



Water Utility Digitalisation in Low- and Middle-Income Countries

Experiences from the
Kenyan water sector



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Water and Sanitation for the Urban Poor (WSUP) is a not-for-profit company headquartered in the UK with an embedded presence in seven countries in Sub-Saharan Africa and Asia. WSUP is a global leader in the provision of urban water, sanitation and hygiene services to underserved residents. In the last 16 years WSUP's work has benefited over 25 million people.

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Foreword

Kenya has witnessed an increasing focus on digital services across sectors coupled with transformational developments in digital technologies themselves. Together, these developments are engendering dramatic new opportunities for water and sanitation service innovation.

With the ongoing COVID-19 crisis, Kenyan water utilities are demonstrating more than ever that they are evolving to digitalise systems, and providing an essential service with a level of commitment that is all too often ignored. The current Covid-related situation is exceptional in its unpredictability and magnitude, highlighting the need for water utilities to be agile in case of crisis, and post-crisis. Those utilities equipped with digital technologies have a wider range of tools at their disposal to react and mitigate risks.

WASREB continues to execute its mandate of protecting the interests and rights of all in the provision of water and sanitation services, while ensuring other stakeholders' interests are safeguarded. WASREB and the licenced water utilities are operating in a rapidly changing technological environment. The rate of emerging technologies in information systems, mobile technologies and smart water and sanitation management systems will require WASREB to not only adopt the affordable technology, but also guide the sector in keeping up with the technologies that will easily be scaled up and yield value for money.

This study is both timely and important, as it explicitly outlines the utility digitalisation journeys, critical factors in digitalisation, lessons, and opportunities for the water and sanitation service providers in Nairobi, Kisumu, Nakuru and Malindi. Fully understanding these opportunities challenges WASREB to question conventional approaches that construe service as a distinctive form of socio-economic exchange and to reconsider what service means and thus how service innovation may develop through enhancing utility digitalisation.

WASREB proposes to review its Consumer Engagement Guidelines to incorporate regulatory enablers for digitalisation of utility core functions geared towards enhanced customer experience. The regulator also proposes to foster business-to-business collaborations between utilities and technology providers, to collaborate on technologies that support utilities reduce losses and increase transparency.



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Abbreviations

AI	Artificial Intelligence	NCWSC	Nairobi City Water and Sewerage Company
CRM	Customer Relationship Management	NRW	Non-Revenue Water
ERP	Enterprise Resource Planning	O&M	Operations and Maintenance
GIS	Geographic Information System	PAYG	Pay-As-You-Go
ICT	Information and Communications Technology	SCADA	Supervisory Control and Data Acquisition
IoT	Internet of Things	USD	United States Dollar
IWA	International Water Association	USSD	Unstructured Supplementary Service Data
KSh	Kenyan Shilling	WASREB	Water Services Regulatory Board
KIWASCO	Kisumu Water and Sanitation Company	WSP	Water Service Provider
KPI	Key Performance Indicator	WSTF	Water Sector Trust Fund
LMIC	Low- and Middle-Income Country	WSUP	Water and Sanitation for the Urban Poor
MAWASCO	Malindi Water and Sanitation Company	WWDA	Water Works Development Agency
NAWASSCO	Nakuru Water and Sanitation Services Company		



Executive Summary

Digitalisation in the water sector

Many leaders in the water sector view digitalisation not as a choice, but an imperative. Digital solutions enable utility managers to meet the coming challenges of rapid urbanisation and climate change while also tackling long-standing sector challenges related to water losses and financial stability.

Digital solutions in water are transforming how utilities and customers interact. Mobile money is a game changer for revenue collection while IoT devices have created new ways to monitor water services and automate processes. Combined with mobile payments, IoT devices enable pay-as-you-go (PAYG) service models, and smart metering has become a clear use case. Finally, digital platforms and enterprise resource planning (ERP) apps are supporting more effective utility management and providing a foundation for digitalisation across utility operations.

Mobile services are critical to many of these services, making mobile operators natural partners for utility services. Utilities verticals have emerged as a key use case for IoT devices, and many mobile operators are looking beyond integrations to become more active players as part of their revenue diversification strategies.

In the water sector, most research on digitalisation has focused on high-income country contexts and solutions. This bias has overlooked important differences in the complexity of water systems, digital payments architecture, availability of finance and inherent complexities in serving dense low-income neighbourhoods, and draws attention away from where digital solutions could have the greatest impact.

This report aims to address this evidence gap by examining the digitalisation journeys of four Kenyan water utilities. Through detailed case studies and interviews with key players in the water sector, we identify important lessons and opportunities.

Utility digitalisation journeys

The four utilities in this research serve three of Kenya's four largest cities. Combined, they are responsible for the water services of more than six million people, employ over 4,000 people and have an annual turnover of 11 billion Kenyan Shillings (about \$104 million). In short, they are some of the larger and better-performing water utilities in Kenya, which is important context for the findings.

Early stages of utilities digitalisation in Kenya generally focused on payments, meter reading and billing. All utilities integrated with Safaricom's PayBill platform in the early 2010s and two have since moved to fully cashless operations.

Between 2015 and 2019, the focus shifted to building customer relationships and engagement, including a web and social media presence. Many utilities also began piloting smart meters or smart-ready meters, and GIS mapping their customers.

More recently, utilities have been working on overhauling ERP systems and deploying smart meters for household connections and kiosks on a larger scale.

Critical factors for utility digitalisation

The research revealed five critical factors for utility digitalisation, which can be barriers or enablers depending on how they are addressed.

- Organisational culture and staff attitudes.** All utility managers interviewed stressed that engaging staff in change processes was critical to success, especially when the introduction of a digital solution changes or displaces jobs. This often requires strong leadership from senior management.
- Funding and financing.** While the availability of funding and financing was identified as a constraint, there were positive signs, particularly that utilities are engaging in innovative, digitally enabled financing models based around revenue share.
- Connectivity and payments.** Kenya's position as a leading mobile money market enabled many utilities to adopt mobile payments early. This meant cash offices could be closed with minimal impact on customers.
- Relationships with technology providers.** None of the utility managers interviewed identified specific challenges with finding suitable technology providers, and generally felt that providers understood their needs. However, utilities did report sourcing some hardware has been a challenge, as well as having good price benchmarking data to assess financial proposals. Technology providers, meanwhile, indicated that the speed at which utilities can make decisions can be a challenge, and that these long decision timelines can act as a break on progress. Long payment cycles have also presented challenges for some providers.
- Governance and strategy.** The most recent strategic plans of the utilities all clearly address digitalisation. However, financial details for these initiatives are lacking and none have a specific digitalisation strategy or business plan. Though the Kenyan water sector has strong regulation and sector monitoring, stronger guidance on digitalisation could be provided to utilities, as well as opportunities to share lessons.





Key lessons

Four key lessons emerged from our analysis and are applicable to utilities at early stages of digitalisation.

- Investing progressively in digitalisation is vital.** Making progress digitalising multiple areas of utility operations is critical to reaping the full benefits in any one area. For example, efficiencies in meter reading will only be realised when they are linked to more efficient billing and mobile payment processes.
- Digitalising core functions first can deliver quick wins.** For utilities, this is most evident in metering and billing and in customer relationships. These are also the areas most likely to improve cash flow and support better customer experiences and relationships.
- When a new technology changes jobs and roles, there needs to be a plan in place for staff retraining or redeployment.** This is critical to shaping a vision of digitalisation and reassuring staff that they have trust in their job security. Effective redeployment is also critical to reaping the benefits of more efficient processes. These transitions need to be supported by senior leadership so that digitalisation can be incorporated in broader change processes and staff feel that reassurances are credible.
- Investment in digital systems must occur alongside the digitalisation of operations or functions.** Utilities that had recently made investments in their ERP systems stressed that this was vital to realising the benefits of their various digitalisation initiatives.

Key opportunities

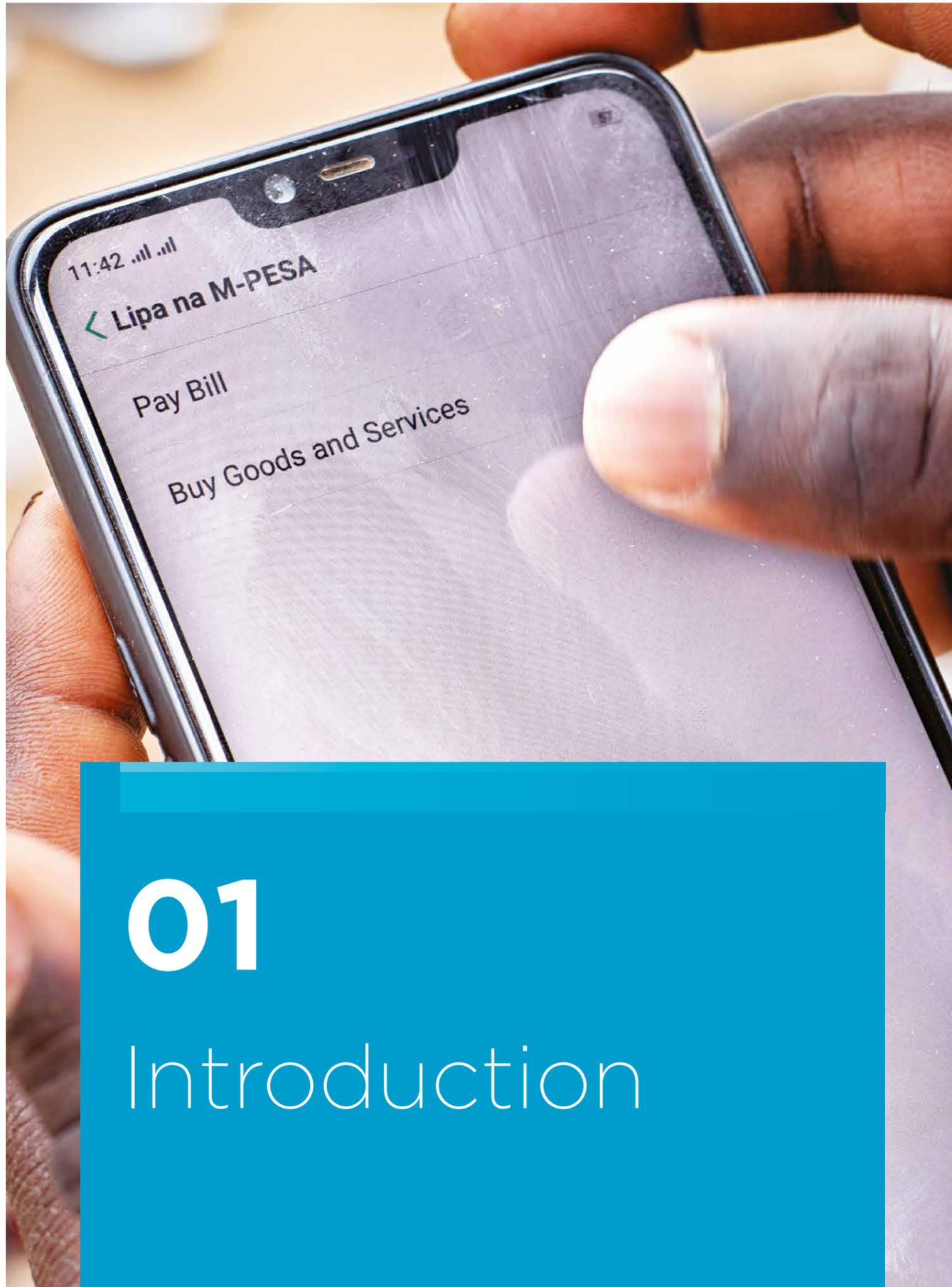
The research team identified five key opportunities for utilities based on their stated objectives and actions that are likely to overcome some of their main constraints.

- Peer learning between utilities. In many cases, the experience of one utility holds lessons for others.** This extends to sharing information on market offerings and price and quality benchmarks. This is a clear opportunity in the Kenyan water sector, but also applies in other low- and middle-income country (LMIC) contexts.
- Documenting the pros and cons and the costs of digitalisation initiatives.** This documentation should also be codified in regulatory guidance for the sector. Robust data on the benefits of digitalisation is still relatively limited. Documenting and sharing this data between utilities would help to inform investment decisions.
- Advanced metering (including PAYG solutions) and network monitoring and control.** These are the technologies most likely to address non-revenue water (NRW) losses, which are still primarily managed manually.
- Digitally enabled financing solutions for financiers, innovators and utilities.** Innovative and flexible financing is already underway as new players emerge and new funds are developed by existing players.
- Stronger partnerships with mobile operators.** Many of the digital solutions discussed in this report have mobile services at their core, including mobile payments, smart metering and network monitoring. This makes mobile operators important partners for utilities. In Kenya, this opportunity is exemplified by Safaricom's move into the smart metering space.

This report seeks to fill the evidence gap in utility digitalisation in LMICs. The case studies detail the extent of digitalisation in the utility sector and the scope for opportunity. Kenya is home to some of the larger and better-performing utilities and the experience of the water sector can provide guidance to utilities in other LMICs seeking to digitalise their operations.

More research is needed in other contexts and the lessons need to be better documented and shared. With many utilities in LMICs at an early stage of digitalisation, the opportunity is enormous.





01

Introduction

TABLE 1

Key global water sector and utility challenges

Challenge	Extent
Macro trends	
 Climate change and additional pressures on water resources	<ul style="list-style-type: none"> 17 countries, home to a quarter of the world's population, already face 'extremely high' water stress.¹ Climate change is set to exacerbate water stress, with water crises consistently ranked in the top five global risks by impact.² Many cities are facing the real threat of running out of water, as seen in Durban (2018) and Chennai (2019). Recent World Bank research has found that water shortages are linked to 10 per cent of the rise in global migration.³
 Rapid urbanisation and the need for water services in cities	<ul style="list-style-type: none"> 90 per cent of the growth in urban populations between now and 2050 is expected to be in African and Asian cities.⁴ In Sub-Saharan Africa, where most this growth will be, just more than half of urban residents have access to safely managed water services.⁵
Utility	
 High water losses due to leaks	<ul style="list-style-type: none"> Non-revenue water (NRW) is the difference between water that is produced and water that is billed for. The global volume of NRW has been estimated at 364 million cubic metres per day, equivalent to \$39 billion per year.⁶ In Kenya, NRW is 42 per cent, on average. That is, 42 per cent of water produced is either lost or not billed for.
 Financial sustainability	<ul style="list-style-type: none"> Many utilities are facing extreme financial pressures. According to the most comprehensive global data, only 35 per cent are generating sufficient revenue to cover operation and maintenance (O&M) costs.⁷ These pressures leave utilities with little room to invest in new infrastructure as they struggle to keep ageing infrastructure operational.

Source: List of challenges compiled by authors, various sources

Digitalisation is high on the agenda of the water sector, and rightly so. With digital tools and solutions giving utility managers the chance to tackle some of the most long-standing and pressing challenges in the sector (see Table 1), many sector leaders view digital

transformation not as a choice, but an imperative.⁸ An annual survey of industry leaders by the Water Policy Group revealed that climate change is the number one issue of concern, followed closely by the pressures of rising demand for water.⁹

1. World Resources Institute. (6 August 2019). "Release: Updated Global Water Risk Atlas Reveals Top Water-Stressed Countries and States".
 2. Based on the World Economic Forum's Global Risk Perception Survey. See: http://www3.weforum.org/docs/WEF_The_Global_Risks_Report_2021.pdf
 3. The World Bank. (23 August 2021). Ebb and Flow: Water, Migration, and Development.
 4. United Nations Department of Economic and Social Affairs. (2018). World Urbanization Prospects.
 5. Authors' analysis of WHO/UNICEF JMP data. See: <https://washdata.org/data/household#/dashboard/new>. Accessed September 2021.
 6. Liemberger, R. and Wyatt, A. (2019). "Quantifying the global non-revenue water problem". Water Supply, 19(3), pp. 831-837.
 7. Authors' analysis of IBNET data. See: <https://www.ib-net.org/>. Accessed September 2021.
 8. Sarni, W. et al. (2019). Digital Water: Industry Leaders Chart the Transformation Journey. The International Water Association and Xylem.
 9. Water Policy Group. (2021). Global Water Policy Report: Listening to National Water Leaders.

According to a Global Water Intelligence survey of utility leaders, the return on investment (ROI) in digital infrastructure is between three per cent and 34 per cent, depending on the technology.¹⁰ The social return on these investments includes reaching those without utility services with innovative service models and investing the savings from efficiencies in extending services. The aim of all utilities is to provide a continuous and safe water supply to customers, and digital technologies enable utilities to build new communication bridges to customers and improve services, creating a virtuous cycle of customer trust, willingness to pay and more sustainable services. Figure 1 provides an overview of some of the key digital solutions in urban water and their common use cases.

Many of these solutions rely on services provided by mobile operators. This is most clearly the case with mobile money and payments, especially in Kenya where mobile payments are so widespread. However, there are also much deeper synergies. As mobile operators develop their IoT networks and offerings, utility services stand out as a clear use case. With so much of the world dependent on mobile data for access to the internet, utility customer engagement in LMICs is increasingly designed with mobile users in mind.

Most of the attention to water sector digitalisation has been overwhelmingly on high-income country contexts. Research in the sector tends to draw on insights from utility managers in these contexts and focus on advanced technical solutions suited to the water infrastructure,¹¹ challenges and digital infrastructure in high-income countries. A recent systematic review¹² of digital innovation in LMICs found that evidence is only just emerging, and good-quality evidence on the impacts of digital innovations is particularly scarce.

Digital innovation in LMICs is very different, both in terms of the challenges these innovations can address and the environments in which they need to operate. There are critical differences in the complexity of water systems, the digital payments architecture, the availability of

finance for utilities and the complexities inherent in serving dense, low-income neighbourhoods. This report aims to address this evidence gap by examining the digitalisation journeys of four Kenyan water utilities.

There are many ways to conceptualise utility digitalisation, but it begins with an examination of the technologies and how they are applied in water services. In examining the journeys of the Kenyan utilities, we considered six technology “domains” (see Figure 2) that were used to guide questions about the utilities experience with digitalisation.

1.1 Methodology

This research documents the process of utility digitalisation and adoption of digital solutions through in-depth case studies of four water utilities in Kenya: the Kisumu Water and Sanitation Company (KIWASCO), Malindi Water and Sewerage Company (MAWASCO), Nairobi City Water and Sewerage Company (NCWSC) and Nakuru Water and Sanitation Services Company (NAWASSCO)¹³. The utilities were selected based on their size and recent efforts to digitalise their operations. The research was guided by three overarching research questions:

1. What has been the experience of utilities with digitalisation to date?
2. What are the key priorities for digitalisation in the short- to medium-term?
3. What are the key constraints and enablers surrounding digitalisation?

The findings of the research are based on 40 interviews with utility staff, the technology partners they work with, mobile operators, the Kenyan water regulator and other key actors in the sector. These interviews were supplemented by a review of the utilities’ strategies and relevant literature.

FIGURE 1

Key digital solutions in urban water

Solutions	Use cases
Voice, SMS and USSD functions	Mobile services create a communication bridge between utilities and customers that makes it easier to register and resolve complaints. These tools enable utilities to inform customers of maintenance work or issue disconnection notices, allowing customers to pay promptly and avoid disconnection.
Pay-as-you-go (PAYG)	Mobile-enabled PAYG services allow customers to make micropayments in advance for water services, and guarantee revenue collection for water service providers. Applications include business models for energy, water, sanitation and clean cooking appliances.
Smart metering	Automatic meter reading is essential for gaining efficiencies in billing as it records consumption and key operational data, and eliminates the time, costs, and errors of manual meter reading. Other uses are post-paid models or water ATMs.
IoT/ M2M connectivity and GIS tracking	Smart monitoring of system performance can improve operational efficiency and avoid the technical losses that contribute to NRW. This is essential in the deployment of real-time data systems, for example, in leak detection, inaccurate meters and fraud.
Big data, AI and machine learning	The use of large data sets to improve decision making and implement algorithmic automation to optimise utility operations. For example, programming pumping to take place when grid energy prices are low.
Augmented reality and virtual reality tools	Combined with remote sensing, these tools create ‘digital twins’ that eliminate the need to travel to a site to identify and resolve issues, and allow remote management of network infrastructure in real time.

10. Leaing Utilities of the World. (2019). Accelerating the digital water utility.

11. Often highly centralised water systems that combine the provision of water and wastewater management.

12. Amankwaa, G., Heeks, R. and Browne, A.L. (2021). "Digital innovations and water services in cities of the global South: A systematic literature review". Water Alternatives. 14(2), pp. 619-644.

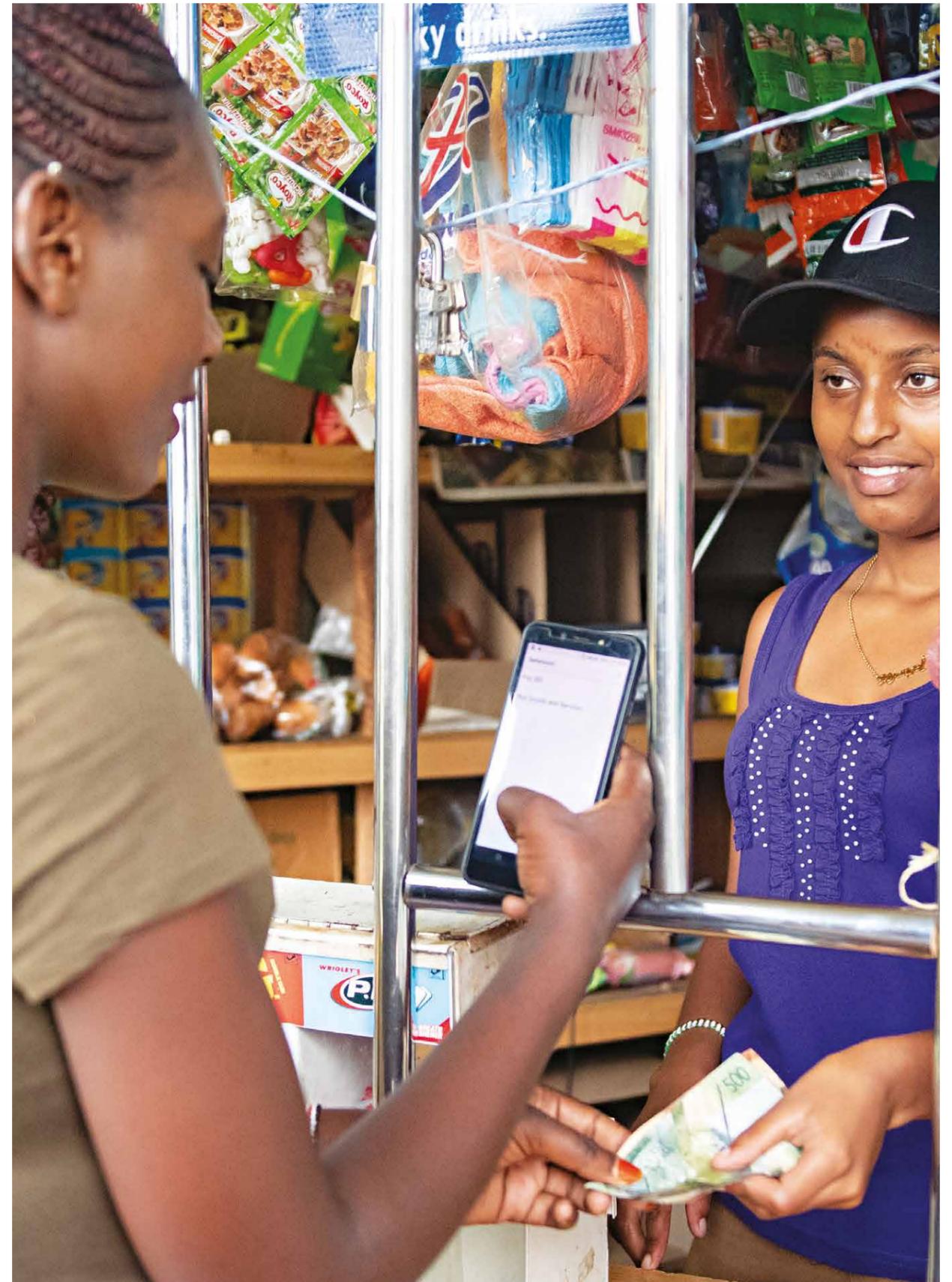
13. Please note: for the remainder of the report the utilities are referred to by their city name as opposed to the full utility acronym.

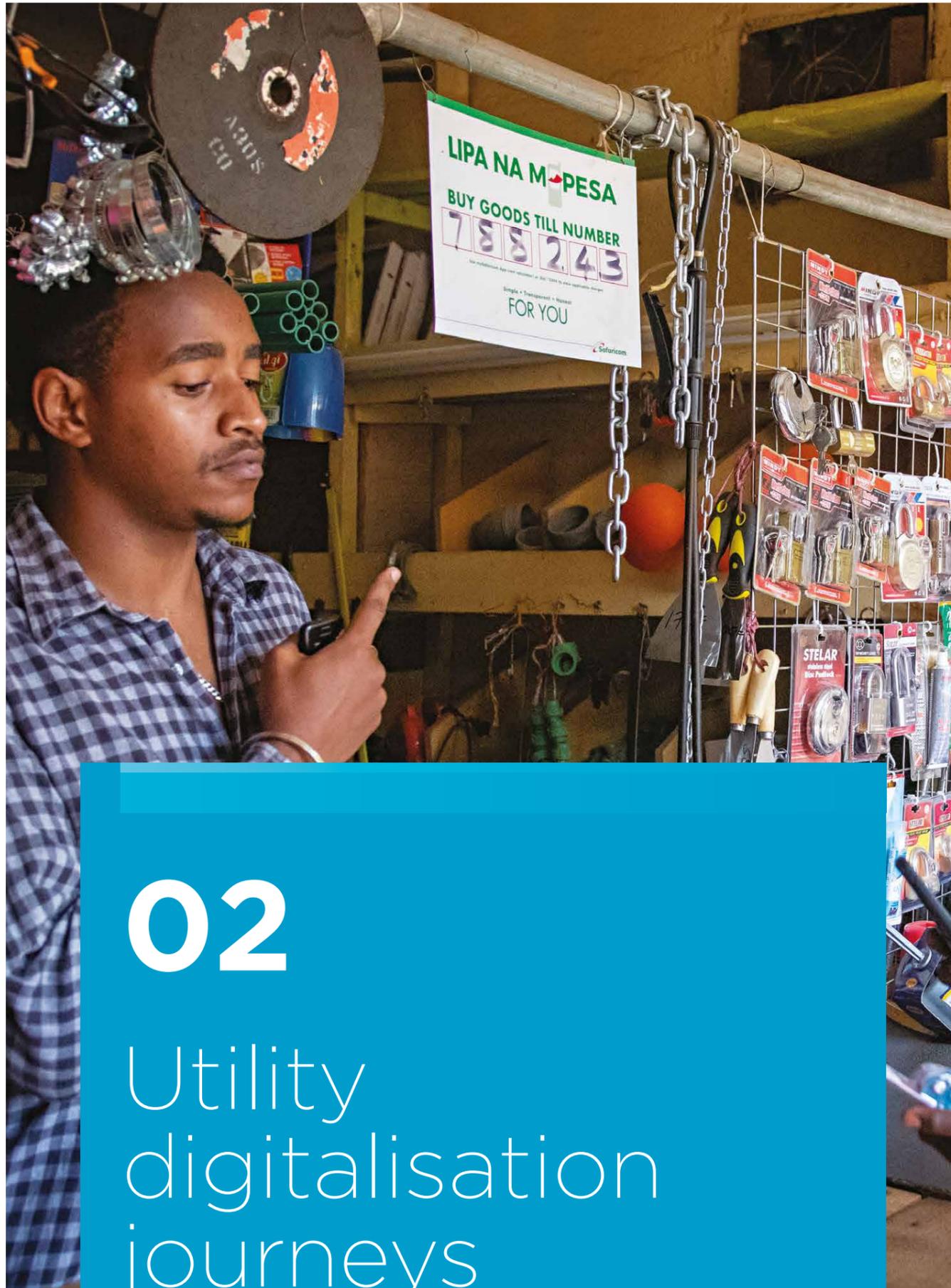


FIGURE 2

Key technology domains considered

Customer relationships		Tools that modify customer-utility relationships (e.g. <i>billing and payments, customer complaints and social media engagement on services</i>).
Data acquisition and integration		The infrastructure needed for digital data collection (e.g. <i>sensor networks, smart pipes, smart meters and data collected using mobile devices and other tools</i>).
Connectivity and network infrastructure		The availability of suitable network infrastructure for communication and the communication infrastructure used (e.g. <i>radio transmitters, wireless fidelity (Wi-Fi), internet, voice, SMS, USSD and data services</i>).
Data processing and storage		The systems and processes used to manage data from different sources (e.g. <i>ERP systems, cloud computing</i>).
Management and control		Technologies that use two-way control to allow for remote operation (e.g. <i>supervisory control and data acquisition (SCADA) and IoT solutions that allow for process automation and optimisation tools</i>).
Modelling and analytics		The combination of data sets to produce specific analytics (e.g. <i>GIS data on assets and customers</i>) and tools used to present data for decision-making (e.g. <i>web-based communication and information systems tools, and dashboards with key company information</i>).





02

Utility digitalisation journeys

This section examines the digitalisation journeys of the four utilities, beginning with a discussion of past digitalisation initiatives in the sector and the contexts in which the utilities operate. It then examines digitalisation by technology domain (as outlined in the previous section) before turning to how the utilities staged and rolled out their digitalisation initiatives. Further details on their journeys can be found in the Appendix.

2.1 Responsibility for water services in Kenya

In Kenya, water services are delivered by 91 water service providers (WSPs). Three of the WSPs are privately owned and the remaining 88 are state owned. The WSPs operate under service provision agreements signed with the independent national regulator, the Water Services Regulatory Board (WASREB). The respective county governments own the assets managed by the WSPs and are responsible for managing the water supplies in their jurisdiction. The WSPs, and the tariffs under which they operate, are regulated by WASREB.

2.2 Digitalisation in the Kenyan water sector

Since 2012, there have been several national-level initiatives to digitalise WSP reporting to WASREB. These include:

- **MajiVoice** – developed in 2012 and rolled out in 2013. MajiVoice is the central complaint system of WASREB, developed by past GSMA grantee Wonderkid. Complaints are logged via USSD, SMS, a URL or the complaints portal on the MajiVoice website.
- **WARIS (Water Regulation Information System)** – WARIS is a reporting and monitoring software first introduced in 2006 and refined several times since. WARIS 3.0 uses a central database and has both an online/web-based version and an offline option for WSPs with limited internet connectivity. WARIS is operated by WASREB and collects key performance indicator (KPI) data on utilities for regulatory reporting.

- **MajiData** – launched in 2011, the MajiData (<http://majidata.go.ke/>) database on all urban low-income areas in Kenya includes utility performance data from WASREB, Water Services Trust Fund (WSTF) investments in urban areas and WSPs. This data is publicly accessible.

There are other innovations in Kenya's water sector that have been adopted by many WSPs, including:

- **Jisomee Mita** – a web-based ICT platform that enables consumers to submit queries and receive and pay their water bills (in use since 2014).
- **Mobile Field Assistant/mobile meter reading** – the Mobile Field Assistant uses smartphones to collect information on georeferences, meter readings and household locations. It supports extended work process functions, for example, an automatic routing system that generates route plans for meter readers.
- **GIS applications** – various organisations (WASPA, KEWI, JICA, GIZ) have projects with a range of WSPs.

2.3 Utility contexts

The four utilities in this research are responsible for the water services of more than 6.1 million people (people living in their regulated service areas) and 4.9 million customers (those with water access managed by the utility). Combined, they have an annual turnover of more than 11 billion Kenyan Shillings (KSh) (-\$104 million) and employ more than 4,000 people (additional details on the utilities and their KPIs can be found in the Appendix). The four utilities are among the largest and highest performing utilities in the country. Figure 3 maps the size of the utilities against their WASREB performance ranking for 2020–21.

The four utilities collect revenues that cover between 99 per cent and 111 per cent of their operating costs. Kisumu, Nairobi and Malindi are below the 110 per cent threshold set by WASREB as the minimum needed to ensure service delivery can be maintained, and all utilities are below the 150 per cent target set by WASREB. These figures show that although revenue collection is better than the national average of 90 per cent, the four utilities have relatively little fiscal space for investment as most of their revenues cover operating expenses.



TABLE 2

Key data on utilities

	Population		Turnover		Staff employed
	In service area	Served	KSh (millions)	USD (millions)	
Kisumu	457,000	388,000	834	7.5	330
Malindi	525,000	372,000	446	4.0	206
Nairobi	4,633,000	3,640,000	9,177	83.0	3335
Nakuru	534,000	487,000	1,004	9.1	214
Total	6,148,000	4,887,000	11,461	104	4,085

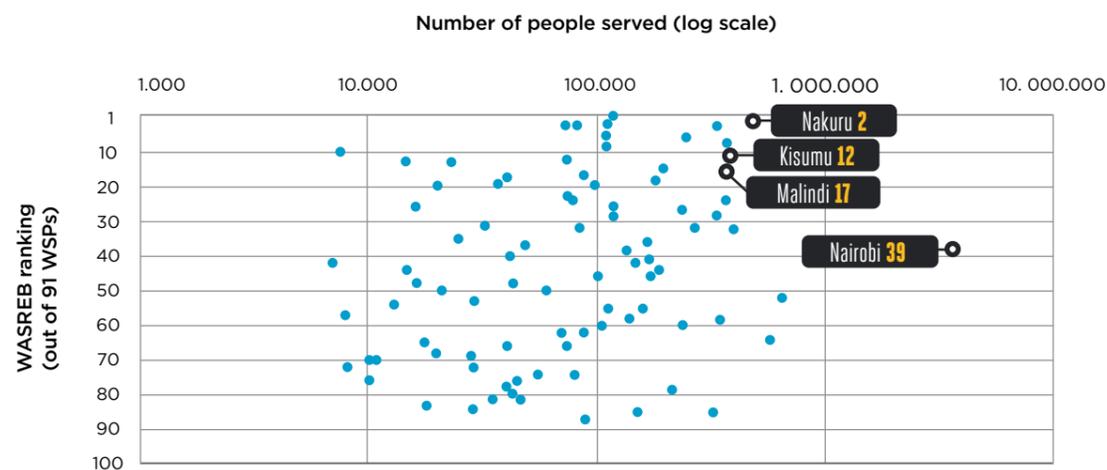
Source: WASREB data

Non-revenue water (NRW) is a key measure of a utility's performance. NRW represents the difference between the amount of water that is produced and the amount that is billed for. The difference can be explained by leaks in the network (known as real or technical losses), unauthorised connections or water not being billed (known as apparent or commercial losses).

WASREB has set a target for utilities to reduce NRW to 25 per cent. Of the four utilities, only Malindi has managed to achieve that target. Nakuru and Kisumu have made considerable progress in reducing NRW in recent years, but are still above the target. Nairobi, meanwhile, has recently seen a steep increase in NRW. For all the utilities, there is still progress to be made on controlling water lost in the network, either due to leaks, inaccurate billing or theft.

FIGURE 3

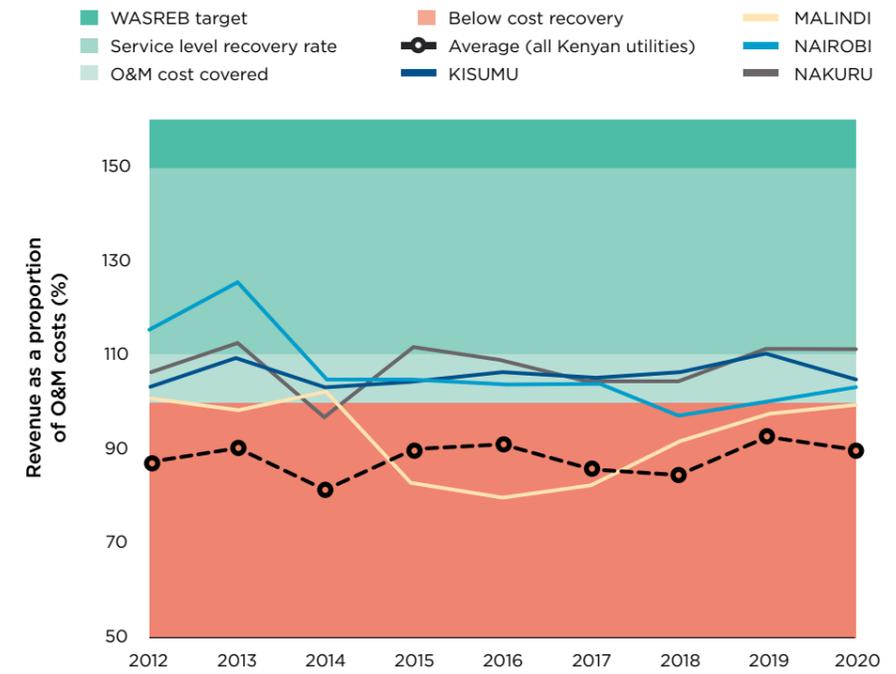
Utility size and WASREB performance ranking



Source: WASREB data

FIGURE 4

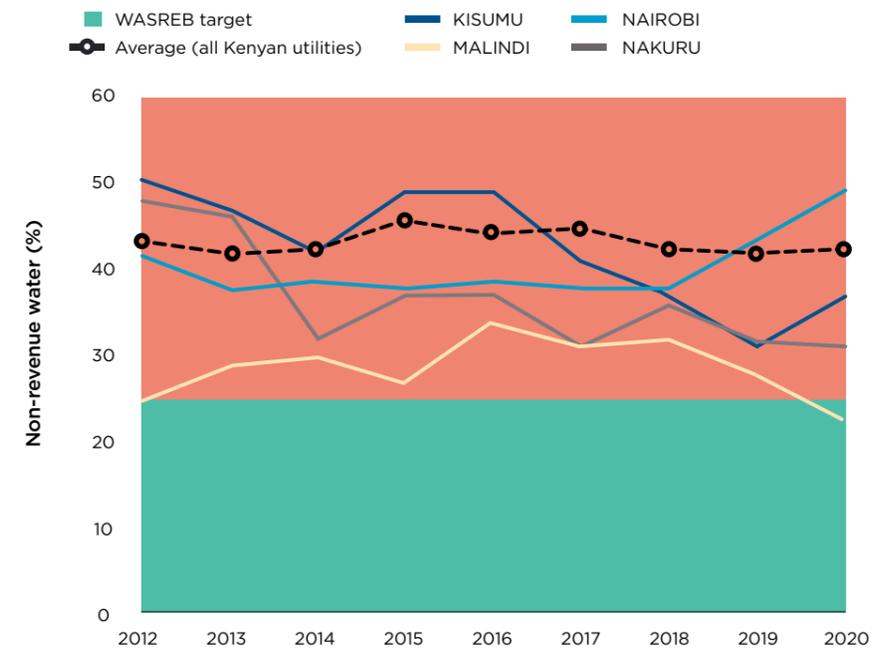
Revenue as a proportion of operation and maintenance (O&M) costs



Source: WASREB data

FIGURE 5

Non-revenue water



Source: WASREB data



2.4 Digitalisation journeys

All the utilities are either in the process of, or have completed, GIS mapping of their core infrastructure. Another major area of focus is the deployment of ERP systems, with Nakuru and Kisumu deploying new ERPs within the last two years. Areas that have received comparatively less attention are IoT deployments and the use of sensors in the network, process automation and investments in data visualisation and decision support. The extent of digitalisation within each domain is discussed in more detail in the later part of this section.

2.4.1 Digitalising customer relationships

All four utilities use mobile payments and have done so for many years, with initial integrations with mobile money payments starting in the early 2010s. This is due to the comparatively early development of the Kenyan mobile money ecosystem. Recently, the utilities have pivoted away from cash – Kisumu closed their cash offices in 2018 and Malindi in 2019 – and payments are now only accepted via mobile money or at payment points in banks. Although Nairobi has closed many payment points across the city in recent years, it continues to accept cash in some locations.

For several of the utilities, the mobile payments journey began with accepting payments, then linking payments to SMS and paperless billing and finally, for some of the utilities, fully automated billing using smart meters. This type of progression is needed for utilities to reap the full benefits of mobile payments. For example, the benefits of mobile payments for financial management are only fully realised when they are combined with efficient billing processes to enhance revenue collection. Similarly, back-end systems (an ERP or otherwise) are required to realise the benefits of better revenue tracking and more efficient financial management.



“The use of technology no longer an option, it is a necessity. The priority area is first on metering and billing, that is the bread and butter of utility operations, and [crucial for] cash flow.”
MAWASCO staff

These changes, combined with the digital tracking of complaints, have introduced greater accountability and led to faster complaint resolution, all of which builds customer trust in the utility and improves service quality.

2.4.2 Data collection

Mobile devices are used by all four utilities for meter reading and reporting. The system, deployed for many utilities by *Wonderkid*, allows meter readers to enter data directly into a digital system via a mobile phone and take a photo of the meter to verify the reading. This has significantly reduced the time it takes to read meters (since data does not have to be transcribed from paper) and reduced the errors and complaints arising from manual data collection.

Pilots of remote meter reading are on-going, with meters read by a remote device using radio frequency (connected either by an established network in the city or by driving close to the home). This has eliminated the need to enter customers’ homes. Nakuru, in partnership with *Danco Capital*, has conducted a test using *Diehl meters*. In a recent drive-by meter reading test, accurate readings were obtained for 88 of the 90 meters in the pilot. Table 3 highlights some of the prominent meter suppliers in Kenya and their product offerings.

Other than smart meters, the utilities have made limited use of IoT devices, but sensors throughout the water distribution network would provide the opportunity to monitor services more effectively. Pressure and level sensors can identify leaks or bursts in the pipe network, and having data on flow and pressure in the system can help manage pumping and reduce the time that water needs to be cut off. Kisumu is the only utility to have introduced sensors across their network. Linked with their ERP, this has given them a better view of the flow of water throughout the system.

The utility staff we interviewed stressed that one of the key benefits of digitalising billing and payments is fewer errors, which were common when data was entered manually. Errors in customer bills would create wider inefficiencies and undermine customer trust. By reducing these errors, the utilities were able to improve customer relationships and reduce the amount of staff time spent managing complaints.

Building consumer trust and delivering a quality service are essential to breaking vicious cycles of poor service delivery.¹⁴ Vicious cycles can develop when poor governance and customer service erodes customer trust and willingness to pay. This, in turn, leads to insufficient revenue collection, undermines the quality of the service and affects staff morale, perpetuating the cycle. Creating virtuous cycles involves building trust in the utility among staff and customers through improved services, greater efficiency, stronger morale and willingness to pay and creating space for additional improvements and investments.

All the utilities have digitalised key aspects of their customer relationships in recent years. All four use *MajiVoice*, the complaints management system developed by WASREB, for tracking and recording complaints. They have also all made investments in their web presence, social media communications and developing their digital service offering. For example, Nakuru and Kisumu have developed customer-facing apps that allow customers to manage their billing and meter reading. Nairobi and Malindi have made significant investments in developing their website and digital services and all have made investments in developing call centre hotlines.

FIGURE 6
Digitalisation of the four utilities, by domain

Function	Technology	Nakuru	Nairobi	Kisumu	Malindi
Customer relationships	Mobile payments	●●●	●●●	●●●	●●●
	Customer engagement	●●●	●●●	●●●	●●●
Data acquisition	Mobile devices	●●●	●●●	●●●	●●●
	Sensors and IoT data	-	-	●	●
Management and control	Smart metering – household	-	●	●	●●
	Smart metering – kiosk	●●●	●●●	-	-
	IoT deployments/SCADA	-	-	●	●
Processing and storage	ERP systems	●●●	●	●●●	●
Modelling and analytics	GIS mapping	●●●	●●	●●●	●
	Visualisation/decision support	-	-	●●●	-
	Cloud computing analytics	-	-	-	-

●●● Technology widely used in operations
●● or ● Some use of technology/ some pilot testing
— Limited or no use of the technology

14. Soppe, G., Janson, N. and Piantini, S. (2018). *Water Utility Turnaround Framework: A Guide for Improving Performance*. World Bank Group.



TABLE 3
Prominent smart meter suppliers in Kenya

Meter brand name	Sales company	Product offering				
		Smart mechanical meters	Smart ultrasonic flow/ electromagnetic meters	Smart valve meters	Prepaid meters	Integrated data platform
Baylan	Rift Valley Machinery Ltd and JUNACO Trading Ltd	●	●	●	●	●
CityTaps	CityTaps	●	●	●	●	●
Diehl	Danco Capital Limited	●	●	-	-	●
Elster Kent	Nairobi Ironmongers Ltd	●	●	-	-	-
ITRON	Coast Industrial Safety & Supplies Ltd	●	●	●	●	●
Kamstrup	N/A	●	●	●	●	●
Lianli*	Lianli Limited	●	-	-	-	-
Precision	Negev Limited	●	●	●	-	●
Sensus	Xylem Inc.	●	●	●	●	●
Susteq	Maji Milele Ltd.	●	●	●	●	●
Teksan	KAPS Ltd	●	●	●	●	●

*Note: Lianli Ultra Sonic flow only and data platform not proprietary

2.4.3 Management and control

The main application of remote control through machine-to-machine (M2M) communication has been the deployment of smart meters. Smart meters come in many forms and have different capabilities, ranging from communicating meter readings remotely to meters that can shut off or turn on automatically according to when payments have been made (PAYG smart meters).

All four utilities have piloted or trialed different smart meters, although only Malindi, Nakuru and Nairobi have undertaken larger scale deployment. Nakuru

and Nairobi have deployed meters that can be read remotely, as well as prepaid meters at water kiosks and communal water points (see Table 3 and Box 1). Malindi has undertaken a more extensive deployment of smart meters for household connections through a partnership with CityTaps (services) and Untapped (financing partner) (see Box 2).

Process automation in the water distribution system is more limited, in part because it relies on deploying monitoring equipment throughout the network. To date, Kisumu is the only utility to have introduced process automation. Their chemical dosing (for water purification) is now automated and remotely controlled.



BOX 1

Nakuru's use of prepaid meters at water kiosk

Kenyan utilities typically have four major customer segments: household connections, commercial/business clients, institutional clients (e.g. schools and government agencies) and kiosk services. Each of these groups has different tariffs that are regulated by WASREB.

Kiosk services generally serve low-income areas and have lower tariffs than commercial or residential customers. There are different models for kiosk service delivery, but many operate on a delegated management model. Under this model, an independent kiosk operator or community group manage the kiosk, buy water from the utility and sell it on to customers.

As with households, kiosk managers that do not pay the water bill can have water disconnected, and this was a problem in Nakuru. Kiosk services being disconnected due to debts can have a particularly negative impact since many people rely on them. While Nakuru has not yet rolled out household smart meters, in 2020, 25 kiosks in the city were moved to a prepaid meter system. Kiosk operators can top-up via tokens charged by USSD or mobile money (Safaricom's PayBill). Shifting to prepaid meters introduces greater accountability for kiosk operators since there is no point at which funds they collect can be diverted. It also leads to better alignment of incentives between the utility and the kiosk operators.

2.4.4 Processing and storage

Historically, many utilities have operated several different systems for their core functions. For example, commercial and billing systems that are separate from financial management, customer relationship management and technical operations. This would create inefficiencies as large amounts of data would need to be moved manually from one system to another, leading to long reporting times and errors in core management information. This is changing as utilities invest in ERP systems to unite the work of the utility in a single digital environment. Both Nakuru and Kisumu have made such investments in the last two years.

2.4.5 Modelling and analytics

Most of the work in this area has focused on GIS mapping of network infrastructure. Two of the utilities (Nakuru and Kisumu) have mapped their core network infrastructure and household connections while the other two (Nairobi and Malindi) are in the process of doing so. GIS mapping of infrastructure is critical for the management of the water system, as many utilities used to rely on institutional memory to locate their



"I was amazed that my meter was read and I received my bill the same day' a customer is quoted saying after the deployment of the system. The management now has quick access to detailed reports covering all departments made possible via integration of the different sub modules, customers have a dedicated customer service module, the over 40 water kiosks serving the low income areas are fully integrated to the ERP enabling quick loading of dispenser tokens via mobile payments, reporting of volumes sold and revenues realized at any given time. We have also improved our call centre capabilities to enable our customers to reach us easily whenever they need.

[...] All these efforts are a deliberate push towards making work easier through automation which is an integral part of the digitization journey in our company and to ultimately transform NAWASSCO into a lean, efficient and fully sustainable water company to delight of the people of Nakuru County."

NAWASSCO staff

core assets. GIS mapping of customers also helps with workflow management as technicians can now be sent to specific connections or parts of the network.

Although none of the utilities has invested in software that would allow them to use their GIS data effectively, utility managers from Kisumu, Nairobi and Nakuru

indicated they planned to make these investments.¹⁵ This software is essential to using GIS data for more advanced analytics and provides the foundation for modelling. Several of the utilities have migrated their data to the cloud, but there are not yet cases of cloud computing computational power being used for advanced analytics.¹⁶

15. ArcGIS and AutoCAD were most frequently mentioned. See: <https://www.autodesk.com/>

16. For examples of AI and machine learning applications in the water sector, see: https://iwa-network.org/wp-content/uploads/2020/08/IWA_2020_Artificial_Intelligence_SCREEN.pdf

17. CityTaps and Malindi Water and Sewerage Co. Ltd. (2021). CityTaps Smart Pay-as-you-go Project in Malindi, Kenya: 2020–2021 MAWASCO.


BOX 2

Malindi's smart meter deployment in partnership with CityTaps

Malindi, in partnership with CityTaps and financing partners (see Box 4) are in the process of deploying smart meters in the city. The smart meters operate on a PAYG basis whereby the meter automatically shuts off if bills have not been paid within a certain time frame. The meters also automatically turn back on once payments are made, ensuring that services can resume promptly when households can afford to pay.

Unpaid bills and debts for water bills are a huge problem for both utilities and customers. Large debt arrears constrain utility cash flow and hamper their ability to provide services. Managing disconnections and reconnections manually requires considerable staff time and creates inefficiencies. For households, large bills can accumulate and ultimately lead to disconnection. Not only is disconnection disruptive to the household supply, but it can also be expensive as alternative water sources can be three to seven times more expensive than utility-supplied water. There can also be delays in reconnection once bills have been paid. PAYG options allow debts to be managed more effectively through a gradual repayment plan. They also ensure that services can continue and that disconnections and

reconnections are rapid and cause minimal disruptions to water services.

An initial pilot of 600 CityTaps meters was conducted in areas where there were high levels of debt. The deployment was rigorously monitored and an end line survey¹⁷ of the pilot found that:

- **The customers that were targeted had debt issues in the past** – 54 per cent earned less than \$100 per month and 39 per cent had experienced a disconnection;
- **The solution was well received and customers found it easy to use** – 75 per cent of customers gave positive feedback on the solution, 88 per cent said the solution was easy to use and 89 per cent said it was easy to pay by phone or USSD options; and
- **The utility was able to recover debt while minimising the impact on customers** – the utility's cash collection rate rose to 126 per cent as debts were recovered, which boosted their credit rating by 17 points.


BOX 3

The introduction of Nakuru's ERP system

In 2019, Nakuru introduced a new ERP system with support from Smart People Africa (SPA). The ERP system was built on Microsoft Dynamics and replaced a system built on Tara Term that had limited functionality and did not link the modules for different departments. The new ERP has five core modules that unite utility operations: i) technical (for the production and transmission of water); ii) commercial; iii) finance and accounting; iv) procurement; and v) billing.

Uniting these elements has had several benefits for Nakuru, including:

- **Resolving issues with multiple contracts and reducing costs and complexity. Maintaining contracts for different IT systems was complex and costly.** Working with a single supplier for the ERP has simplified this and enabled Nakuru to identify and resolve issues more easily.
- **Accuracy and accountability in reading and billing.** There used to be many issues with customers entering the wrong account number. Uniting the billing and finance systems and introducing safeguards (such as requiring account numbers for payment) has minimised these issues. The finance department used to have to download payments three times a day and upload them across the various systems, but these updates are now automatic and instant.
- **Complaint management and resolution.** The CRM module of the ERP is linked to MajiVoice and allows complaints to be tracked from when they are raised to when they are resolved, introducing accountability and traceability to the process.
- **Improvements in meter reading efficiency and billing.** Before the ERP, the utility used three to four IT systems for meter reading and billing, which meant a failure in one of the systems would cause issues in the others. Although Nakuru aimed to bill and collect revenue within the same month, these delays would impact cash flow. The new ERP, combined with the mobile meter reading, has made meter reading and billing more efficient.

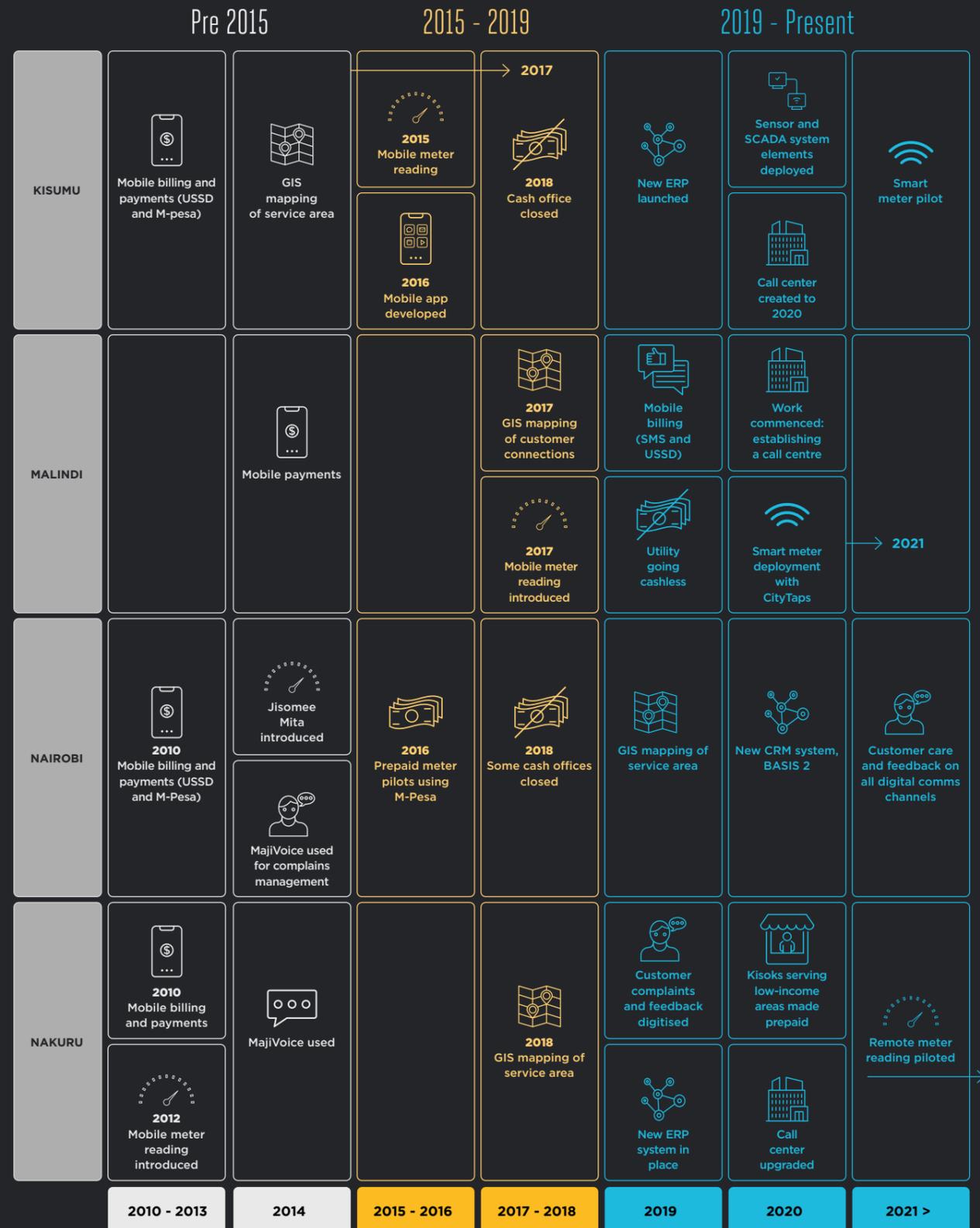
2.5 Sequencing of digitalisation efforts

Figure 7 shows some of the digitalisation milestones for each utility. These mark a clear progression of introducing and then combining more advanced technologies. For all four utilities, digitalising

operations began with the use of three technologies: mobile payments, mobile meter reading and customer engagement. Later, the utilities started GIS mapping, and Nakuru and Malindi also trialled or introduced smart and prepaid meters. More recently, the focus has shifted to fully digitalising customer engagement, building robust ERP systems and deploying IoT devices (sensors and smart meters) throughout the network.



FIGURE 7
Key stages of digitalisation



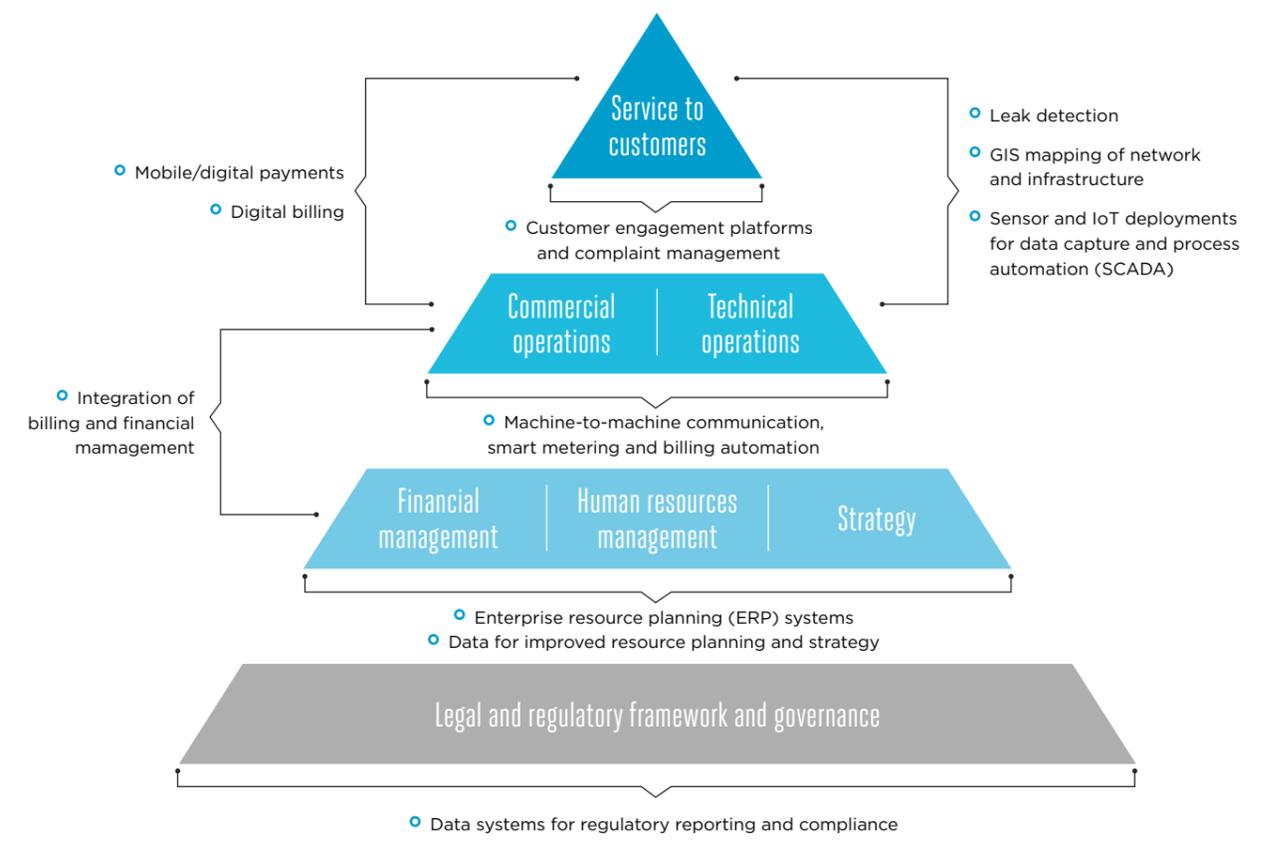
2.6 Mapping digitalisation initiatives against utility operations

Figure 8 shows some of the key digital solutions used by the utilities, as outlined in the previous section, mapped against the World Bank Utilities of the Future (UoF) framework. The UoF framework highlights the building blocks of successful utility operations. Service to customers is the ultimate objective and located at

the top of the pyramid, but those services are built on sound technical and commercial operations. These operations, in turn, depend on strategy, human resource management and financial management. The legal and regulatory frameworks underpin everything, providing the context in which providers operate.

Mapping digital tools against this framework reveals where digital tools would be most relevant to different aspects of utility operations and how these tools can unite them.

FIGURE 8
Digital solutions and their application to utility operations



Source: Authors' design based on: <https://documents1.worldbank.org/curated/en/796201616482838636/pdf/Utility-of-the-Future-Taking-Water-and-Sanitation-Utilities-Beyond-the-Next-Level.pdf>



03

Critical factors in utility digitalisation

This section examines five factors identified in the research as critical to the digitalisation journeys of utilities.¹⁸ Factors 1, 2 and 4 were common themes emerging from the interviews and factors 3 and 5 were identified in the case study analysis. Depending on the context and how utilities have approached them, these factors can act as either enablers or constraints.

3.1.1 Critical factor 1: Organisational culture and staff attitudes



Enabling aspects: When staff embrace a change, there is an opportunity to acquire new skills and be retrained. All utility staff we interviewed stressed that introducing digital technologies that affect jobs must be accompanied a plan to redeploy those staff and reassurances of job security backed by senior leadership. Where changes significantly improve staff efficiency (for example, closing a cash office or switching to mobile meter reading), there needs to be a clear plan for staff to use their extra time productively elsewhere.



As a constraint: Staff resistance to technologies can slow the implementation of digitalisation. While none of the utilities reported that staff resistance had a negative impact on their digitalisation initiatives, they all stressed that digitalising operations had to be accompanied by a culture change. There was also

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"The smart meters have caused a change in ways of working. They [the meter readers] get alerts in cases of: leakages, tampering, abnormal consumption. [This] makes the meter readers 'problem solvers'. Customer care officers also become data experts, as the debt collectors now focus on repayment plans. The meters do the billing themselves, so the billing collectors become 'data analysts' understanding what's coming through."
MAWASCO staff

a general sense that many staff feared change or were "stuck in their ways". Issues with staff resistance were reportedly most acute before digitalisation initiatives were implemented. Managers reported that acceptance of technology grew through the process of training staff and implementation. Especially as the benefits became clear, staff adapted to new ways of working and became more confident in their job security.

3.1.2 Critical factor 2: Funding and financing



Enabling aspects: Several of the utilities are now operating in a 100 per cent to 125 per cent cost-recovery bracket, which is above average for Kenyan utilities. This has given them some room to invest in digital solutions using their own revenues. The utilities also have their own credit ratings (assessed by WASREB) and are authorised to take commercial loans,¹⁹ but relatively few utilities in Kenya have done so. Figure 9 details some recent commercial loans to water utilities documented by the Water Sector Trust Fund.

On the positive side, there is an emerging trend of tailored and innovative digitally enabled financing options. The digital tracking of infrastructure and payments has opened the door to new financing models, since having a digital trail of payments can reduce the risk for lenders and enables different models for managing repayments. *Untapped* is a financing partner that works with such technologies and has partnered with two Kenyan utilities to deploy smart meters that use digitally tracked payments (see Box 4).

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"Investment in technology for any water utility is an investment for the future towards not only sustainable services but also in an efficient and effective manner."
NCWSC staff

18. These were identified through an analysis of interviews conducted for the utility case studies, and a synthesis analysis of the case studies.

19. USAID. (n.d.). Expanding Finance for Water Service Providers in Kenya: USAID's Water, Sanitation and Hygiene Finance (WASH-FIN) Program - Country Brief Series.



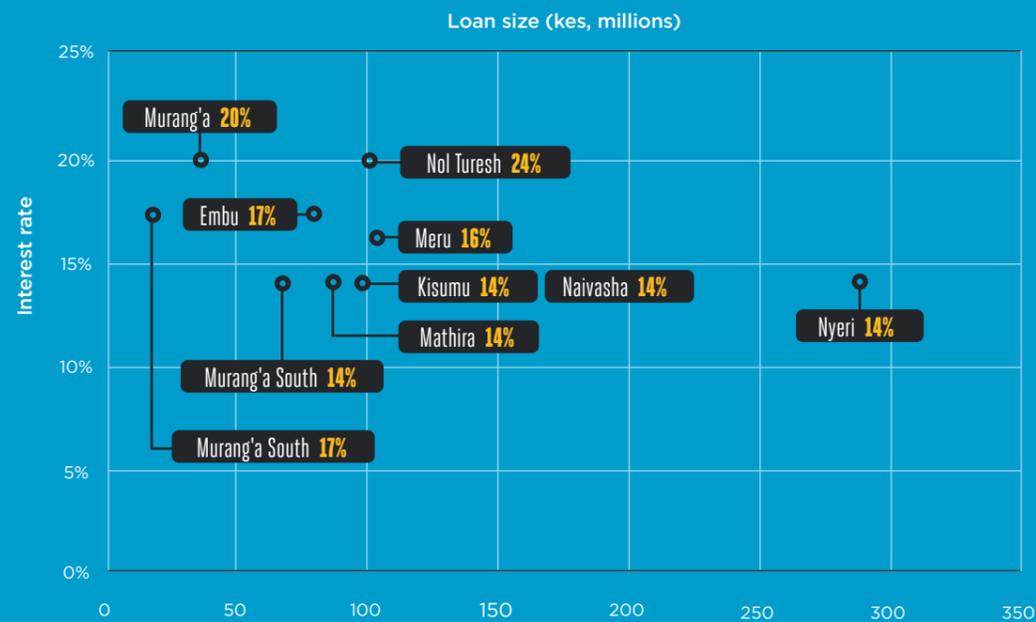
A new water sector fund from the National Bank of Kenya (see Box 5) works on similar principles. Unlike traditional debt financing, the bank plans to focus on utility cash flows when considering credit risk. As with Untapped, this combination of digitally tracked assets and digital payments significantly reduces risk because National Bank can be the first receiver of funds or use an escrow account to manage repayments.



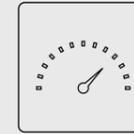
As a constraint: Although the utilities collect revenues sufficient to cover O&M costs, only Nakuru has achieved the 110 per cent target set by WASREB. The

utilities have financed digitalisation efforts, but lack of financing was raised as a major challenge in interviews. Except for the developments highlighted above, there are few flexible financing options, and commercial lending has high interest rates (often 14 to 20 per cent, see Figure 9). Many utilities in Kenya have also struggled to reach benchmarks for creditworthiness. Figure 10 shows there has been little progress in the past six years, with utilities having an average score (46 in 2019–2020) below the BBB rating (the lowest level for investment-grade ratings).

FIGURE 9
Select commercial loans to water utilities, 2016–2018



Source: Water Sector Trust Fund loans analysed include those from K-Rep Bank, Co-op Bank and Family Bank



BOX 4

Funding Malindi's smart meter deployment, a partnership with Untapped and CityTaps

This smart meter deployment was funded through a grant provided by the FASEP (French General Directorate of the Treasury) and financing from Untapped.

Following a successful pilot of 600 meters (see Box 2), Malindi and CityTaps scaled by using financing from Untapped for hardware and imports. CityTaps received the funds from Untapped for the meters and managed their delivery to the utility while Malindi is responsible for installing the meters and managing the service. The parties signed a tripartite agreement clarifying these roles.

Repayments are based on a revenue-share model. Under the agreement, Untapped receives the funds collected from the meters, recovers the repayments and sends the balance to the utility. Although it is unusual for the financing partner to be the first receiver of the funds, it is permissible in the Kenyan sector and significantly reduces risk for the lender. Untapped has also entered a similar agreement in Bomet where meters and financing are being deployed on a rolling basis.



BOX 5

National Bank's Water Sector Fund

In September 2021, National Bank and Aqua for All announced the launch of a KSh 5 billion (\$45 million) fund for MSMEs working in the Kenyan water sector. The fund is aimed at two market segments:

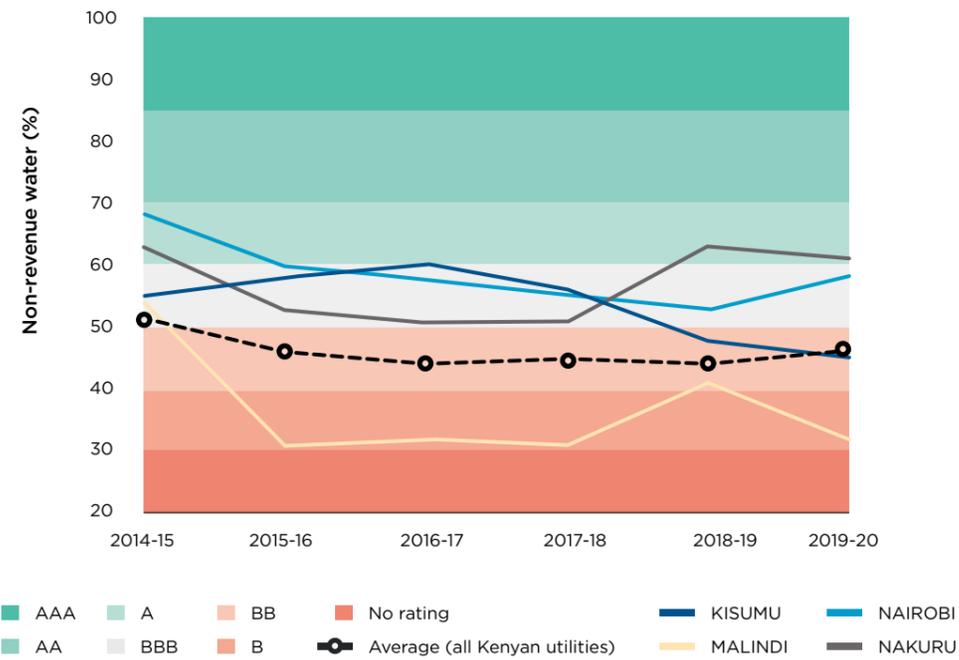
- Capital loans (Jenga Biashara loans) up to EUR 40,000 for entrepreneurs providing water, sanitation and hygiene products/services in urban and rural areas; and

- Infrastructure project loans up to EUR 400,000 for household connections, smart metering, solar projects and other efficiency-improvement assets.

Aqua for All provides technical advice on identifying suitable solutions. In addition, the fund is working in partnership with a range of technology providers to build a pipeline of bankable projects. The fund could inject considerable commercial capital in the sector given that the size of the fund (KSh 5 billion) represented roughly 25 per cent of combined utility turnover for 2020 (~KSh 23 billion).



FIGURE 10
Creditworthiness of select utilities and national average



Source: WASREB

Additionally, financing partners report struggling to work with utilities due to the nature of the water sector (capital intensive with long payback times) and the pace at which utilities can make decisions.

3.1.3 Critical factor 3: Mobile connectivity and Kenya's mobile money ecosystem



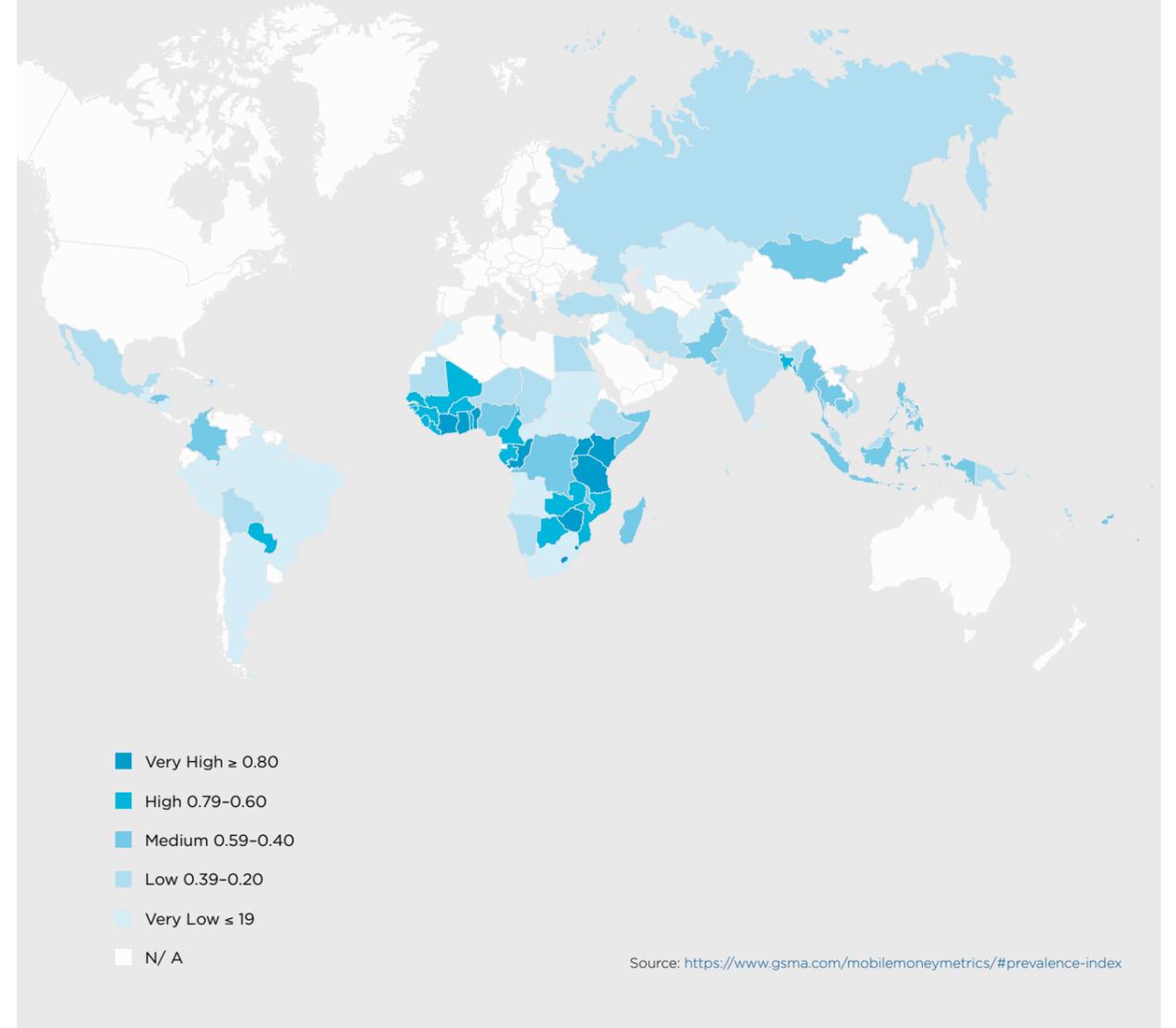
Enabling aspects: Kenya is the home of mobile money. Launched in 2007, M-Pesa was the world's first mobile money service. The initial pilot was supported by a grant from the UK Foreign, Commonwealth & Development Office (FCDO), then DFID, for Vodafone and Safaricom/Vodacom to develop and launch the service. Since then, Kenya has led the indices in mobile money adoption. This is a critical enabler, as utility customers are very familiar with mobile money

and the agent network is highly developed. Kenya's leadership in mobile money has enabled the early adoption of mobile money bill payments for many utilities and allowed utilities to go cashless with little resistance from customers and with minimal risk of exclusion.



As a constraint: It is important to note that not all mobile money ecosystems are as developed as Kenya's, and not all utilities in other countries have such easy payment options. Difficult integration processes and lack of user familiarity and acceptance can hinder the ability of utilities to transition to digital payments. However, this landscape is changing, and Kenya's advanced mobile money and digital payments environment is no longer so unique. Figure 11 shows the prevalence of mobile money in LMICs. As many countries catch up with Kenya, stronger mobile money ecosystems present an opportunity for utilities in those markets.

FIGURE 11
GSMA Mobile Money Prevalence Index



Source: <https://www.gsma.com/mobilemoneymetrics/#prevalence-index>



3.1.4 Critical factor 4: Relationships with technology providers



Enabling aspects: In deploying the solutions outlined in section 2.4, the utilities reported they were able to source suitable vendors. In procuring solutions from technology providers, the utilities generally felt that when they released a tender they would receive suitable bids from qualified providers that understood their needs and the needs of the water sector. Partnerships with technology providers fall into four main categories (see Table 4).



As a constraint: Interviews with utilities and technology providers revealed lengthy procurement processes. Both parties also raised issues with evaluation processes, in particular that it can be challenging to assess the

comparability of on-going costs. This is significant because some hardware and technologies have long life cycles (15 to 20 years in some cases). Both groups also pointed to the risk of “lowball” offers with low-quality technical designs winning if the evaluators do not prioritise technical quality. This was particularly the case with hardware; many utilities reported experiencing difficulties in sourcing reliable hardware (especially smart meters). A lack of benchmarking data for price and quality available to the utilities compounds this issue.

For technology providers, there are known issues with working with utilities that can prove challenging if not actively managed. Payment cycles can be long, which is particularly harmful for start-ups or companies with limited cash flow or at an early stage of deploying their solutions. Also, as mentioned earlier, utilities may not have the capital for large investments, and this is leading some providers to adapt their offering to a software as a service (SaaS) model.

TABLE 4

Partnerships with technology providers

Relationships with technology providers	Examples
Vendor for an advertised procurement/contractors	<ul style="list-style-type: none"> Smart People Africa deliver ERPs for Kisumu and Nakuru (system based on Microsoft Dynamics), 2019 Giza Systems provide Nairobi with a new CRM and billing system (BASIS 2), 2020 Contractors including Newport International Ltd. support the establishment of Kisumu’s call centre, 2020
Integration with services offered	<ul style="list-style-type: none"> Safaricom’s PayBill platform/M-Pesa (all utilities) and Airtel Money (Nairobi), various dates
Partnerships to pilot technology	<ul style="list-style-type: none"> Safaricom and Kisumu test smart meters. Safaricom provided the meters and the use of their network for a pilot, <i>on-going</i> Danco Capital and Nakuru – Danco provide smart meters (that can be read remotely) as part of a pilot, <i>on-going</i>
Other partnerships	<ul style="list-style-type: none"> Malindi, Untapped and CityTaps enter a tripartite partnership to deploy smart meters (see Box 4), <i>on-going</i>

3.1.5 Critical factor 5: Governance and strategy



Enabling aspects: Part of our research included a review of the most recent strategic plans of the utilities. Table 5 identifies their planned initiatives or objectives. It is encouraging that a review of past digitalisation efforts is included in most plans and that progress has been charted.

In the past few years, two of the utilities, Kisumu and Nakuru, have created stand-alone ICT departments. This has provided a home for digitalisation efforts and

created an accountable unit with responsibility for, and incentives to promote, digitalisation efforts.



As a constraint: While none of the utilities directly cited strategy as a critical constraint, several utility managers pointed out that long-term financial planning for digitalisation, and investments in digital infrastructure, were not always considered when reviewing and setting tariffs. Another challenge was a lack of detailed information on the costs and standards of different digital technologies. It was also noted that none of the utilities had a specific digitalisation strategy or strategic business plan.

TABLE 5

Digital adoption in utilities’ strategic plans

Domain	Technology	Nakuru	Nairobi	Kisumu	Malindi
Customer relationships	Mobile payments	●	●	●	●
	Customer engagement	●	●	●	-
Data acquisition	Sensors	-	●	●	-
	IoT deployments/ SCADA	●	●	●	-
Management and control	Smart metering – household	●	●	●	●
	Smart metering – kiosk	●	●	-	-
Processing and storage	Cloud computing analytics	-	-	-	-
	ERP systems	●	●	●	●
Modelling and analytics	Visualisation and decision support	●	●	●	-
	GIS	●	●	●	●

Source: KIWASCO Strategic Plan 2017–2022 (revised Apr 2020), NAWASSCO Strategic plan 2020/21–22/23, MAWASCO Strategic Plan 2019/20–23/24, NCWSC Strategic Plan 2019/20–23/24



04

Summary, lessons and opportunities

This section revisits and summarises key findings against the research questions. The findings are then discussed in relation to the lessons that can be gleaned for utilities at an early stage of digitalisation, as well as future opportunities.

4.1 Research questions

4.1.1 What has been the digitalisation experience of utilities to date?

Section 2.4 provides a synthesis of key digitalisation initiatives, and the Appendix includes a detailed case study of each utility. In the period reviewed, there were some common elements in the digitalisation journeys of the utilities.

- **Pre-2015** – The initial stages of digitalisation generally focused on payments, meter reading and billing.
- **2015–2019** – A focus on overhauling customer relationships and engagement, including web and social media presence. Many utilities also started piloting different smart meters or smart-ready meters and GIS mapping their customers.
- **2019–present** – Some of the utilities shifted their focus to overhauling ERP systems. There was also an increased focus on deploying smart meters for household connections and kiosks.

4.1.2 What are the key priorities for digitalisation in the short- to medium-term?

The case studies in the Appendix describes the utilities' stated priorities, while section 3.1.5 discusses where digitalisation fits into their strategic plans. Three digitalisation initiatives featured heavily in the future plans of utilities:

- **Developing, or fully deploying, ERP systems** to provide a single digital environment;
- **Testing, or further deploying, IoT solutions**, including smart meters and sensors across the network; and

- **Strengthening customer engagement through digital tools** and expanding the digital services offering.

For the utilities that had not completed GIS mapping, this was identified as a priority. Finally, as operations have become increasingly digitalised, cybersecurity has emerged as a priority. Given that they provide a core service, utilities are particularly vulnerable to ransomware attacks, as demonstrated by a spate of such attacks in the USA over the course of 2021.

4.1.3 What are the key constraints and enablers of digitalisation?

Section 3 discusses the enablers and constraints observed. The research identified five critical factors:

- **Organisational culture and staff attitudes.** All the utility managers interviewed stressed that engaging staff in change processes was critical to success, especially when the introduction of a digital solution changed or displaced jobs. It often required strong leadership from senior management.
- **Funding and financing.** While the availability of funding and financing was identified as a constraint, there were also positive trends. For example, utilities are engaging in innovative, digitally enabled financing models based around revenue share. Also, because they were on reasonably stable financial footing, the utilities have been able to make investments in digital infrastructure using their own funds. However, the availability of commercial finance is still low, utilities have not yet reached the WASREB target for O&M cost coverage and the creditworthiness of most utilities is not yet investment grade.
- **Mobile connectivity.** Kenya's position as a leading mobile money market enabled many utilities to adopt mobile payments early, which meant that closing cash offices had a limited impact on customers.
- **Relationships with technology providers.** None of the utilities interviewed identified specific challenges with finding suitable technology providers, and generally felt that the providers understood their needs. However, there have been challenges sourcing some hardware and having quality price

benchmarking data to assess financial proposals. Some technology providers found the speed at which utilities make decisions a challenge, as well as the bureaucracy of utilities stalling payments. Many providers are also adjusting their business models to minimise upfront capital expenditure. Smaller recurring payments (such as in SaaS models) can make services more affordable for utilities and help avoid long payment cycles for large payments.

- Governance and strategy.** The most recent strategic plans of the four utilities included developing and deploying ERP systems, smart metering and other IoT solutions and GIS mapping. These are clearly key focus areas. Within the last two years, two of the utilities have established a stand-alone ICT department that they felt gave utility digitalisation initiatives a home at the utility. However, the strategic plans do not contain much financial detail on the proposed initiatives, and none of the utilities has a specific digitalisation strategy or business plan. Utility managers also raised the issue that the long cycle of tariff reviews has meant new digitalisation initiatives are not always accounted for in the gazetted tariffs.

4.2 Key lessons from the four utilities

Analysis of the utilities' digitalisation journeys yielded four key lessons. Since these lessons were based on their experience to date, they are most applicable to utilities at an earlier stage of digitalisation.

- Investing progressively in digitalisation is vital.** Making progress in multiple areas is critical to reaping the full benefits of others. For example, the benefits of more efficient meter reading will only be fully realised when they are linked to more efficient billing and mobile payments.
- Digitalising core functions first can deliver quick wins.** With utilities, this is most evident in metering and billing and in customer relationships. These are also the areas most likely to support improved cash flow and customer experiences/relationships. Digitalising these first can help kick-start virtuous cycles of service improvement.

- When technology changes jobs and roles, there must be a plan in place for retraining or redeployment.** This is a critical part of creating a vision for digitalisation and reassuring staff that they have job security. Effective redeployment of staff is also critical to realising the benefits of more efficient processes. These transitions need to be supported by senior leadership so that digitalisation can be incorporated in broader change processes and reassurances are credible.
- Investment in digital systems must occur alongside the digitalisation of operations or functions.** This was evident in the experience of Kisumu and Nakuru, which both found that investing in ERP systems was key to realising the benefits of their digitalisation initiatives.

4.3 Key opportunities

The research team identified five major opportunities for the utilities sector. These are based on a combination of the utilities' stated objectives and actions likely to help overcome some of their key constraints.

- Improving peer learning between utilities.** In many cases, the experience of one utility holds lessons for others. This extends to sharing information on market offerings and price and quality benchmarks.
- The pros and cons and the costs of digitalisation initiatives need to be better documented and codified in regulatory guidance for the sector.** There is still relatively limited hard data on the benefits of different aspects of digitalisation. Documenting and sharing these benefits between utilities would help to inform investment decisions.
- Advanced metering (PAYG) and network monitoring and control have the greatest potential.** These are the technologies most likely to address the technical losses of NRW and are in areas that are still primarily managed manually. Since these are hardware-heavy investments, sharing lessons on price and quality will be important.
- Digitally enabled financing solutions present new opportunities for financiers, innovators and utilities.** More innovative and flexible financing is



already underway with the entrance of new players and the development of new funds by existing players. With progress in this area moving quickly, there will be opportunities for information to be shared on which investments and partnership models improve services most effectively.

- There is scope to deepen partnerships with mobile operators in utility digitalisation.** Many of the digital solutions discussed in this report have mobile services at their core. Mobile payments, smart metering and network monitoring are core aspects of digitalisation and make mobile operators important partners for utilities.

This research has sought to fill a gap in the literature on utility digitalisation in LMICs. The case studies illustrate

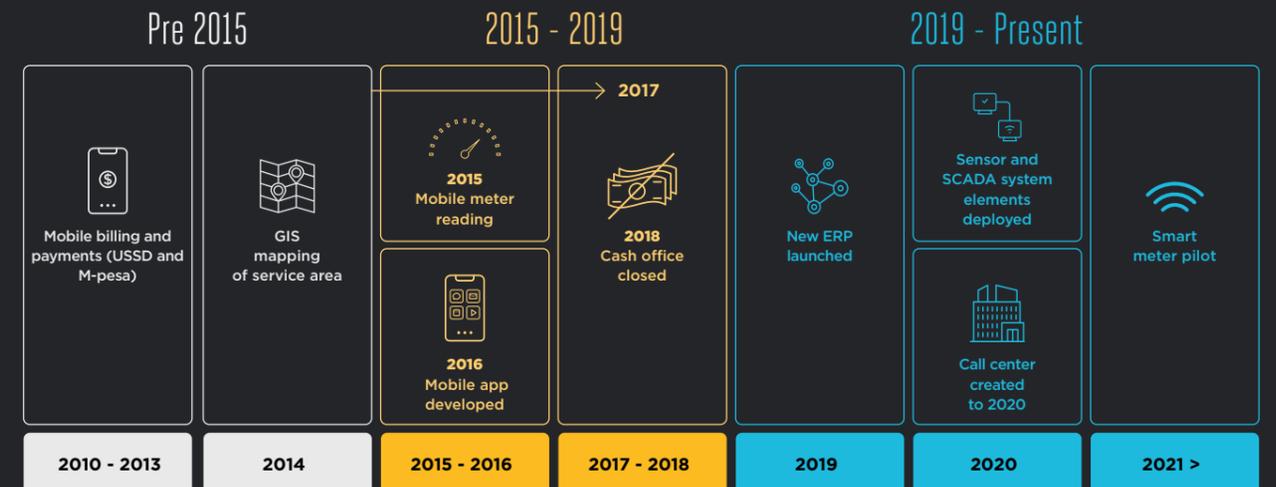
the extent of digitalisation in the four featured utilities, as well as the remaining opportunity. Since these utilities are some of the larger and better-performing utilities in Kenya, and in LMICs generally, their journeys can serve as a guide for other utilities seeking to digitalise their operations. The research also highlights the critical role of mobile services and mobile devices in supporting utility digitalisation. This will only continue as the digitalisation priorities of many utilities centre around IoT devices. Safaricom's recent move into Kenya's smart meter market is a sign of the opportunity available for utility services with IoT.



Kisumu (KIWASCO)

FIGURE 12

KIWASCO overview



Key digitalisation initiatives

- GIS** was used to map major infrastructure and track services, managed by an in-house team.
- Payments and billing were **digitalised**, although some low-income areas served under a delegated management model do not have these services.
- Some **remote monitoring and process automation** was introduced in 2020.
- A **smart meter pilot** began in 2021 with Danco Capital.
- The **COVID-19 pandemic** accelerated the digitalisation of customer complaints, and a call centre was established through WSUP's HBCC programme.

Key WSP statistics (2019)

Overall performance (200 max):	105 - 7th in category	
Population in service area:	461,001	
Population served	333,799 (72%)	
NRW	31%	
Number of staff	328	
Revenue collection efficiency	84%	
Revenue to O&M cost coverage	110%	
Metering ratio	100%	

Note: KIWASCO was one of the four utilities that piloted a tool developed by Wonderkid with support from the GSMA. For more information, see: <https://www.gsma.com/subsaharanafrika/resources/wonderkid-digitising-water-utilities-in-kenya> and <https://www.gsma.com/mobilefordevelopment/resources/scaling-digital-solutions-in-the-water-sector-lessons-from-citytaps-and-wonderkid/>

Appendix: The digitalisation journeys of the four utilities



Utility context

KIWASSCO has nearly half a million people in their service areas and serves almost 400,000 people. The utility has expanded their services significantly in recent years. In 2012, KIWASSCO served only 62 per cent of people in their service area, but in 2020 this had risen to 85 per cent. This rapid extension of services has been matched with an increase in revenues. In the same period, KIWASSCO's turnover more than doubled to 834 million KSh in 2020 (approximately \$7.6 million). Over the past few years, O&M cost coverage has remained stable between 100

per cent and 105 per cent, indicating the utility has enough revenues to sustain services, but limited funds for investment.

KIWASSCO operates two treatment plants: the Dunga treatment plant (44,000 m³ capacity) and Kajulu (36,000 m³ capacity). Water production in 2020 was 29 million litres per day, equating to 63 litres per person in the service area. The expansion in services over the last eight years has been paired with a sharp reduction in NRW, from 50 per cent in 2012 to 37 per cent in 2020. However, this figure remains well above the 25 per cent recommended by WASREB.

TABLE 6
KIWASSCO's key performance indicators, 2012–2020

	2012	2014	2016	2018	2020
Customers					
Population in service area	404,000	404,000	426,000	449,000	457,000
Population served	252,000	256,000	286,000	342,000	388,000
Connections, active and inactive	19,000	37,000	32,000	75,000	54,000
Active connections	19,000	43,000	43,000	55,000	54,000
Water production and consumption					
Non-revenue water (%)	50	42	49	37	37
Total water produced (m ³ , millions)	7,7	7,7	11,1	9,5	10,5
Total billed volume (m ³ , millions)	-	4,5	5,6	6,0	6,7
Domestic and kiosk-billed volume (m ³ , millions)	1,9	1,8	2,8	3,2	3,6
Financial and efficiency					
Turnover (KSh million)	373	452	550	706	834
O&M cost coverage (%)	103	103	106	106	104
Metering ratio (%)	-	94	100	100	100
Revenue collection efficiency (%)	96	94	95	93	95
Staffing					
Total staff	126	274	166	331	330
Staff productivity (number of staff per 1,000 connections)	7	6	4	6	6
Personnel expenditures as % of total O&M costs	-	23	29	36	35

Source: WASREB Impacts Reports Issues 6 through 13 <https://wasreb.go.ke/impact-reports/>

KIWASSCO's digitalisation journey

Year	Milestone	Partners	Details
2010-13	Mobile payments introduced	Safaricom	Mobile payment integration via PayBill
2014	GIS mapping of network infrastructure	In-house	GIS mapping of core network infrastructure began, including locations of pipes and household connections
2015	Mobile meter reading	WonderKid	Meter reading enabled using a mobile phone with a photo taken of the meter reading and GPS tagging for validation
2016	Email and SMS billing	Airtouch	Bills available either by email or through USSD menus
2018	Cash office closed	n/a	The utility closed the cash office and only accepted payments by mobile money or through banks
2019	New ERP system introduced	Smart People Africa	New ERP system using Microsoft Dynamics for finance, supply and human resources; CRM system built by Smart People Africa
2020	App launched and social media channels	WSUP and Smart People Africa	New customer-facing app launched with services for: reading meters, applying for connections, buying water tokens, reporting incidents and complaints, and viewing bills and statements.
2020	Call centre created	Newport International Ltd. and WSUP	Customer call centre established with support from the HBCC programme
2020	Remote monitoring of network infrastructure	Hardware supplied by Nairobi Ironmongers	Pressure and level sensors introduced across the network and some processes (chemical dosing) were automated
2021	Smart meter pilot	Safaricom	Pilot test of a small number of smart meters in partnership with Safaricom



Digitalisation by domain/function

Function	Technology	Use
	Data acquisition	Sensors Some deployment of pressure and level sensors
		Mobile devices Meter readings and data collection
	Connectivity	Mobile networks (GSM) Bill payments and customer complaints
	Management and control	SCADA Deployment of pressure and level sensors throughout the network; chemical dosing at plants automated
		Smart metering Multiple tests at various points over the past 10 years, but the hardware was not found to be reliable. Another test is being conducted in partnership with Safaricom, but has yet to be introduced at scale.
	Processing and storage	Cloud computing Data storage for mail services, database and website
		ERP systems Systems built on Microsoft Dynamics and Ufanisi
	Visualisation and decision support	Data visualisation Dashboard linked the SCADA data collection
	Modelling and analytics	GIS Mapping of core network infrastructure and connections completed
	Customer relationships	Mobile payments Utility is cashless
		Customer engagement/complaints Customer complaints digitised and linked to CRM module

Key benefits of digitalisation

<p>Utility staff mentioned the following benefits:</p> <ul style="list-style-type: none"> Tracking and accountability with complaints; Improved collaboration with other function units; Increased efficiency and revenue collection; Reduced operational costs; Better customer service and service delivery; Convenient bill payment methods during the pandemic; Improved turnaround time (TAT); 	<ul style="list-style-type: none"> Better operations management; Faster delivery of water bills through SMS and email; Better data handling and reduced reading errors through analysis; Safe data storage in cloud; Change of culture; Improved collaboration between business and stakeholders; and Paperwork and manual processes are now things of the past.
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Priority areas for digitalisation

<p>Utility staff mentioned the following priorities:</p> <ul style="list-style-type: none"> Smart metering (pilot on-going); Minimising cybersecurity threats; Customer focus; Full ERP support; 	<ul style="list-style-type: none"> Video conferencing tools; Document management system; and Automation of balanced score cards.
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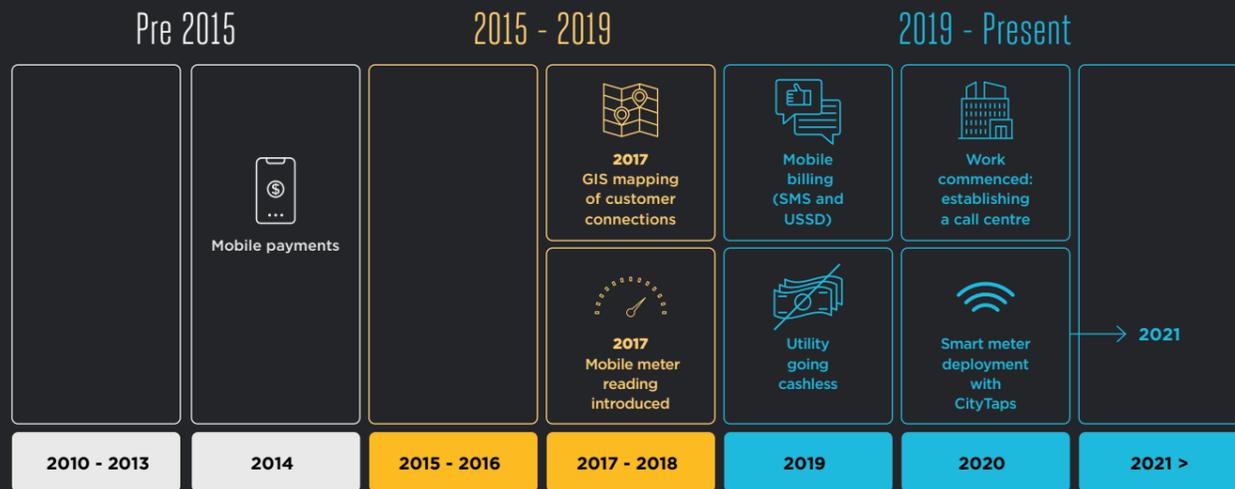
Constraints and enablers

Enablers	Constraints
<ul style="list-style-type: none"> Stand-alone ICT department; Pairing the introduction of technology with a culture change in staff; Full support from top management; Employee commitment; Collaboration between business units; Change of organisational structure in line with ICT structure; and ICT project management team. 	<ul style="list-style-type: none"> Entry-level ICT skills of staff vary. Although this has not been a major challenge, some staff require additional support and investment in the initial adjustment; Staff access to data-enabled phones; Customer familiarity with mobile money; Budget for research and development into innovations; Employees slow to adapt to new technology; Overreliance on legacy systems for extended periods; Frequent changes in hardware and software technologies create integration challenges; and Frequent changes in strategy, policy, regulatory and legal frameworks.



Malindi (MAWASCO)

FIGURE 13
MAWASCO overview



Key digitalisation initiatives

- Mobile meter reading** introduced in 2017.
- Mobile payments and billing** are active.
- GIS mapping of network infrastructure** is on-going.
- A customer call centre** was established in 2020 with the help of WSUP's HBCC programme.
- Currently piloting prepaid meters with CityTaps** and will also be using their CT Cloud services for billing and payments.

Key WSP statistics (2019)

Overall performance (200 max):	81 - 14th in category	
Population in service area:	389,888	
Population served	271,535 (70%)	
NRW	28%	
Number of staff	109	
Revenue collection efficiency	103%	
Revenue to O&M cost coverage	97%	
Metering ratio	92%	

Like KIWASCO, MAWASCO piloted a tool developed by Wonderkid with support from the GSMA. CityTaps is also a former GSMA grantee. For more information, see: <https://www.gsma.com/mobilefordevelopment/programme/digital-utilities/citytaps-delivering-safe-water-to-the-urban-poor-through-prepaid-smart-metering-and-mobile-money/>

Utility context

MAWASCO has more than half a million people in their service area. This number has more than doubled from 205,000 in 2012. There has been a rapid expansion in services to match the growth of the utilities service area, with MAWASCO reaching more than 200,000 new customers with services. However, this growth has not kept pace. In 2012, MAWASCO served 89 per cent of those in their service area, but in 2020 this fell to 71 per cent. Although their customer numbers nearly doubled, revenues increased by just 50 per cent. At the

same time, O&M cost coverage has remained stable at approximately 100 per cent, indicating that the utility has been able to expand services while also meeting O&M requirements.

Malindi's bulk water is supplied by Coast WWDA, after which there is a second stage of chlorination treatment by MAWASCO. MAWASCO's production is currently 17 million litres per day, equivalent to roughly 32 litres per person in the service area. MAWASCO's NRW is low at 23 per cent, and Malindi is one of only eight WSPs that have NRW below WASREB's target of 25 percent.

TABLE 7
MAWASCO's key performance indicators 2012-2020

	2012	2014	2016	2018	2020
Customers					
Population in service area	205,000	286,000	304,000	378,000	525,000
Population served	182,000	237,000	225,000	261,000	372,000
Connections, active and inactive	24,000	22,000	29,000	29,000	34,000
Active connections	24,000	19,000	24,000	21,000	24,000
Water production and consumption					
Non-revenue water (%)	25	30	34	32	23
Total water produced (m ³ , millions)	5,3	6,6	6,9	6,8	6,2
Total billed volume (m ³ , millions)	-	4,6	4,6	4,6	4,8
Domestic and kiosk-billed volume (m ³ , millions)	3,2	3,6	3,5	3,6	3,8
Financial and efficiency					
Turnover (KSh million)	299	381	330	418	446
O&M cost coverage (%)	101	102	79	91	99
Metering ratio (%)	100	91	100	100	100
Revenue collection efficiency (%)	97	92	110	100	94
Staffing					
Total staff	113	139	154	200	206
Staff productivity (number of staff per 1,000 connections)	5	7	7	9	9
Personnel expenditures as % of total O&M costs	-	-	28	38	43

Source: WASREB Impacts Reports Issues 6 through 13 <https://wasreb.go.ke/impact-reports/>



MAWASCO's digitalisation journey

MAWASCO, like many other utilities, adopted mobile meter reading several years ago. MAWASCO has also gradually digitised billing and payments, culminating in

the utility going cashless in 2019. In 2020, a call centre was established and a priority of the utility is to make the line toll-free for customers. In 2020, MAWASCO took steps to introduce smart meters to their network. After an initial pilot of 600 meters there is now a plan to deploy another 2,400.

Key digitalisation milestones

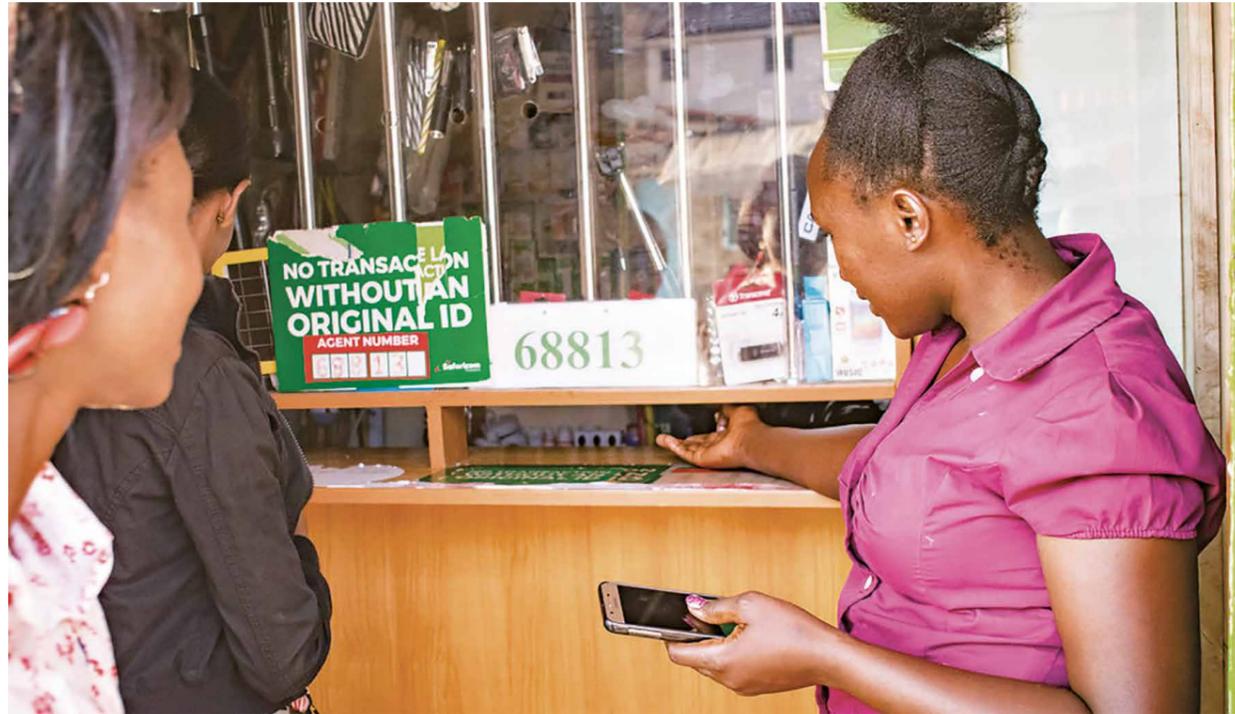
Year	Milestone	Partners	Details
2010-13	Mobile payments introduced	Safaricom	Mobile payment integration via PayBill
2017	Mobile meter reading introduced	WonderKid	Enabled meter reading using a mobile phone with a photo taken of the meter reading and GPS tagging for validation.
-	GIS mapping of customers	KEWI (Kenya Water Institute)	Mapping of customer connections is underway with approximately 75 per cent of connections mapped.
2019	SMS billing introduced	WonderKid	Domestic customers only receive digital bills. Printed bills retained for corporate clients.
2019	Utility went cashless	-	-
2020	Call centre introduced	WSUP	Customer call centre established with support from the HBCC programme.
2021	Smart meter deployment	CityTaps	Following a pilot of 600 meters, another 2,400 will be deployed.

Digitalisation by domain/function

Function	Technology	Use	
	Data acquisition	Sensors Mobile devices	Not in use Meter reading, GIS mapping and for customer payments
	Connectivity	Mobile networks and services (GSM)	Customer payments, smart metering
	Management and control	SCADA Smart metering	Not in use Smart metering initial deployment underway
	Processing and storage	Cloud computing	A component of the smart meters pilot project
ERP systems		Single ERP not used, multiple systems across utility business units	
Visualisation and decision support	GIS	Approximately 75 per cent of connections mapped	
Customer relationships	Mobile payments	Utility is cashless	
	Customer engagement/complaints	Call centre and SMS billing	

Key benefits of digitalisation

- Utility staff mentioned the following benefits:
- Recovery of customer debt.** A pilot of 600 meters were installed at accounts with high debts (Ksh 6.15 million for the 600 connections put on smart meters). Within six to seven months, 50 per cent of the debt had been collected. Based on this success, the board decided to scale up the project and deploy an additional 2,400 meters.
 - More efficient billing.** Efficiencies were realised through a combination of mobile payments and mobile meter reading, and digitalisation reduced errors significantly.



Priority areas for digitalisation

Utility staff mentioned the following priorities:

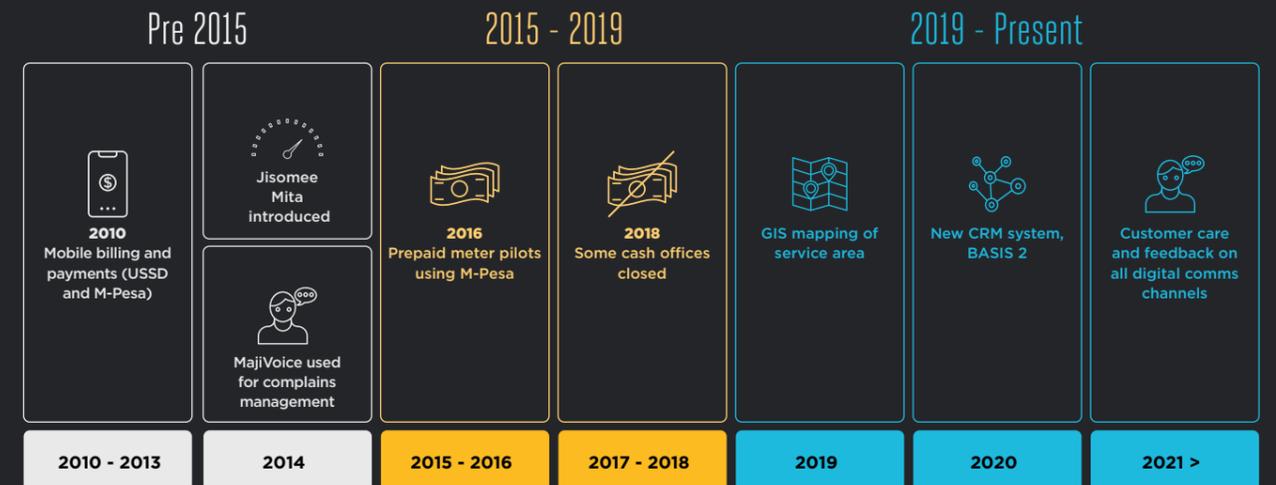
- Implementation of an ERP system to unite separate systems;
- Creation of a toll-free line for the call centre; and
- GIS mapping of network infrastructure.

Constraints and enablers

Enablers	Constraints
<ul style="list-style-type: none"> • Board and management support; • 75 per cent of staff members willing to learn new things/technology; • Partnering with development partners for technical and financial support; and • “Go-getter” culture of management. 	<ul style="list-style-type: none"> • Staff resistance to smart metering related to fears about job losses; • Some customers resistant to smart meters because they will need to repay debts; • On-going costs associated with software fees place a strain on the utility; and • Not all staff have smartphones (they were procured for staff, but they could not cover the additional expense).

Nairobi (NCWSC)

FIGURE 14
NCWSC overview



Key digitalisation initiatives

- Mobile billing and payments** via USSD menus with M-Pesa.
- Early adoption of Jisomee Mita and MajiVoice** for mobile payments.
- Browser service Tambua** introduced for those with manual meters.
- Communication channels for customer complaints and feedback** integrated with the support of WSUP’s HBCC programme (accelerated by the COVID-19 pandemic).
- Extensive GIS mapping** of all major infrastructure components (water and sewer lines). GIS data can be updated on the WARIS platform.

Key WSP statistics (2019)

Overall performance (200 max):	76 - 9th in category	
Population in service area:	4,640,674	
Population served	3,585,866 (77%)	
NRW	38%	
Number of staff	3,440	
Revenue collection efficiency	94%	
Revenue to O&M cost coverage	105%	
Metering ratio	99%	



Utility context

NCWSC is Kenya's largest utility, serving more than 3.6 million people in Nairobi. The utility employs more than 3,000 staff and has an annual turnover exceeding KSh 9 billion (approximately \$83 million). In the past eight years, NCWSC has extended services to nearly a million new customers. However, this growth has just been sufficient to match the rapid growth of the city and NCWSC has served approximately 80 per cent of those in the service area for the past six years.

The city draws its water supply from three main dams (Thika, Sasumua and Ruiru), with Thika dam accounting for 84 per cent of Nairobi's current water supply. Water production is 176 million cubic meters annually, approximately 480 million litres a day or 104 litres per person in the service area. This is just above the minimum threshold of 100 litres per person per day recommended by WHO. However, Nairobi has stubbornly high NRW, with 49 per cent of water produced not billed for or lost in transmission. NCWSC has an operating cost coverage ratio of 103 per cent, indicating that revenues are sufficient to maintain services, but not enough to invest in service expansion.

TABLE 8

NCWSC's key utility performance indicators, 2012-2020

	2012	2014	2016	2018	2020
Customers					
Population in service area	3,727,000	3,724,000	4,067,000	4,333,000	4,633,000
Population served	2,755,000	2,963,000	3,277,000	3,454,000	3,640,000
Connections, active and inactive	462,000	522,000	562,000	585,000	606,000
Active connections	462,000	522,000	562,000	553,000	571,000
Water production and consumption					
Non-revenue water (%)	42	39	39	38	49*
Total water produced (m ³ , millions)	169	201	200	172	176
Total billed volume (m ³ , millions)	-	123	122	106	90
Domestic and kiosk-billed volume (m ³ , millions)	71	26	69	56	58
Financial and efficiency					
Turnover (KSh million)	6,090	6,890	8,404	8,478	9,177
O&M cost coverage (%)	115	105	103	97	103
Metering ratio (%)	-	94	100	100	100
Revenue collection efficiency (%)	86	91	98	96	91
Staffing					
Total staff	2,340	2,785	3,162	3,554	3,335
Staff productivity (number of staff per 1,000 connections)	5	5	6	6	6
Personnel expenditures as % of total O&M costs	-	50	58	61	61

Source: WASREB Impacts Reports Issues 6 through 13 <https://wasreb.go.ke/impact-reports/>

* Note: in 2020, the methodology for calculating NRW changed. According to NCWSC, this largely explains the jump in NRW and means it was underreported in previous years.

NCWSC's digitalisation journey

Since NCWSC was formed in 2005, the utility has strived to digitalise its operations, moving from recording meter readings on paper to using Psion notebooks. Marketing assistants would manually read meters, come back to the office to download the data and charge the notebook overnight. This was found to be expensive and notebooks were not very durable in the field, resulting in breakages and malfunctioning.

In 2013, the utility began using a mobile app on Android phones for meter reading. The original app was called Mobile Field Assistant (MFA), but the utility has since upgraded to Utility Master (UM). NCWSC sent customers physical bills until 2018 when it was decided that only corporate customers would continue to receive physical bills and all other customers would receive them via SMS or email.

NCWSC used to operate cash offices in all their business centres, but challenges with running the cash offices, including theft, motivated them to close them in 2018 and move to mobile payments. The utility was an early adopter of the mobile payment platforms MajiVoice and Jisomee Mita.

Priorities for NCWSC now include completing GIS mapping of network infrastructure and updating the CRM system. The utility has rolled out Jisomee Mita in nearly all low-income areas, but smart meters and remote meter reading have yet to be widely introduced. Network monitoring using sensors and the automation of water production and distribution have yet to be digitised. To ease the water and sewer application process, NCWSC rolled out an online portal in 2020 for customers to apply for services.

Key digitalisation milestones

Year	Milestone	Partners	Details
2010	Mobile payments	Safaricom	Introduced using Safaricom's PayBill service
2013-14	Introduction of MajiVoice for customer complaints	WASREB	-
2013	Mobile meter reading	WonderKid	-
2014	Jisomee Mita introduced for post-paid systems	WSUP	Allows households to self-read their meters and self-report the readings to NCWSC
2018	Cash office closed	n/a	Integration with Equitel and Airtel for mobile money payments
2018	Paper billing stopped	n/a	Paper billing stopped for all but commercial clients
On-going	GIS mapping of network infrastructure and connections	n/a	Approximately 50 to 60 per cent of the network has been mapped (using ArcGIS)
2020	New CRM system (BASIS 2)	Giza Systems	CRM and billing module developed and introduced
2020	Applications for connections digitalised	-	Portal added to website allowing digital applications for connections



Digitalisation by domain/function

Function	Technology	Use
	Sensors	<i>Not in use</i>
	Mobile devices	Meter readings and data collection
	Mobile networks and services (GSM)	Bill payments and customer engagement
	SCADA	<i>Not yet introduced</i>
	Smart metering	Currently testing remote/automatic meter reading; IoT smart meters not in use
	Cloud computing	Used for BASIS 2 CRM system
	ERP systems	<i>Core systems (billing, accounting, GIS systems) not fully linked but there are plans to do so</i>
	GIS	GIS mapping is on-going
	Mobile payments	Widely used
	Customer engagement/complaints	Largely digitised



Priority areas for digitalisation

Utility staff mentioned the following priorities:

- Completing GIS mapping of network infrastructure;
- Integrating separate systems (billing, GIS, human resources and network monitoring);
- Smart metering, with an initial focus on high-revenue commercial clients;

Smart meters for domestic clients likely considered too expensive at this stage since the cost would need to be passed on to the consumer; and

- Sensor and IoT deployments in the network.

Key benefits of digitalisation

Utility staff mentioned the following benefits:

- More efficient data collection and management. The new CRM system has allowed better access to data. The previous system was centralised and regional teams had little access, but the new system allows regional teams to run reports.
- Better tracking and accountability with customer complaints. Digitising customer complaints has enabled accurate tracking and recording of customer complaints and introduced greater accountability to the process.

Constraints and enablers



Enablers

- Stand-alone ICT department;
- Knowledgeable and experienced staff; and
- Board and management commitment to digitalisation.



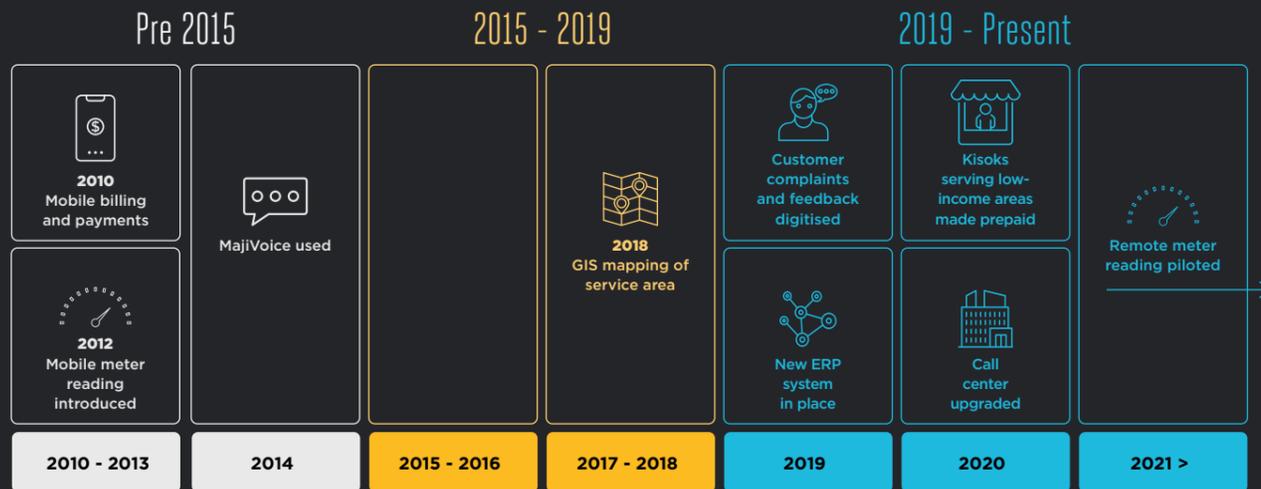
Constraints

- Mobile payments: customer concerns about payment notifications and additional fees; and
- Cost of smart meters prohibitive.



Nakuru (NAWASSCO)

FIGURE 15
NAWASSCO overview



Key digitalisation initiatives

- Early introduction of mobile payments and a switch to paperless billing in 2019.** Customers can choose between email billing or phone billing (via USSD).
- New ERP system introduced in 2019,** uniting systems across all major departments.
- GIS mapping of low-income areas in Nakuru** completed in 2018 with WASREB.
- Pilot of automatic meter reading in 2021.** Meters are read remotely via radio signal, removing the need for meter readers to enter houses.
- Planned centralisation and digitalisation of customer complaints.** Complaints can be registered in one of five zonal office through the customer toll-free line, walk ins, email and social media.
- 2021 and beyond:** the utility is keen to implement customer-facing systems (customer portals and improved mobile apps) to improve service quality.

Key WSP statistics (2019)

Overall performance (200 max):	144 - 3rd in category	
Population in service area:	528,158	
Population served	481,595 (91%)	
NRW	32%	
Number of staff	245	
Revenue collection efficiency	96%	
Revenue to O&M cost coverage	111%	
Metering ratio	100%	

Utility context

Nakuru is Kenya's fourth largest city and NAWASSCO serves nearly half a million customers. NAWASSCO is consistently rated by WASREB as one of the highest performing "very large" utilities in Kenya and is currently rated third of 16 utilities in this category. The utility has a metering ratio of 100 per cent, having seen rapid improvement in the early 2010s. O&M cost coverage is 111 per cent, just above the 110 per cent threshold set by WASREB as the minimum needed to maintain services. However, they are below the 150 per cent threshold for full cost recovery. Domestic and kiosk customers account

for approximately 75 per cent of billed water volumes. Non-revenue water fell dramatically in the 2010s, from 48 per cent in 2012 to 31 per cent in 2010.

The city's water supply comes mainly from groundwater sources (-90 per cent is drawn from 24 boreholes around the city) with the remaining from surface water. Water from the boreholes has low turbidity and requires minimal treatment and is chlorinated in the city's reservoirs. Current water production (approximately 40,000 cubic meters daily) is less than the city requires (approximately 70,000 cubic meters daily), and water rationing is used to balance supply and demand.

TABLE 9
NAWASSCO's key performance indicators, 2012-2020

	2012	2014	2016	2018	2020
Customers					
Population in service area	3,727,000	3,724,000	4,067,000	4,333,000	4,633,000
Population served	2,755,000	2,963,000	3,277,000	3,454,000	3,640,000
Connections, active and inactive	462,000	522,000	562,000	585,000	606,000
Active connections	462,000	522,000	562,000	553,000	571,000
Water production and consumption					
Non-revenue water (%)	42	39	39	38	49
Total water produced (m ³ , millions)	169	201	200	172	176
Total billed volume (m ³ , millions)	-	123	122	106	90
Domestic and kiosk-billed volume (m ³ , millions)	71	26	69	56	58
Financial and efficiency					
Turnover (KSh million)	6,090	6,890	8,404	8,478	9,177
O&M cost coverage (%)	115	105	103	97	103
Metering ratio (%)	-	94	100	100	100
Revenue collection efficiency (%)	86	91	98	96	91
Staffing					
Total staff	2,340	2,785	3,162	3,554	3,335
Staff productivity (number of staff per 1,000 connections)	5	5	6	6	6
Personnel expenditures as % of total O&M costs	-	50	58	61	61

Source: WASREB Impacts Reports Issues 6 through 13 <https://wasreb.go.ke/impact-reports/>



NAWASSCO's digitalisation journey

NAWASSCO's digitalisation journey began in the early 2010s when it introduced mobile payments and

digitised meter reading. GIS mapping was introduced later, but the utility took a leap forward in 2019 with the introduction of a new ERP system. Built on Microsoft Dynamics, the system serves all utility departments and replaced unintegrated, stand-alone systems.

Key digitalisation milestones

Year	Milestone	Partners	Details
Pre-2010	Pre-2002: manual billing system 2003: began using QuickBooks 2004: began using Pastel for accounting	-	-
2010	Introduction of M-Pesa	Safaricom	Integration directly with Safaricom using their PayBill product. Linked to billing system built on IBM Informix version 7.3.
2012	Mobile meter reading introduced	WonderKid and GSMA	Enabled meter reading using a mobile phone, with a photo taken of the meter reading and GPS tagging for validation.
2013	Acquired cloud hosting for data	List Telecommunications	Hosted the e-billing, mobile meter reading and SMS query systems
2014	MajiVoice for customer complaints	WASREB and WonderKid	National system introduced by WASREB that enables customer complaints to be recorded and tracked
2019	Creation of a stand-alone ICT department	-	-
2019	New ERP system introduced	Smart People Africa	Smart People Africa was the technology provider and the system is built on Microsoft Dynamics
2020	Conversion of kiosks to a prepaid system	Various	Kiosk operators now use a prepaid system whereby they can obtain credit via USSD or M-Pesa PayBill. Paying upfront can ensure supply as failure to pay bills in the past would result in disconnection until accounts were settled
2020	Call centre introduced	WSUP	Introduced a customer call centre with support from the HBCC programme
2021 on-going	Pilot of remote meter reading	Danco Capital	The utility has been buying smart-ready meters for several years. They are now testing remote meter reading with Danco Capital in a pilot of 300 meters. Meters are read remotely via M2M communication, enabling drive-by readings and eliminating the need to enter customers' homes.

Digitalisation by domain/function

Function	Technology	Use
Data acquisition	Sensors	NAWASSCO has yet to deploy sensors across the system at a large scale.
	Mobile devices	Mobile meter reading and GIS tagging
Connectivity	Mobile networks (GSM)	Mobile money payments Communication for remote meter reading
	SCADA	Not in use
Management and control	Smart metering	Tests of remote meter reading for household connections ongoing; ATM prepaid meters installed at kiosks
	Cloud computing	Migration to the cloud complete
Processing and storage	ERP systems	Introduced in 2019
	Visualisation	The ERP system provides reports on the general performance of different departments. A dashboard summarising key areas has yet to be implemented but is planned.
Modelling and analytics	GIS	GIS mapping of the main water and sewer lines and household connections completed
	Mobile payments	Used extensively
Customer relationships	Customer engagement/complaints	Used extensively

Key benefits of digitalisation

- Utility staff mentioned the following benefits:**
- Improvements in meter reading efficiency and billing;
 - Resolving issues with multiple contracts and reducing costs and complexity;
 - Accuracy and accountability in reading and billing; and
 - Better complaint management and resolution.



Priority areas for digitalisation

Utility staff mentioned the following priorities:

- Digitalising customer connection applications;
- Improving communication channels; and
- Exploring the feasibility of sensor deployments.



BOX 6

The launch of KIWASCO's call centre

KIWASCO becomes the first utility in Kenya to unveil a state-of-the-art call centre on 3rd February 2021. The call centre was funded in partnership with WSUP and Unilever as an intervention towards the fight of Covid-19.

The outbreak of Covid-19 brought a dramatic shift in how businesses are able to operate and accelerate moves to ways of working that adhered to the 'new normal'. The Corporate Affairs and Communication team realised a call centre was the missing link that would help the company reach and serve more customers.

This call centre has given the customer care team new capabilities, including: allowing for remote complaint resolution; self-service functions that enable customers to troubleshoot and resolve issues without talking to an agent (effectively making the service available for 24hrs); resolves potential issues related to agent availability; and allows for more customers to be served at the same time.



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Constraints and enablers



Enablers

- Support from the board of directors and management;
- Experienced and stand-alone IT department;
- Financial footing of the utility;
- Suitable suppliers; and
- Knowledgeable staff.



Constraints

- Staff resistance to changes due to familiarity with the old systems and a fear of job losses;
- Strategic planning on a five-year cycle means that new initiatives within that period need to be financed from allocations not accounted for in the tariff agreed with WASRE; and
- High cost of digital systems.





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