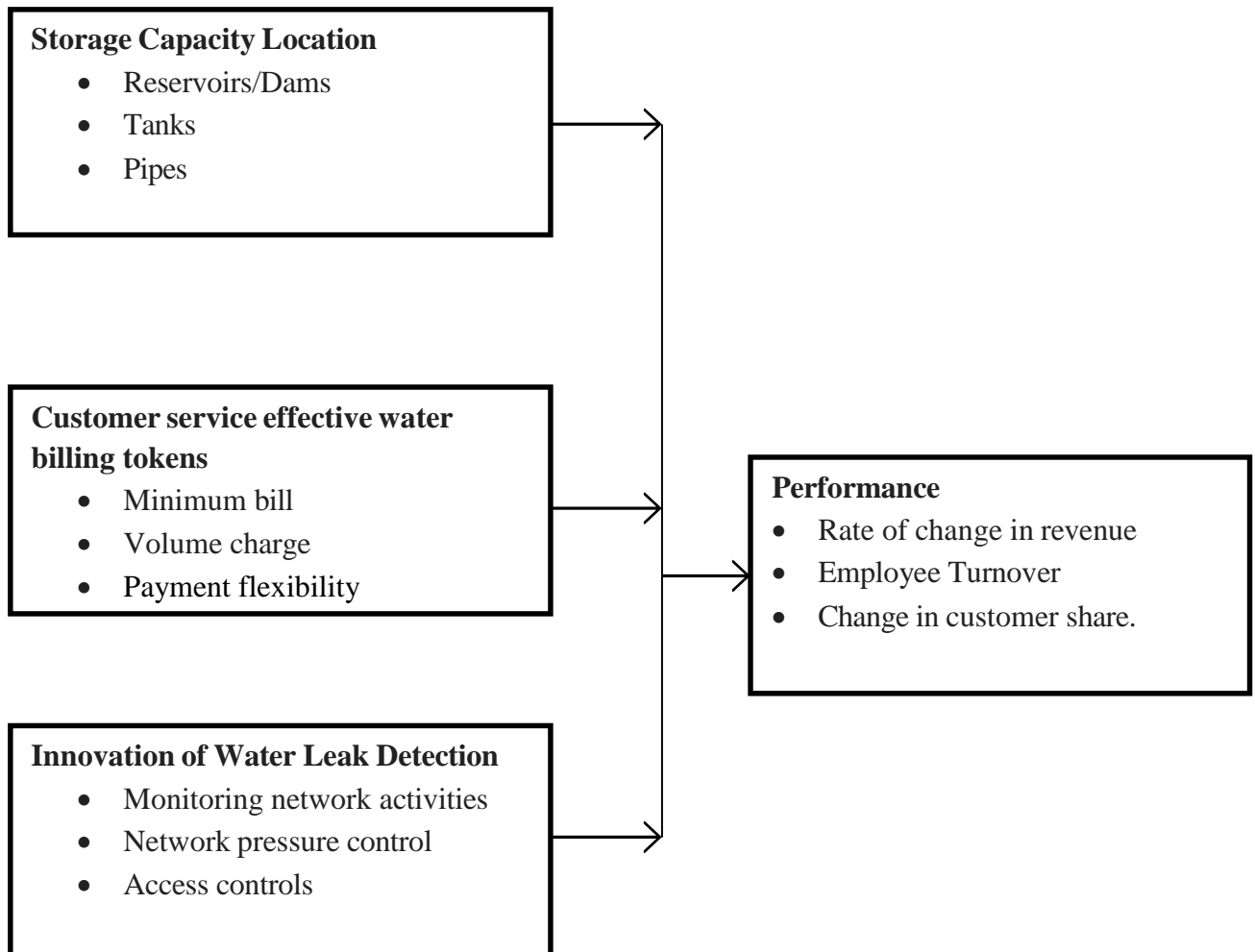


Figure 2.1: Conceptual framework

Source: Researcher (2024)

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This chapter provides a comprehensive overview of the essential components of the research process, ensuring a thorough understanding of the methodology employed, the design of the research, the identification of the target population, determination of sample size, sampling procedures, utilization of appropriate data collection methods, proposed strategies for data analysis, and the ethical considerations integral to the research endeavor. This chapter aims to establish a strong foundation for the credibility and reliability of the research findings, thus enhancing the overall value and impact of the study.

3.2 Research Design

This study adopted a descriptive research design, which is appropriate for studies that seek to systematically describe the characteristics, behaviors, or relationships among variables in a specific context without manipulating the study environment. Descriptive design enables researchers to obtain quantifiable information from a target population and is particularly useful when the goal is to explore associations between variables and provide a clear picture of prevailing conditions (Kothari, 2004). In the context of this study, the design was suitable because it facilitated an in-depth investigation into how specific smart water strategies influence the organizational performance of the Nairobi Water and Sewerage Company. The design allowed for the collection of both numerical and categorical data through structured questionnaires, enabling the analysis of relationships between independent and dependent variables. Furthermore, descriptive research is advantageous in enhancing

the generalizability of findings across similar utility institutions (Mugenda & Mugenda, 2003), making it a methodologically sound choice for this study.

3.3 Target Population

A target population refers to the entire group of individuals or elements to which a researcher intends to generalize the findings of a study (Kothari, 2004). According to Mugenda and Mugenda (2003), it comprises individuals, groups, or objects that possess observable and measurable characteristics relevant to the study's objectives. For this study, the target population consisted of employees and departmental managers at Nairobi Water and Sewerage Company (NWSC) who are directly involved in operations, infrastructure development, customer service, and innovation-related activities. These individuals were selected because they possess specialized knowledge and experience in implementing smart water strategies such as storage infrastructure planning, water billing systems, and leak detection technologies—factors central to the research.

As per internal administrative records obtained from NWSC's human resources department (2023), the total number of employees falling under the relevant operational and technical departments within the Nairobi City County jurisdiction was 94. This figure included unit heads, technical engineers, customer service supervisors, IT staff involved in smart metering, and innovation officers. This population formed the basis for sample selection in this study, as it represented the staff most conversant with smart water strategy implementation and its influence on organizational performance.

Table 3.1: Target Population

Section/ Category	Number	Percentage /Fraction
Managers in charge of innovation	15	16%
Staff in charge of Innovation	79	84%
Total	94	100%

Source: NWSC, HRM report of 2023

3.4 Sampling Design and Sample Size

According to Odho (2005), researchers choose a sample to represent the entire population, since they may not be able to reach the entire population due to various constraints. Mugenda and Mugenda (2003) advise that sampling is not necessary when the population under study is less than 100. To produce this study's sample size, 94 respondents were selected using a census sampling technique. Their numbers are tabulated below.

Table 3.2: Sample Size

Division/Category	Number	Fraction/Percentage
Managers in charge of innovation	15	16%
Staff in charge of Innovation	79	84%
Total	94	100%

Source: NWSC, HRM report of 2023

3.5 Data Collection Instrument

In order to collect data, questionnaires were used, with sections containing demographic information, storage capacity location, customer service, and enhanced billing tokens divided into sections. Section A covered demographic information; Section B covered storage capacity location; Section C covered customer service and

enhanced billing tokens; Section D analyzed water leak detection innovations, while Section E examined performance metrics. This study used a 5-point Likert scale as the rating scale; additionally, open-ended questions were included so respondents could express their opinions; thus, the questionnaire format adopted was semi-structured.

3.6 Pilot Study

A pilot study is a small-scale preliminary investigation carried out before the main research to assess the clarity, consistency, and appropriateness of research instruments (Orodho, 2005). The purpose of a pilot is to detect any ambiguity, difficulty, or weakness in the questionnaire design and to make necessary adjustments to improve its effectiveness. In this study, a pilot was conducted using 9 respondents, selected purposively from departments within Nairobi Water and Sewerage Company (NWSC) that are directly related to operations, billing, infrastructure, or innovation. These respondents were not included in the final study to avoid response contamination and bias.

The selection of 9 participants was guided by recommendations from scholars such as Connelly (2008), who proposes that a pilot sample should be approximately 10% of the intended sample size, especially in social science research. Given the study's sample frame, the choice of 9 respondents met this rule of thumb and provided sufficient feedback for refining the questionnaire. The pilot helped the researcher test the instrument's face validity, ensuring that the items captured the intended constructs accurately, and also assessed the reliability of the instrument using internal consistency measures. Feedback from the pilot study was used to revise unclear items,

improve wording, and eliminate redundancy, thus enhancing the overall quality and precision of the data collection tool.

3.6.1 Validity of Research Instrument

Based on Oddho (2005), validity refers to the degree to which data collection instruments measure what they are designed to measure, in accordance with the study objectives. Three types of validity tests were conducted to ensure the research instrument's validity: content validity, construct validity, and criterion validity. Construct validity ensured the instruments aligned with the study objectives, whereas content validity ensured the instruments were clear. Criterion validity checked that all questions systematically addressed the study's objectives. Content validity was achieved by reviewing each item to ensure comprehensive coverage of the study's objectives.

3.6.2 Reliability of Research Instrument

A measure of reliability is the probability that the instrument under test will produce identical results under repeated conditions (Mugenda & Mugenda, 2003). In order to calculate the coefficient that describes the correlation of an instrument, Cronbach's alpha test was applied. Reid (2016) explains that Cronbach's Alpha indicates whether each statement is reliable in measuring the objective across categories and whether or not there is any variance caused by chance or randomness in the scores. According to Mugenda and Mugenda (2003), a tool's correlation coefficient must exceed 0.7 if it is to be considered reliable. As such, the study aimed to obtain a correlation coefficient of 0.8.

3.7 Data Collection Procedure

In order to conduct the study, the researcher obtained permission from the relevant bodies; National Commission for Science, Technology and Innovation (NACOSTI) and the organization's management. Using the drop-and-pick method, questionnaires were distributed to study participants, who were given two weeks to complete them. In order to maximize response rates, the researcher followed up with respondents and stressed the importance of completing the questionnaires fully.

3.8 Data Analysis and Presentation

Data analysis is a critical phase of research that involves organizing, summarizing, and interpreting collected data to draw meaningful conclusions. In this study, both descriptive and inferential statistical techniques were used to analyze the quantitative data obtained from the structured questionnaires. Descriptive statistics such as means, standard deviations, frequencies, and percentages were used to summarize respondents' demographic characteristics and provide insights into the general patterns and trends within each variable. These measures helped describe the extent to which respondents agreed with the statements related to storage capacity location, customer service and effective billing tokens, innovation in water leak detection, and organizational performance.

For inferential statistics, the study employed multiple linear regression analysis to examine the nature and strength of the relationship between the independent variables and the dependent variable. This technique was appropriate for determining the predictive influence of smart water strategies on organizational performance, and for testing the study's hypotheses at a 95% confidence level ($\alpha = 0.05$). Prior to conducting the regression analysis, diagnostic tests were performed to check for normality, multicollinearity, and homoscedasticity, ensuring that the assumptions of

linear regression were met.

The regression equation was formulated as:

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

Where,

Y = refer to Performance

X₁ = Storage capacity location

X₂ = Customer service effective water billing tokens

X₃ = Innovation of water leak detection

β₁ to β₃ = Coefficients of determination

ε = refer to the error term

The regression output was used to determine the statistical significance (p-values) and predictive power (R-squared) of each independent variable on organizational performance. Findings from the analysis were presented using tables, charts, and figures to facilitate clear interpretation. The results also informed whether the null hypotheses were to be rejected or not, thereby providing empirical support for the study's conclusions and recommendations.

3.9 Ethical Consideration

Ethics received significant consideration throughout the process. Before data collection, consent was sought from Kenyatta University Graduate School and NACOSTI. Measures were implemented to protect the anonymity and confidentiality of all collected data. This was done in adherence to ethical guidelines and principles, ensuring privacy and the well-being of research participants. In cases where conflicts of interest arose, they were promptly disclosed and addressed through ethical means as necessary.

CHAPTER FOUR: RESEARCH FINDINGS AND DISCUSSIONS

4.1 Introduction

This chapter presents the findings derived from the field data and is organized into several sections: response rate, background information of respondents, descriptive statistics on the key variables (storage capacity location, customer service and effective water billing tokens, and innovation in leak detection), and inferential statistics using multiple linear regression analysis to determine the effect of these smart water strategies on organizational performance.

4.2 Response Rate

The overall response rate for the study is represented in Table 4.1 and is based on 94 questionnaires administered to managers and staff members who are responsible for innovation at Nairobi Water and Sewerage Company.

Table 4.1: Response Rate

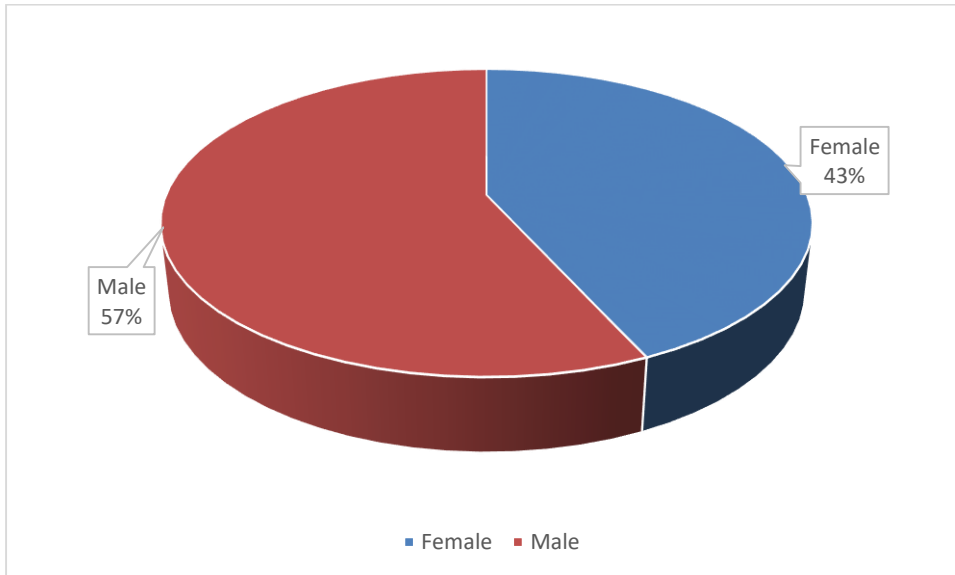
Category	Frequency	Percentage
Response	88	93.6
Non response	6	6.4
Total	94	100

Source: Research Data (2024)

According to the findings in Table 4.1, the study had a 93.6% response rate and a 6.4% non-response rate. Baruch and Holtom (2014) state that a response rate of 80% or more is adequate for data processing. Consequently, a 93.6% study response rate was judged suitable for data analysis. The high response rate of the study led to acceptance and credibility of the research findings.

4.3 Demographic Information of the Respondents

4.3.1 Gender



Source: Research Data (2024)

Figure 4.1: Gender

According to Figure 4.1, there were 57% (50) male respondents and 43% (38) female respondents. This shows an acceptable gender distribution.

4.3.2 Highest Education Level Attained

Table 4.2: Highest Education Level Attained

Education level	Frequency	Percentage
Diploma	13	14.77
Undergraduate degree	41	46.60
Master degree	32	36.36
PhD	2	2.27
Total	88	100

Source: Research Data (2024)

The results illustrated in Table 4.2 indicate that majority (46.60%) of the respondents had undergraduate degree, 36.36% were master graduates, 14.77% had diploma and

2.27% had PhD. This suggests that the respondents had a range of educational backgrounds.

4.3.3 Age Bracket

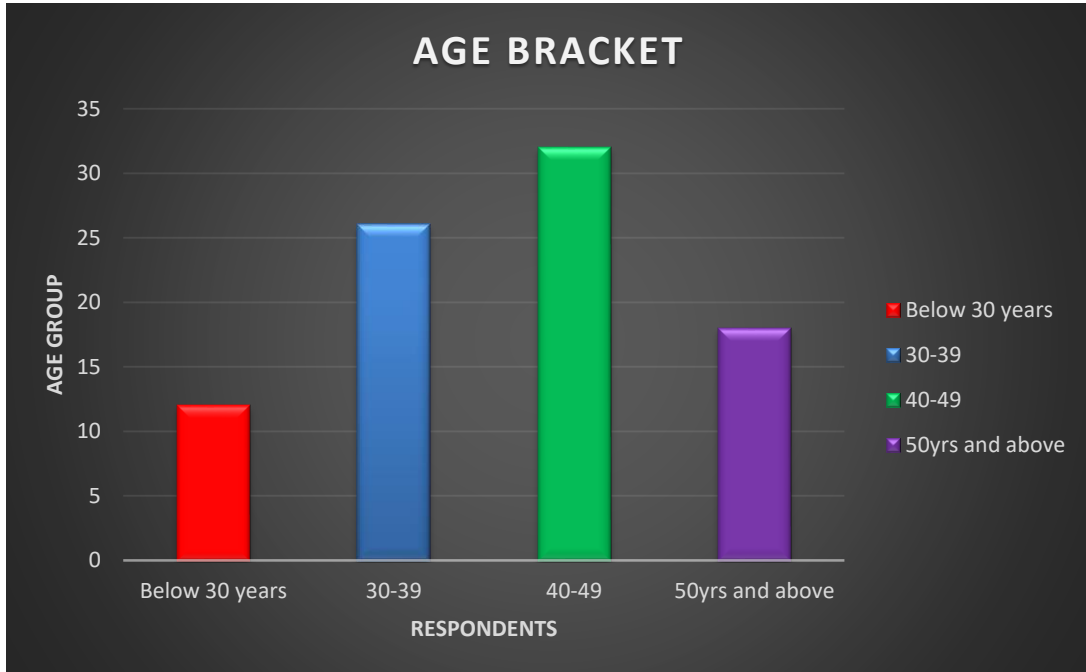


Figure 4.2: Highest Education Level

Source: Research Data (2024)

According to the results shown in Figure 4.2, the majority of respondents (36%) were between the ages of 40 and 49, 30% were between the ages of 30 and 39, 20% were 50 years of age or more, and 14% were under the age of thirty. This shows that the study's participants came from a variety of age groups.

4.3.4 Work Experience

Table 4.3: Work Experience

Years	Frequency	Percentage
Less than 5	8	9.09%
5 to 9	14	15.91%
10-15	28	31.82%
Above 15	38	43.18%
Total	88	100

Source: Research Data (2024)

The results as presented in Table 4.3 indicate that majority 43.18% of the respondents accounted for the respondents who had a work experience of more than 15 years, 31.82% between 10 to 15 years, 15.91% were respondents 5 to 9 years and 9.09% less than 5 year. This is an indicator the respondents involved in the study had a good number of years in working with the organization.

4.4 Descriptive Statistics Results

4.4.1 Storage Capacity Location and Performance

The goal of the study was to determine how storage capacity location affected organizational performance and smart water practices. Table 4.4 displays the descriptive findings.

Table 4.4: Storage Capacity Location and Performance

Statements	M	SD
Having a storage water capacity location allows the organization to have a reliable and consistent water supply.	4.60	0.917
The organization can ensure that it always has an adequate supply of water, even during periods of drought or water scarcity by having a dedicated storage facility	4.31	0.814
A storage water capacity location enables the organization to store water during times of excess supply	3.84	0.932
The organization can mitigate the risk of water shortages during times of scarcity by storing water during periods of abundance	4.53	1.006
Having a storage water capacity location allows the organization to take advantage of cost savings opportunities	4.56	0.846
A storage water capacity location can enhance the organization's sustainability efforts.	4.08	1.741
Aggregate score	4.32	0.348

Source: Research Data (2024)

According to the results presented in Table 4.4, the aggregate mean and standard deviation of 4.32 and 0.348 respectively proves that the respondents agreed on statements describing the influence of Storage Capacity Location on Smart water strategies and organizational performance of Nairobi water and sewerage company in Nairobi city county, Kenya based on a 5 point likert scale. To better understand how Storage Capacity Location affects the organizational performance of Nairobi water and sewerage company in Nairobi city County, Kenya, Odenyo (2014) conducted research. All independent variables significantly and positively influenced the organizational performance of Nairobi water and sewerage company in Nairobi city County, Kenya, as determined by a regression analysis of the data. These variables

are storage capacity location, Customer service effective water billing token and innovation of water leak detection.

The respondents strongly agreed that; Having a storage water capacity location allows the organization to have a reliable and consistent water supply. (M=4.60, SD=0.917), Having a storage water capacity location allows the organization to take advantage of cost savings opportunities (M=4.56, SD=0.846), The organization can mitigate the risk of water shortages during times of scarcity by storing water during periods of abundance (M=4.53, SD=1.006). Mwendwa (2015) conducted a survey on the management of NWSC in Nairobi City County, Kenya, to examine the factors influencing resource allocation for various water infrastructure projects. The study found strong positive correlations between organizational performance and Storage Capacity Location, Reservoirs/Dams, Tanks, Pipes, and the role of regulatory bodies in Storage Capacity Location for water and sewerage projects.

The respondents agreed that; The organization can ensure that it always has an adequate supply of water, even during periods of drought or water scarcity by having a dedicated storage facility (M=4.31, SD=0.814), A storage water capacity location can enhance the organization's sustainability efforts(M=4.08, SD=1.741), A storage water capacity location enables the organization to store water during times of excess supply (M=3.84, SD=0.932). In their analysis of the relationship between Storage Capacity Location and organization performance, Kobugabe and Rwakihembo (2022) looked at the examples of private universities in Uganda. Capacity Location was shown to be positively correlated with various strategies for mobilizing organization performance, which provided ample justification for Nairobi Water and Sewerage Company to implement a wide range of smart water strategies to enhance organizational performance.

These results are in line with Xie and Zilberman (2018), who argued that investment in decentralized storage infrastructure significantly mitigates the effects of water scarcity, especially in urban areas, by improving system reliability. Similarly, Yu et al. (2021) emphasized that optimal storage location enhances operational flexibility and reduces supply disruptions, confirming the strong positive perception of storage infrastructure observed in this study.

4.4.2 Customer Service Effective Water Billing Token and Performance

The study sought to identify the effect of Customer Service Effective Water Billing Token on Smart water strategies and organizational performance of nairobi water and sewerage company in nairobi city county, kenya.. The descriptive results are presented in Table 4.5.

Table 4.5: Customer Service Effective Water Billing Token and Performance

Statements	M	SD
Efficient water billing tokens can greatly improve customer service by providing accurate and timely billing information to customers.	4.53	1.413
Efficient water billing tokens help to build trust and transparency between the organization and its customers, leading to increased customer satisfaction and loyalty.	3.82	0.548
The use of water billing tokens can streamline the billing process, reducing the likelihood of errors and disputes	4.09	1.064
The use of water billing tokens saves time and resources for the organization, allowing them to focus on other important aspects of their operations	4.56	0.811
Efficient water billing tokens can enhance the overall performance of an organization by improving customer service	3.99	1.380
Efficient water billing tokens can enhance the overall performance of an organization by enhancing operational efficiency.	4.52	1.294
Aggregate score	4.25	1.347

Source: Research Data (2024)

According to the results presented in Table 4.5, the aggregate mean and standard deviation of 4.25 and 1.347 respectively proves that the respondents agreed on statements describing the effect of Customer Service Effective Water Billing Token on Smart water strategies and organizational performance of Nairobi water and sewerage company in Nairobi city County, Kenya based on a 5-point likert scale. Juma (2019) conducted a study on smart water strategies and organizational performance, focusing on NWSC in Nairobi City County, Kenya. The findings highlighted a mutual dependence between the adoption of minimum bill policies, volume-based charging, and payment flexibility, demonstrating their collective impact on operational efficiency and service delivery.

The respondents strongly agreed that; The use of water billing tokens saves time and resources for the organization, allowing them to focus on other important aspects of their operations (M=4.56, SD=0.811), Efficient water billing tokens can greatly improve customer service by providing accurate and timely billing information to customers (M=4.53, SD=1.413), Efficient water billing tokens can enhance the overall performance of an organization by enhancing operational efficiency (M=4.52, SD=1.294). After analyzing data on water management strategies, Kohli and Singh (2017) concluded that the adoption of smart water strategies in urban utilities was driven by affordability and accessibility of essential resources. Similarly, McGuirk and Mundlak (1991) observed that efficient water pricing mechanisms, including minimum bill structures, volume-based charges, and payment flexibility, played a crucial role in optimizing resource utilization and enhancing service delivery in urban water systems..

The respondents agreed that; The use of water billing tokens can streamline the billing process, reducing the likelihood of errors and disputes (M=4.09, SD=1.064), Efficient

water billing tokens can enhance the overall performance of an organization by improving customer service (M=3.99, SD=1.380), Efficient water billing tokens help to build trust and transparency between the organization and its customers, leading to increased customer satisfaction and loyalty (M=3.82, SD=0.548). Olwande, Sikei, and Mathenge's (2019) panel data analysis examined the factors influencing the adoption and utilization of smart water strategies in service provision. Using a double-hurdle model, the study determined that variables such as customer demographics, proximity to water access points, and household income levels play a crucial role in the likelihood of adopting smart water billing mechanisms. The intensity of smart water strategy adoption was influenced by factors such as payment flexibility, the affordability of the minimum bill, volume-based charges, and accessibility to digital payment platforms, highlighting the significance of tailored pricing models in enhancing service uptake and organizational performance.

4.4.3 Innovation of Water Leak Detection and Performance

The study sought to identify the effect of Innovation of Water Leak Detection on Smart water strategies and organizational performance of Nairobi water and sewerage company in Nairobi city County, Kenya.. The descriptive results are presented in Table 4.6

Table 4.6: Innovation of Water Leak Detection and Performance

Statements	M	SD
Cutting-edge water leak detection technology can help companies identify and locate leaks quickly and accurately.	3.91	1.073
Innovative of water leak detection help the organization save money on costly repairs, water bills, and potential damage to infrastructure or equipment caused by water leaks.	3.77	0.814
Innovative of water leak detection enable companies to monitor their water usage and identify areas of improvement.	4.01	0.812
Innovative of water leak detection help companies maintain the integrity of their assets and ensure uninterrupted operations	4.06	0.647
Innovative of water leak detection allow the organization to collect and analyze data on water usage, leak patterns, and trends.	4.33	0.714
Innovative of water leak detection help identify leaks early on, preventing the growth of these hazards and ensuring a safe and healthy working environment.	4.57	1.514
Aggregate score	4.11	0.327

Source: Research Data (2024)

Based on a 5-point Likert scale, the respondents agreed on statements describing the impact of innovation in water leak detection on smart water strategies and organizational performance of Nairobi Water and Sewerage Company in Nairobi City County, Kenya, as indicated by the results shown in Table 4.6, which also shows the standard deviation of 0.327 and the aggregate mean of 4.11. Ogundele (2017) examined the effectiveness of smart water techniques to improve NWSC's organizational performance, with a particular emphasis on access controls, network pressure control, and activity monitoring. The study hypothesized a link between effective network monitoring and operational efficiency, as well as the relationship

between strategic pressure regulation and sustainable water management. The findings highlighted the importance of implementing smart water strategies in optimizing service delivery and improving overall organizational performance..

The respondents strongly agreed that; Innovative of water leak detection help identify leaks early on, preventing the growth of these hazards and ensuring a safe and healthy working environment (M=4.57, SD=1.514). Nwokolo (2017) investigated the effectiveness of smart water strategies in enhancing organizational performance. The study analyzed data using descriptive statistics, Chi-square tests, and a t-test for independence. The findings revealed that monitoring network activities, network pressure control, and access controls play a significant role in improving the efficiency and reliability of water service delivery, ultimately enhancing the performance of water utilities..

The respondents agreed that; Innovative of water leak detection allow the organization to collect and analyze data on water usage, leak patterns, and trends (M=4.33, SD=0.714), Innovative of water leak detection help companies maintain the integrity of their assets and ensure uninterrupted operations (M=4.06, SD=0.647), Innovative of water leak detection enable companies to monitor their water usage and identify areas of improvement (M=4.01, SD=0.812), Cutting-edge water leak detection technology can help companies identify and locate leaks quickly and accurately(M=3.91, SD=1.073) and Innovative of water leak detection help the organization save money on costly repairs, water bills, and potential damage to infrastructure or equipment caused by water leaks (M=3.77, SD=0.814). Onsomu (2010) investigated the role of monitoring network activities, network pressure control, and access controls in enhancing the operational efficiency of Nairobi Water and Sewerage Company. The study's findings highlight the significance of these smart

water strategies in optimizing water distribution, minimizing losses, and ensuring reliable service delivery, ultimately contributing to improved organizational performance..

4.4.4 Performance of Smart water strategies

The study sought to investigate organizational performance of Smart water strategies of Nairobi water and sewerage company in Nairobi city County, Kenya.. The descriptive results are presented in Table 4.7.

Table 4.7: Performance of Smart water strategies

Statements	M	SD
The revenue collected has increased making the organization expand its operations	3.65	1.348
The revenue collected has increased enabling the organization to invest in new products or services	4.11	0.890
The organization has a larger workforce that allows for a greater division of labor, enabling tasks to be allocated more efficiently and completed in a shorter amount of time.	3.94	1.060
The organization has a larger workforce that enhances the organization’s ability to handle larger workloads and meet deadlines	3.57	1.429
There is an increased customer base that has enabled the organization to increase its brand visibility and awareness.	3.87,	0.529)
There is an increased customer base that enabled the organization to enjoy economies of scale	4.29	0.709
Aggregate score	3.912	0.307

Source: Research Data (2024)

According to the results presented in Table 4.7, the respondents agreed that; The revenue collected has increased making the organization expand its operations (M=3.65, SD=1.348), The revenue collected has increased enabling the organization

to invest in new products or services (M=4.11, SD=0.890), The organization has a larger workforce that allows for a greater division of labor, enabling tasks to be allocated more efficiently and completed in a shorter amount of time (M=3.94, SD=1.060), The organization has a larger workforce that enhances the organization's ability to handle larger workloads and meet deadlines (M=3.57, SD=1.429), There is an increased customer base that enabled the organization to enjoy economies of scale (M=4.29, SD=0.709) and There is an increased customer base that has enabled the organization to increase its brand visibility and awareness (M=3.87, SD=0.529). Organizational performance is influenced by various factors, including financial stability, workforce retention, and customer engagement. In the context of NWSC, the effectiveness of smart water strategies can be assessed through key performance indicators such as the rate of change in revenue, employee turnover, and changes in customer share. A well-managed water utility that implements innovative water management solutions can enhance service delivery, reduce operational inefficiencies, and improve financial sustainability, ultimately leading to increased customer satisfaction and reduced workforce attrition.

These findings are consistent with Ribeiro and Silva (2020), who emphasized that smart water management enhances organizational adaptability and financial sustainability. Likewise, Santos et al. (2022) reported that smart technologies in water utilities not only improved operational efficiency but also enabled scalable service delivery in growing urban environments, supporting the evidence from NWSC.

4.5 Regression Analysis Results

Table 4.8: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.898 ^a	.806	.785	0.068

Source: Research Data (2024)

The results from the model summary, as presented in Table 4.8, show that the adjusted R-squared value was 0.785, indicating that 78.5% of the variation in organizational performance at Nairobi Water and Sewerage Company was influenced by innovation in water leak detection, customer service effectiveness in water billing tokens, and storage capacity location. This also highlights a gap of 21.5%, representing other factors not examined in the study.

Table 4.9: Analysis of Variance

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	210.512	3	70.171	94.473	.002
	Residual	70.562	95	0.751		
	Total	281.074	98			

Source: Research Data (2024)

The results presented in Table 4.9 indicate that the model was statistically significant, as evidenced by an F-statistical value of 70.109, which exceeds the statistical mean value of 52.628. Furthermore, the significance level of 0.002, being lower than the threshold of 0.05, confirms the model's reliability in assessing the impact of innovation in water leak detection, customer service efficiency in water billing token systems, and strategic storage capacity location on the organizational performance of NWSC.

Table 4.10: Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
	(Constant)	0.771	.215		3.586	.002
	Innovation of Water Leak Detection	0.851	.145	.3652	5.869	.001
	Customer Service Effective Water Billing Token	0.708	.351	.2145	2.017	.000
	Storage Capacity Location	0.654	.429	.1154	1.524	.001

Source: Research Data (2024)

Using the values generated, it is possible to create a multiple regression equation of the form:

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

Where Y = performance of NWSC in Nairobi city county, Kenya; X1 = Storage capacity location; X2 = Customer service effective water billing tokens; X3 = Innovation of water leak detection.

$$\text{Hence, } Y = 0.771 + 0.654X_1 + 0.708X_2 - 0.851X_3 + \varepsilon$$

According to the results provided in Table 4.10, the constant value of 0.771 represents the level of organizational performance at NWSC in Nairobi City County when innovation of water leak detection, customer service effective water billing token, and storage capacity location are held constant. The regression coefficients for innovation of water leak detection, customer service effective water billing token, and storage capacity location were 0.851, 0.708, and 0.654, respectively, indicating the extent to which each factor contributes to the improvement of organizational performance. Therefore, the regression equation is expressed as follows:

Organizational Performance = 0.771 + 0.851 (Innovation of Water Leak Detection) + 0.708 (Customer Service Effective Water Billing Token) + 0.654 (Storage Capacity Location)

The results further indicate that the beta value for innovation of water leak detection was ($\beta=0.3652$, $p<0.05$), customer service effective water billing token ($\beta=0.2145$, $p<0.05$), and storage capacity location ($\beta=0.1154$, $p<0.05$). Therefore, it was found that innovation of water leak detection, customer service effective water billing token, and storage capacity location had a positive significant influence on the organizational performance of Nairobi Water and Sewerage Company in Nairobi City County.

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The study's findings on how smart water techniques affect the performance of the Nairobi Water & Sewerage Company are summarized in this chapter. It also includes recommendations, findings, and ideas for additional research.

5.2 Summary of Findings

In terms of storage capacity and location, the study found that eliminating distribution inefficiencies and guaranteeing a steady water supply depend heavily on the strategic placement of storage facilities. Inconsistencies in supply caused by poorly situated storage facilities have an impact on customer satisfaction and service dependability.

On the other hand, strategically designed storage facilities aid in controlling peak demand, minimizing water shortages, and enhancing system performance in general.

The study also discovered that NWSC's performance is greatly influenced by customer service, namely the efficiency of water billing using token-based systems.

Smart billing systems increase revenue collection, decrease billing errors, and promote transparency. Consumers were more satisfied with real-time billing updates and convenient access to consumption records, which improved bill payment compliance and decreased dispute instances.

Lastly, the results showed that NWSC's operational sustainability and efficiency are greatly impacted by innovation in water leak detection. Leaks can be found and fixed more quickly because to the use of smart sensors, AI-driven monitoring, and automated warnings, which lowers operating expenses and water losses. By reducing waste and maximizing resource allocation, this invention not only strengthens water

conservation efforts but also boosts financial performance.

5.3 Conclusions of the Study

According to the study's findings, Nairobi Water & Sewerage Company's performance in Nairobi City County, Kenya, is greatly impacted by smart water techniques. Adoption of cutting-edge technologies, such smart meters, automated water management systems, and real-time monitoring, improves service delivery, lowers water losses, and increases operational efficiency. The company's total performance is positively impacted by these tactics since they improve resource utilization, lower costs, and increase revenue collection.

The study also discovered that a company's operational efficiency and service dependability are significantly impacted by the location of its storage capacity. Water storage facilities that are thoughtfully designed and positioned guarantee a steady supply, prevent losses from theft or leaks, and eliminate distribution inefficiencies. The results show that strategically placing reservoirs and tanks improves water accessibility, especially in areas with high demand, which eventually helps the business better serve customers and perform better overall.

The study came to the conclusion that prepaid water tokens and digital billing systems enhance customer satisfaction, revenue collection, and service effectiveness in relation to customer service. Using smart billing techniques guarantees on-time payments, improves transparency, and lowers fraud incidents. Real-time water usage updates for customers encourage accountability and prudent water use, which eventually improves the business's operational efficacy and financial sustainability.

Lastly, the study found that the Nairobi Water & Sewerage Company's performance is greatly impacted by innovation in water leak detection. Smart leak detection system installation reduces water waste, saves maintenance expenses, and improves service

dependability. Leaks should be found and fixed quickly to guarantee a continuous supply, cut down on non-revenue water, and boost overall effectiveness. The company's sustainability is improved and its capacity to supply Nairobi City County's expanding water demand is reinforced by this proactive approach to leak management.

5.4 Recommendations of the Study

Several suggestions to improve operational effectiveness and service delivery may be made in light of the study's results on smart water initiatives and organizational performance at Nairobi Water and Sewerage Company (NWSC).

First, in order to enhance overall performance, NWSC should use and incorporate cutting-edge smart water methods. By utilizing smart meters, automated water management systems, and predictive analytics, the business can improve revenue collection and water distribution efficiency by utilizing data-driven decision-making. The business should also spend money on real-time monitoring systems to quickly detect leaks and water loss, which will lower non-revenue water and enhance service sustainability.

Second, increasing water accessibility and supply reliability requires strategically placing water storage facilities. In order to ensure fair water distribution throughout Nairobi City County, NWSC should carry out feasibility studies to identify key sites for additional storage tanks and reservoirs. By increasing storage facilities' capacity and accessibility, the business can lower supply interruptions and raise customer satisfaction.

Thirdly, it is critical to enhance customer service by implementing efficient water billing and token-based payment systems. To reduce client complaints and conflicts,

NWSC should make sure that its billing processes are precise, open, and easy to use. Using mobile-based water tokens and digital payment systems can increase consumer convenience while increasing the effectiveness of revenue collection. Additionally, self-service choices and digital platforms for client participation can improve communication and service delivery.

Finally, cutting water losses and operating expenses requires innovation in water leak detection. To effectively identify and fix leaks, NWSC should implement contemporary leak detection technologies like satellite imaging, acoustic monitoring, and Internet of Things-based sensors. To stop leaks in the future, proactive infrastructure upgrades and regular maintenance plans should also be given top priority. The company's sustainability initiatives will be strengthened even more by promoting research and development in water-saving solutions.

5.5 Contribution to Knowledge

This study offers empirical evidence on the role of smart water strategies in enhancing organizational performance within a public utility context in a developing country. While most prior research has focused on utilities in developed regions, this study contextualizes the application of digital water solutions in the urban Kenyan environment, demonstrating their relevance and scalability in low-resource settings. By integrating operational technology into performance evaluation, the study provides a framework that future scholars and practitioners can build upon to assess efficiency, customer satisfaction, and infrastructure resilience in water service delivery. Furthermore, the findings extend theoretical application by linking the Resource-Based View (RBV) and Balanced Scorecard perspectives to smart infrastructure strategies, bridging a gap between theory and practice in utility management research.

5.6 Suggestions for Further Studies

Additional facets of smart water policies and their wider effects on organizational performance may be the subject of future studies. The contribution of new technologies like artificial intelligence (AI) and the Internet of Things (IoT) to improving water management effectiveness and lowering losses is one possible topic for additional research. To find out how to promote equal access to water services, future study might also look into the socioeconomic effects of smart water measures, especially on low-income households. An in-depth examination of how environmental sustainability and climate change affect the uptake and efficacy of smart water measures is another direction for future research. Researchers could also look at how regulatory actions and policy frameworks influence the adoption of smart water management techniques outside of Nairobi City County. Insights into best practices and obstacles in putting smart water initiatives into practice could also be gained from comparative studies involving other water utilities in Kenya or in other locations. Finally, to find out how well smart water efforts improve service delivery and operational performance, future research might evaluate consumer perception and satisfaction, especially with relation to digital billing systems and leak detection advances.

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APPENDICES

Appendix I: Letter of Introduction

Dear Respondent

Re: Request for Research Data

I am currently undertaking a study on the *'influence of smart water strategies on the performance of Nairobi Water & Sewerage Company in Nairobi City County Kenya'*. Please, go ahead and participate in this exercise by filling out the attached questionnaire. Assurances of confidentiality of information provided will be ensured, and if need be, a copy of this study shall be provided once the research is done.

Your assistance will be highly appreciated.

Appendix II: Questionnaire

Kindly tick [] where appropriate or fill in the required information in the spaces provided

Section A: Demographic Data

Indicate your Gender: [] Male [] Female

Indicate your age bracket.

[] Below 30 years [] 30 to 39 years [] 40 to 49 years [] 50 years

Indicate your highest level of education

[] Diploma

[] Post Graduate Diploma

[] Bachelors Degree

[] Master's Degree

Indicate your work experience:

[] Less than 5 years

[] 5-9 years

[] 10- 15 years

[] Above 15 Years

Section B: Storage Capacity Location

The following statements describe the influence of storage capacity location on the performance of Nairobi Water & Sewerage Company in Nairobi City County Kenya. Kindly indicate your level of agreement on each statement guided by the following Likert scale.

Strongly agree(SA)=5, Agree(A)=4, Undecided(U)=3, Disagree(D)=2, and Strongly Disagree(SD)=1.

Statement	1	2	3	4	5
Having a storage water capacity location allows the organization to have a reliable and consistent water supply.					

The organization can ensure that it always has an adequate supply of water, even during periods of drought or water scarcity by having a dedicated storage facility					
A storage water capacity location enables the organization to store water during times of excess supply					
The organization can mitigate the risk of water shortages during times of scarcity by storing water during periods of abundance					
Having a storage water capacity location allows the organization to take advantage of cost savings opportunities					
A storage water capacity location can enhance the organization's sustainability efforts.					

Section C: Customer Service Effective Water Billing Tokens

The following statements describe the influence of customer service effective water billing tokens on the performance of Nairobi Water & Sewerage Company in Nairobi City County Kenya. Please indicate with a tick your response to each of the following statements guided by the Likert scale below.

Where: 1 {Agree} 2. {Strongly Agree} 3. {Neutral} 4. {Disagree} 5. {Strongly Disagree}.

Statement	1	2	3	4	5
Efficient water billing tokens can greatly improve customer service by providing accurate and timely billing information to customers.					
Efficient water billing tokens help to build trust and transparency between the organization and its customers, leading to increased customer satisfaction and loyalty.					
The use of water billing tokens can streamline the billing process, reducing the likelihood of errors and disputes					
The use of water billing tokens saves time and resources for the organization, allowing them to focus on other important aspects of their operations					
Efficient water billing tokens can enhance the overall performance of an organization by improving customer service					
Efficient water billing tokens can enhance the overall performance of an organization by enhancing operational efficiency.					

Section D: Innovation of Water Leak Detection

The following statements describe how innovation of water leak detection influences the Nairobi Water & Sewerage Company's performance

Please indicate with a tick your response to each of the following statements guided by the Likert scale below. Where: 1 {Agree} 2. {Strongly Agree} 3. {Neutral} 4. {Disagree} 5. {Strongly Disagree}.

Statement	1	2	3	4	5
Cutting-edge water leak detection technology can help companies identify and locate leaks quickly and accurately.					
Innovative of water leak detection help the organization save money on costly repairs, water bills, and potential damage to infrastructure or equipment caused by water leaks.					
Innovative of water leak detection enable companies to monitor their water usage and identify areas of improvement.					
Innovative of water leak detection help companies maintain the integrity of their assets and ensure uninterrupted operations					
Innovative of water leak detection allow the organization to collect and analyze data on water usage, leak patterns, and trends.					
Innovative of water leak detection help identify leaks early on, preventing the growth of these hazards and ensuring a safe and healthy working environment.					

Section E: Performance

The following statements describe the performance of Nairobi Water & Sewerage Company in Nairobi City County Kenya. Kindly indicate your level of agreement on each statement guided by the following Likert scale. Strongly agree (SA)=5,

Statement	1	2	3	4	5
The revenue collected has increased making the organization expand its operations					
The revenue collected has increased enabling the organization to invest in new products or services					
The organization has a larger workforce that allows for a greater division of labor, enabling tasks to be allocated more efficiently and completed in a shorter amount of time.					
The organization has a larger workforce that enhances the organization's ability to handle larger workloads and meet deadlines					
There is an increased customer base that has enabled the organization to increase its brand visibility and awareness.					
There is an increased customer base that enabled the organization to enjoy economies of scale					

Agree(A)=4, Disagree(D)=2,

The National Commission for Science, Technology and Innovation, hereafter referred to as the Commission, was established under the Science, Technology and Innovation Act 2013 (Revised 2014) herein after referred to as the Act. The objective of the Commission shall be to regulate and assure quality in the science, technology and innovation sector and advise the Government in matters related thereto.

CONDITIONS OF THE RESEARCH LICENSE

1. The License is granted subject to provisions of the Constitution of Kenya, the Science, Technology and Innovation Act, and other relevant laws, policies and regulations. Accordingly, the licensee shall adhere to such procedures, standards, code of ethics and guidelines as may be prescribed by regulations made under the Act, or prescribed by provisions of International treaties of which Kenya is a signatory to.
2. The research and its related activities as well as outcomes shall be beneficial to the country and shall not in any way;
 - i. Endanger national security
 - ii. Adversely affect the lives of Kenyans
 - iii. Be in contravention of Kenya's international obligations including Biological Weapons Convention (BWC), Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO), Chemical, Biological, Radiological and Nuclear (CBRN).
 - iv. Result in exploitation of intellectual property rights of communities in Kenya
 - v. Adversely affect the environment
 - vi. Adversely affect the rights of communities
 - vii. Endanger public safety and national cohesion
 - viii. Plagiarize someone else's work
3. The License is valid for the proposed research, location and specified period.
4. Neither the license nor any rights thereunder are transferable.
5. The Commission reserves the right to cancel the research at any time during the research period if in the opinion of the Commission the research is not implemented in conformity with the provisions of the Act or any other written law.
6. The Licensee shall inform the relevant County Director of Education, County Commissioner and County Governor before commencement of the research.
7. Excavation, filming, movement, and collection of specimens are subject to further necessary clearance from relevant Government Agencies.
8. The License does not give authority to transfer research materials.
9. The Commission may monitor and evaluate the licensed research project for the purpose of assessing and evaluating compliance with the conditions of the License.
10. The Licensee shall submit one hard copy, and upload a soft copy of their final report (thesis) onto a platform designated by the Commission within one year of completion of the research.
11. The Commission reserves the right to modify the conditions of the License including cancellation without prior notice.
12. Research, findings and information regarding research systems shall be stored or disseminated, utilized or applied in such a manner as may be prescribed by the Commission from time to time.
13. The Licensee shall disclose to the Commission, the relevant Institutional Scientific and Ethical Review Committee, and the relevant national agencies any inventions and discoveries that are of National strategic importance.
14. The Commission shall have powers to acquire from any person the right in, or to, any scientific innovation, invention or patent of strategic importance to the country.
15. Relevant Institutional Scientific and Ethical Review Committee shall monitor and evaluate the research periodically, and make a report of its findings to the Commission for necessary action.

National Commission for Science, Technology and
Innovation(NACOSTI),
Off Waiyaki Way, Upper Kabete,
P. O. Box 30623 - 00100 Nairobi, KENYA
Telephone: 020 4007000, 0713788787, 0735404245
E-mail: dg@nacosti.go.ke
Website: www.nacosti.go.ke

Appendix IV: Research Approval Letter from Kenyatta University



KENYATTA UNIVERSITY GRADUATE SCHOOL

E-mail: dean-graduate@ku.ac.ke

Website: www.ku.ac.ke

P.O. Box 43844, 00100
NAIROBI, KENYA
Tel. 810901 Ext. 4150

Internal Memo

FROM: Executive Dean, Graduate School

DATE: 24th January, 2025

TO: Oscar Andrew Waweru
C/o Business Administration Dept.

REF: D53/OL/CTY/22295/2022

SUBJECT: APPROVAL OF RESEARCH PROJECT PROPOSAL

This is to inform you that Graduate School Board at its meeting of 15th January, 2025 approved your Research Project Proposal for the M.B.A Degree Entitled, "Smart Water Strategies and Organizational Performance: A Case of Nairobi Water and Sewerage Company in Nairobi City County, Kenya."

You may now proceed with your Data Collection, Subject to Clearance with Director General, National Commission for Science, Technology and Innovation.

As you embark on your data collection, please note that you will be required to submit to Graduate School completed Supervision Tracking and progress report Forms per semester. The Forms are available at the University's Website under Graduate School webpage downloads.

Also, please ensure that you publish article(s) from your project before submitting it to Graduate School for examination as per the Commission for University Education and Kenyatta University guidelines.

Thank you.

ANNBELL MWANIKI
FOR: EXECUTIVE DEAN, GRADUATE SCHOOL

c.c. Chairman, Business Administration.

Supervisors:

1. Dr. Janesther Karuga
C/o Department of Business Administration
Kenyatta University

AM/mw



Appendix IV: Research Authorization Letter from Kenyatta University



**KENYATTA UNIVERSITY
GRADUATE SCHOOL**

E-mail: dean-graduate@ku.ac.ke

Website: www.ku.ac.ke

P.O. Box 43844, 00100
NAIROBI, KENYA
Tel. 8710901 Ext. 57530

Our Ref: D53/OL/CTY/22295/2022

DATE: 24th January, 2025

Director General,
National Commission for Science, Technology
and Innovation
P.O. Box 30623-00100
NAIROBI

Dear Sir/Madam,

RE: RESEARCH AUTHORIZATION FOR OSCAR ANDREW WAWERU – REG. NO. D53/OL/CTY/22295/2022

I write to introduce **Oscar Andrew Waweru** who is a Postgraduate Student of this University. The student is registered for M.B.A degree programme in the **Department of Business Administration**.

Oscar intends to conduct research for a M.B.A Project Proposal entitled, **“Smart Water Strategies and Organizational Performance: A Case of Nairobi Water and Sewerage Company in Nairobi City County, Kenya.”**

Any assistance given will be highly appreciated.

Yours faithfully,

**PROF. ELIUD NJAGI
EXECUTIVE DEAN, GRADUATE SCHOOL**

AM/wo

Transforming Higher Education... Enhancing Lives
Kenyatta University is ISO 9001:2015 Certified



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