

**Asset Management: A Way Forward to Improving the Performance of
Urban Water Utilities in Nigeria**

Imonikhe Oseigbowa Margaret

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Declaration

The candidate confirms that the work submitted is her own except where work which has formed part of jointly-authored publications has been included. The contribution of the candidate and the other authors to this work has been explicitly indicated below. The candidate confirms that appropriate credit has been given where reference has been made to the work of others.

The findings of my research were published in the following articles

Imonikhe, O. and Moodley, K., 2014. The challenge of applying whole-life asset management to improve the performance of water utilities in sub-Saharan African countries.

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These works form part of Chapters 2, 3, 4, 5 and 7 of this thesis.

The bulk of the paper and publications were written by me with substantial guidance and contributions by my supervisor in all sections of the papers

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Abstract

This research is about adapting modern-day asset management practices to suit the Nigerian urban water sector. The research established what asset management best practices entail by looking at countries like the UK, Australia, USA and South Africa. It was observed that asset management best practices occurred because of good governance, proper monitoring schemes, the existence of training schemes and standard guidelines. Additionally, asset management best practices seemed to be more pertinent to developed countries, it, therefore, became necessary to examine the urban water context of middle-income and low-income African countries to identify unique features pertinent to their context.

From the analysis of African urban water context, issues such as poor governance, political interference, lack of financial resources, infrastructural decay and population growth and prevalence of illegal urban settlements were found. Also, an in-depth analysis of African countries like Senegal, Burkina Faso, Cote d'Ivoire, and Uganda which were referenced as good urban water management practices occurred. Fundamentals for good practice observed in these four African countries include autonomy, financial sustainability, the existence of pro-poor systems, capacity building and developing an assurance framework. It is vital to have these characteristics and principles as a precursor to adopting modern asset management practices to the Nigerian urban water sector. The research was limited to the Nigerian urban water sector because of the significant contribution it had on how Sub-Saharan African region and West African region in meeting the sustainable development goal for water and sanitation.

A critical look into the Nigerian urban water sector was undertaken during the research. An assessment of the Nigerian urban water sector revealed that key challenges such as poor governance, political interference, lack of financial resources, infrastructural decay and population growth and prevalence of illegal urban settlements impacting African countries were also evident in the Nigerian urban water sector. After this, a conceptual asset management framework was developed based on the review of best practices in asset management, African countries with good urban management practices and the Nigerian Urban water context. The conceptual model was tested using a multiple case study design. Four representative case utilities were selected out of the 36 utilities in Nigeria to test the feasibility of applying modern-day asset management practices to the Nigerian Urban water context. Interviews and focus groups were data collection instruments used for collecting data from the case studies. A total of 60 participants from the four utilities were interviewed for 45-60 minutes and asked to give their candid views about key elements of the conceptual framework which include understanding the context, asset management system, performance measuring system and key areas for improvement.

The recorded interviews were transcribed based on these key components of the conceptual framework. The Key themes emerged for each of the elements of the conceptual framework were used to modify the framework. In addition, the framework was validated with 14 experts and revised based on the responses of the participants of the validation exercise. After the validation exercise, elements of the revised framework were discussed with reference to literature to establish the implications of the findings. The results showed that that water utilities in Nigeria will need sustainable funding mechanisms that can enable the asset management process to deliver the required levels. The research also established the importance of developing an enabling environment that empowers all key stakeholders associated with the urban water sector. The research also established the need to proper engagement structures, introduction of resilient infrastructure and improve the maturity of management processes for adopting asset management.

In conclusion, the following propositions can be taken from the review of the Nigerian water sector. Asset management can be adapted to the Nigerian urban water sector when all asset types are actively managed. Asset management can also be adapted to the Nigerian urban water context when existing risk management processes are able to tackle contextual issues, stakeholders' interest and risks related to managing all asset types simultaneously. Additionally, Asset management can be adapted to the Nigerian urban water context when performance measures are in place to evaluate the asset management process, contextual factors and all asset types. Finally, Asset management can be adapted to the Nigerian urban water sector where contextual factors are integrated into the asset management system.

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List of Abbreviations

| | |
|--------|--|
| AM | Asset Management |
| ADB | Asian Development Bank |
| AfDB | African Development Bank |
| AMMCOG | Australian Asset Management Collaborative Group |
| BSI | British Standards Institution |
| CSOs | Civil Society Organizations |
| DFID | Department for International Development |
| EPA | Environmental Protection Agency |
| FCDA | Federal Capital Development Authority |
| FCT | Federal Capital Territory |
| FCTA | Federal Capital Territory Administration |
| FMWR | Federal Ministry of Water Resources |
| FRN | Federal Republic of Nigeria |
| GAO | Government Accountability Office |
| IAM | Institute of Asset Management |
| ICE | Institution of Civil Engineers |
| IDEV | Independent Development Evaluation |
| IIM | International Infrastructure Management Manual |
| JICA | Japan International Cooperation Agency |
| MDGs | Millennium Development Goals |
| NBS | National Bureau of Statistics |
| NGOs | Non-Governmental Organisations |
| NTWG | National Technical Working Group |
| OECD | Organisation for Economic Co-operation and Development |
| OFWAT | the Water Services Regulation Authority |
| SDGs | Sustainable Development Goals |
| SSA | Sub-Saharan Africa |
| SUWASA | Sustainable Water and Sanitation in Africa |
| SWA | State Water Agency |
| UN | United Nations |
| UNESCO | United Nations Educational, Scientific and Cultural Organization |
| UNICEF | United Nations Children's Fund |
| UKWIR | UK Water Industry Research |
| WECD | World Commission on Environment and Development |
| WHO | World Health Organization |

Chapter One

Introduction

1.1 Background and Context

Sustainable development is an important concept that is increasingly being considered as a pathway that leads to all that is good and desirable in a society (Holden and Linnerud, 2007, Holden et al., 2014). Sustainable development is defined in the Brundtland Report as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs”(WECD, 1987). The Brundtland report was a pioneer in describing sustainable development and associating it to a type of growth that promotes worldwide health and wealth without necessarily harming the environment. Economic growth, environmental stewardship and social inclusion are dimensions described by (Muralikrishna and Manickam, 2017) as the (3) three pillars of sustainable development.

Sustainable development retains an extensive moral appeal globally. It is widely recognised as the central norm and guidance for environment and development politics (Connelly, 2007, Lafferty, 2006). The importance and global appeal for sustainable development were clearly illustrated in 2000 at the United Nations millennium summit which is regarded as the largest gathering of world leaders in history (Bailey et al., 1996, Mejia et al., 2012, UNESCO, 2014, Whittington et al., 2008, WHO, 2003).

The Millennium summit is also regarded as the world most successful anti-poverty movement in history due to a significant decline in the number of people impacted by extreme poverty (UN, 2015). Leaders of various nations made joint commitments to achieve sustainable development through a framework known as the Millennium Development Goals (MDGs). The MDG framework was developed with eight (8) goals and eighteen (18) targets aimed at ending poverty worldwide by 2015. The MDG goals as shown in fig 3.1 include poverty eradication, universal primary education, gender equality and women empowerment, child mortality rate reduction, maternal health improvement, disease prevention, environmental sustainability and global partnerships for development.

Out of the established MDGs, Access to water and sanitation for all is stated by (Mugagga and Nabaasa, 2016, Connor, 2015, Holden et al., 2014, UNESCO, 2014, UNESCO, 2012) as a

central goal that delivers other sustainable development goals. Fig 3.1 also gives a clear representation as to how access to water and sanitation services directly impacts each MDG goals.

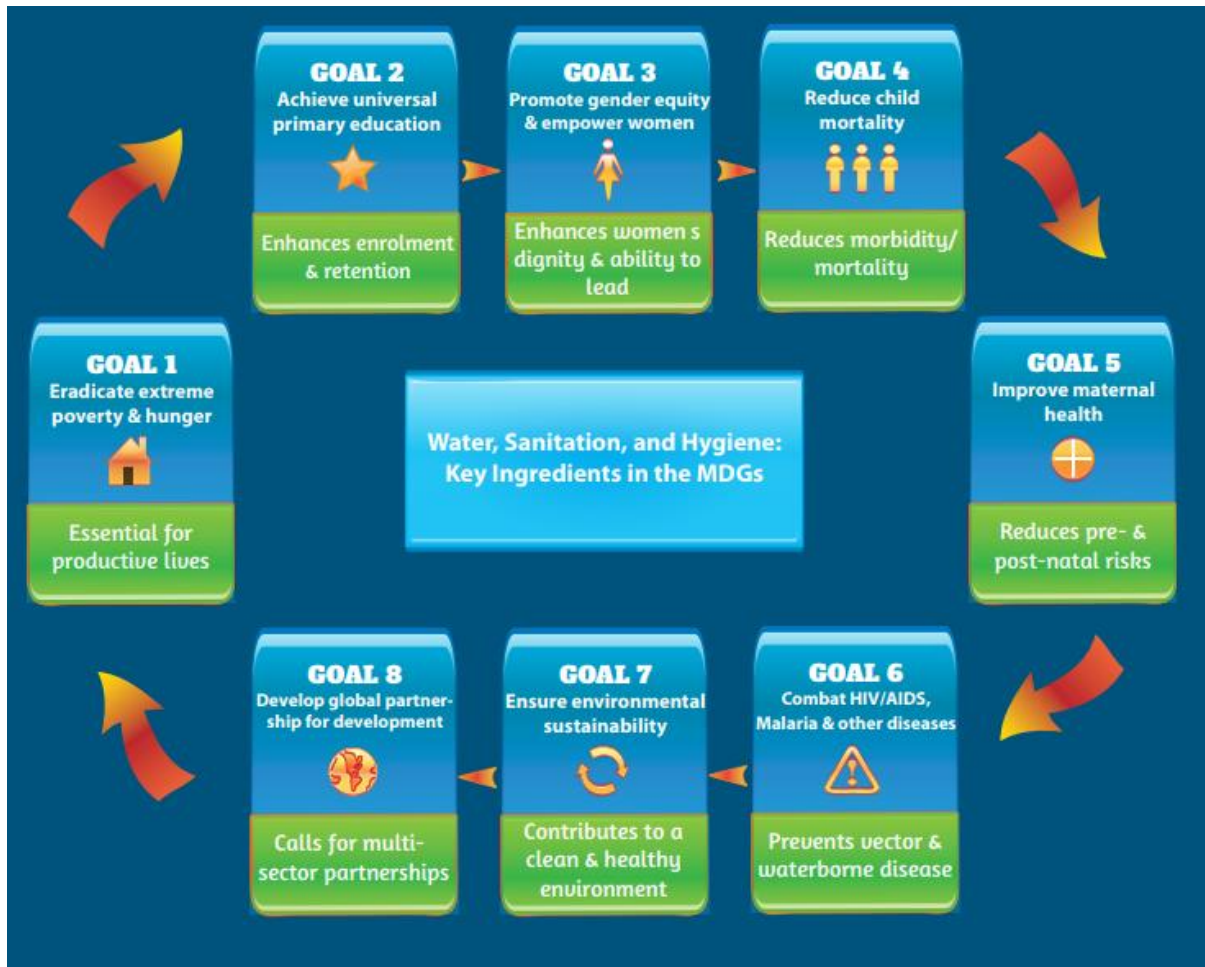


Figure 1.1: The centrality of water and sanitation in delivering sustainable development goals
 Source: (UNESCO, 2014, UNESCO, 2012)

Firstly, increased access to water and sanitation and better services has a direct impact on improved education outcomes and improved economic productivity (UNESCO, 2014). It directly impacts economic productivity as reduced times for sourcing for water enhances education enrolment and offers an opportunity for people to earn a living.

Secondly, improved water and sanitation services impact child mortality and health outcomes. (UNESCO, 2014, UNESCO, 2012) assert that improved water and sanitation services provide great health benefits to countries by decreasing vector and waterborne diseases and child mortality rates. It is estimated that improved water and sanitation can reduce diarrhoeal diseases by nearly 90% and also reduce the number of children who die each year by 2.2 million (UNESCO, 2012, Haller et al., 2007). The impact of diarrhoea on children is also estimated to

be greater than the combined impact of human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS), tuberculosis and malaria (UNESCO, 2014).

Huge savings in health-care costs and gains in productive days can, therefore, be realised by improving access to safe water and basic sanitation. Also, investing in sanitation and drinking water is stated by (UNESCO, 2012) to achieve large cost savings ranging from 2 – 7% of the gross domestic product in various countries. Cost savings from improved water and sanitation access include lower health system costs, lower mortality rate, fewer days lost at work or at school through illness or caring for an ill relative, and convenience time-savings (Hutton et al., 2007, Haller et al., 2007). Additionally, improved water and sanitation access contribute to a healthier and cleaner environment for people thus sustaining the needs for the future generation.

The role of water in delivering sustainable development has been clearly defined in the MDGs by dedicating a specific target (Target 7C) on water and sanitation as part of the overall goal of realizing environmental sustainability (Goal 7). The target aimed to “*halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation*” (WHO and UNICEF, 2005, WHO and UNICEF, 2006). Remarkable progress has occurred in access to drinking water during the Millennium Development Goals era. The MDG target for water was met in 2015 as 91% of the world population which is equivalent to 6.6 billion people used improved drinking water sources compared to 82% in 2000, (WHO and UNICEF, 2015).

However, 2.1 billion people still lack access to safely managed drinking water services as of 2015. Precisely 1.3 billion had access to basic water services, 263 million utilised limited services, 423 million had access to unimproved water sources and 159 million still used untreated surface water. 58% of 159 million people using untreated surface water are situated in Sub-Saharan Africa (UNDESA, 2018, WHO and UNICEF, 2017). A lot of countries in the Sub-Saharan Africa region compared to other developing regions are yet to achieve the newly established target for drinking water by 2030 as only a low percentage of its total population which is 24% precisely have access to safely managed drinking water as at 2015.

Despite major health and economic benefits from increased access to sanitation and drinking water many countries seem to dedicate less attention to water and sanitation (UNESCO, 2012). When compared to other sectors (namely education and health sectors), sanitation and drinking water receive a relatively low priority for developing countries most especially African countries (UNESCO, 2014). For instance, Nigeria ranks among the top 5 countries globally for

having a large population of citizens lacking access to safe water and sanitation practices and practising open defecation and the most significant contributor to Sub-Saharan Africa ranking as the lowest in the world for access to improved drinking water and sanitation (Oluseyi Abdulmalik et al., 2016, WHO and UNICEF, 2014, WHO and UNICEF, 2015, WHO and UNICEF, 2017).

The water and sanitation sector also performs poorly compared to other infrastructure sectors. For example, piped water network coverage from water utilities is only a fraction of the energy network of the nation. Also piped water network coverage which represents services supplied by state water agencies declined from 32% to 3% (WHO and UNICEF, 2015). This is by far the worst decline for water and sanitation coverage in Nigeria. Significant improvements in the Nigerian water and sanitation sector would, therefore, have an impact on sustainable development in the sub-Saharan African region based on the ranking of Nigeria globally in poor drinking water and sanitation practices.

According to (Bahri, 2012, Closas et al., 2012, Furlong et al., 2016, Kirshen et al., 2018, Whitler and Warner, 2014) solving the challenge of water and sanitation in African countries can only occur by implementing management systems that are adaptive, holistic, integrated, iterative and strategic. Therefore, a management system must be adopted for solving the Nigerian water and sanitation crisis. An example of a management system with the aforementioned characteristics is asset management. This is why the research will seek to adapt modern-day asset management practices to the Nigerian urban water context.

1.2 Problem Statement

Asset management (AM) has become a sustainable discipline that allows professionals in various sectors, move from a fragmented approach to a more integrated approach where the focus is on whole life cycle value realization (EPA, 2008a). Diverse industries adopt asset management as a critical management process for taking various business decisions.

The financial services sector, for example, is generally acknowledged by (Brown and Humphrey, 2005, Brown and Spare, 2004, Woodhouse, 2007, Woodhouse, 1997) as the first sector where the 'asset management' concept emanated. It involves the management of different financial instruments such as bonds, stocks, real estate, which were regarded as assets. The fundamental standard for AM in the finance industry was based on deriving an optimal

trade-off between risks, performance, returns and capital security (Brown and Humphrey, 2005, Brown and Spare, 2004).

The AM philosophy also emerged in the processing and manufacturing and mining industries (Bhagwan and Wall, 2008, Bhagwan, 2009, Woodhouse, 2010a). In the manufacturing, pharmaceutical, mining and petrochemical industries, asset management applies to short-term decisions, day-to-day activities ‘temporary tasks’ such as equipment maintenance and asset care. However, there are success stories of implementation and case studies in these sectors which could serve as platforms for transferring legacies and capturing critical lessons.

The level of asset management maturity in oil and gas exploration and productions sector, on the other hand, is said to be more sophisticated in comparison to other processing industries, as most of the innovative thinking on the AM was first developed in these sectors. This is adequately documented in the content and structure of BSI PAS 55 (Woodhouse, 2010a, Institute of Asset Management, 2015a). The European North Sea oil and gas sector was one of the first to develop an integrated approach to AM after the Piper Alpha disaster in 1988 (Beck and Woolfson, 2000, Woolfson et al., 2000) and the crash in oil prices (Manase, 2015, Lambie, 2013). Furthermore, great outcomes like the Cullen enquiry on asset risk management were resultant effects (Woodhouse, 2007).

The public sector is not left out when it comes to asset management implementation. As far back as 1980, the case for providing a proactive approach for the management of public infrastructure and property was raised in Australia, New Zealand and UK to address the deterioration of valuable public services (Male, 2010, Woodhouse, 2010b). One of the ways by which the concept and principles of asset management were formally implemented were through the development of the International Infrastructure Manual (IIMM) (Vanier and Rahman, 2004, Laue et al., 2011, Laue et al., 2014). The Total asset management guideline (TAM -06) is also an example of a system created to assist central governments and government agencies wishing to successfully implement AM strategies for public infrastructure management.

The utility and rail sector have also realised immense benefits from developing and implementing formal asset management Systems. Utilities and rail industry have a unique characteristic that distinguishes this sector from its peers. The unique characteristic is that Capital expenditure (CAPEX) and operational expenditure (OPEX) combined or Total

Expenditures (TOTEX) associated with their asset portfolio are usually higher than generated revenues and profits. In the UK for instance, when water utilities were privatised, they had to look for optimal ways for achieving high-performance levels and higher efficiencies. The reduction in maintenance regimes became a necessity as huge investments were made on maintenance due to a historic case of poor maintenance and the accountability required by probing government agencies and regulators (Edwards, 2010).

Thus the rationale for asset management came into existence and the development of the Institute of asset management in the UK occurred where most key players were from the water industry. Huge financial investments needed to operate, renew, refurbish and maintain ageing infrastructure asset means that asset management is now and will be a fundamental business strategy for water utilities in the UK and many other high-income countries (Brint et al., 2009).

The water industry is increasingly recognising that asset management practices allow water utilities to serve customers more effectively by encouraging better financial, social and environmental responsibility (Aikman, 2014). Ultimately, organisations are looking to deliver water in a sustainable manner that meets the needs of present customers and future generations to come. Successful asset management practices continue to emerge in countries like Australia, New Zealand, Canada, the European Union and the UK (Bhagwan and Wall, 2008, Bhagwan, 2009). Water Utilities. It is important to note that countries like UK, Australia, New Zealand are regarded as asset management best practices because they have the required financial maturity, training schemes, good governance and assurance frameworks that allow asset management to thrive.

The majority of literature on asset management for water refers to high-income countries while less attention has been given to developing countries. (Alegre and Coelho, 2012, Alegre and do Céu Almeida, 2009, AWWA, 2001, Bhagwan and Wall, 2008, Bhagwan, 2009, Vinnari et al., 2009, Gleick, 2008, Schulting and Alegre, 2009). High-income countries are countries that are seeking to become more advanced economically and socially. But most times the required financial maturity, competencies, infrastructure, political stability and governance that allows asset management thrive is sometimes questionable and absent in such countries.

In Nigeria, the water and sanitation sector is characterised by having a lot of political interference, poor governance, corruption, poor finance and low competencies (Nwankwoala, 2011, Nwankwoala, 2014, Obinna et al., 2010, Odigie and Fajemirokun, 2005, Ogwueleka, 2010, Ohwo, 2016, Okeola and Raheem, 2016, Okoye and Achakpa, 2007, Olajuyigbe, 2010,

Omole, 2013, Orubu, 2006, Oyebande, 2006, Oyebode, 2014, Oyedepo, 2012, Oyegoke S. O., 2012, World Bank, 1994, World Bank, 2005, World Bank, 2011a, World Bank, 2000, World Bank, 2004). These issues could adversely impact asset management implementation in the water and sanitation sector. The research will, therefore, seek to explore **“how modern asset management practices can be adapted to suit the urban water sector in a middle-income and low-income African country”**.

The research questions which have been developed specifically to address the research problem are outlined below:

1. What are the essential features of asset management best practices in the water sector?
2. What are the benefits of implementing asset management best practices?
3. How have countries in Africa developed good urban water management practices?
4. What are the existing management practices in Nigerian and what has been their impact on water utilities?
5. How can good urban water management practices and countries from African utilities and asset management best practices in high-income countries be transferred and adapted to the Nigerian urban water sector?

1.3 Aim and Objectives

The primary aim of the research is to explore how modern-day asset management improvements can be implemented successfully in a middle-income and low-income African urban water sector. To achieve this aim, the following objectives should underpin the research to:

- Examine the features of asset management best practices
- examine and clearly outline the inherent unique characteristics of a middle-income and low-income African water context
- examine the features of good management practices in African countries
- examine the maturity levels and factors required for delivering modern-day asset management practices
- examine the existing urban water management practices of Nigeria and its impact on the performance of water utilities
- explore how modern-day asset management can be adapted to the Nigerian Urban Water context

1.4 Significance of the Research

The delivery of improved water and sanitation services in urban utilities in African is a critical issue that impacts the sustainable development of the continent (OECD and UNECA, 2013). In recent times, various reforms and initiatives have been established to address the underperformance of water utilities in meeting the water demands of their population amid rapid urbanisation and increased population growth coupled with the absence of proper governance and limited financial resources and low competencies.

Conventions such as the World summit on sustainable development, West African Ministers conference in conjunction with international organisations AFBF, DFID, World Bank have created projects, studies and specific requirements in ensuring African utilities are better equipped to meet the water demands. (Bogardi et al., 2012, Gleick, 2004, Gleick, 2008, Lane, 2004, Mwanza, 2005, Salman, 2004). This is why the research will explore how modern-day asset management improvements can be implemented successfully in a developing African urban water sector using the Nigerian urban water context.

Focus on Nigerian Utilities only is because of how improvements in the Nigerian urban water sector could potentially impact the achievement of SDG goals of west African and Sub-Saharan African region; Nigeria is the most significant contributor to Sub-Saharan Africa ranking as the lowest in the world for access to improved drinking water and sanitation (Oluseyi Abdulmalik et al., 2016, WHO and UNICEF, 2014, WHO and UNICEF, 2015, WHO and UNICEF, 2017). Thus the industrial rationale for this research is established because developing modern-day asset management practices for Nigeria has the potential to impact the overall performance of the Nigerian Urban water sector, the West African region and Sub-Saharan African region simultaneously.

Also, Nigeria represents one of the countries that have the largest economies in the African region and since water and sanitation have a role to play in poverty alleviation (Ciancio et al., 2013, Namara et al., 2010, Postel, 1996, Sullivan, 2002), delivering asset management improvement in the Nigerian water sector will, therefore, impact poverty alleviation and the wider African economy. Hence the rationale for focusing on the Nigerian urban water sector is justified.

Furthermore, focus on implementing asset management in water and sanitation specifically is as a result of how central access to water sanitation is important in delivering all other sustainable development goals like poverty eradication, universal primary education, gender

equality and women empowerment, child mortality rate reduction, maternal health improvement, disease prevention, environmental sustainability and global partnerships for development (Ciancio et al., 2013, Namara et al., 2010, Postel, 1996, Sullivan, 2002).

Contrasting Nigeria with other African countries that have existing good urban water management practices will demonstrate the impact of these good practices within similar operating context. Furthermore, this will elucidate the main aspects of the current practices of the Nigerian urban water sector that needs to be changed.

Conducting research using the Nigerian Scenario which is a country where asset management is novel will be regarded as a stepping stone and progress towards the broader Sub-Saharan African context as lessons learnt should be transferrable to other developing African countries. Successful completion of this research using the context Nigeria will be an addition to few asset management studies conducted in countries in sub-Sahara Africa like South Africa and Kenya which have applied formal asset management approaches successfully.

Secondly, Population growth and rapid rate of migration to urban settlements have been described previously as major determinants for water scarcity, in African countries most especially (Jacobsen et al., 2012). Being the most populated nation in the African continent, Nigeria has been selected as a representative sample for this characteristic as most of its urban settlements like Lagos which will be the 3rd world megacity by 2025 and Abuja for example, (which will be used as case studies) experience rapid population growth due to migration from rural areas and high birth rates.

The majority of asset management literature, framework, manuals and standards produced, are mainly about high-income countries however less attention has been given to the challenges middle-income and low-income countries face with the management of their water companies most especially in Sub-Saharan African countries (Vinnari et al., 2009). Asset management institutes like IAM, are constantly increasing the awareness of asset management by developing standards and specification in collaboration with more countries overtime (Katičić and Lovrinčević, 2012, Woodhouse, 2013).

Thus the importance of the research is established as it provides awareness to the case study Nigerian utilities about the benefits of implementing whole-life asset management which is a relatively new development in Nigeria. Little research has been focused on developing asset management practices in the Nigerian water sector. The focus has been majorly associated with financial asset management (Ikpefan and Mukoro, 2012), asset maintenance and facilities

management (Eti et al., 2005, Eti et al., 2006b, Eti et al., 2006a) which are only part and not the complete process of modern asset management practices.

1.5 Proposed Contribution

Frameworks and standards usually developed in asset management are focused on the internal context of organisations and little focus is on the external context because of the assumptions that external enabling environments with governance, policy implementation, established legislation, regulatory frameworks and required competencies and information system and financial resources exist already exist (Amadi-Echendu et al., 2010, Stapelberg, 2006). The novelty and theoretical contribution the research brings is based on establishing asset management models that integrate the management of contextual factors with the management of all types of assets and consider contextual issues and stakeholder issue within the scope of the asset management system.

Also, most asset management standards developed tend to focus sole of physical asset management even though people, finances and information are all critical for meeting required service levels. Additionally, water supply and sanitation involve coordinating and managing all asset types. Thus, another theoretical contribution will be to research on how asset management can be adapted to all types of assets simultaneously i.e. human assets, information assets, physical infrastructure and financial resources.

Secondly, a considerable body of literature on asset management are majorly about high-income countries with little attention to low-income and middle-income countries (Alegre and do Céu Almeida, 2009, AWWA, 2001, Bhagwan and Wall, 2008). Asset management is relatively new to the Nigerian water context as most literature focus on an aspect of asset management such as maintenance and facility management. This research will, contextually contribute to the urban water sector of low-income countries and middle-income countries, sub-Saharan African countries and Nigeria because issues such as governance, low resources and funding, political interference, human competencies, population growth and urbanisation which are associated to their context have been addressed.

Conducting research using the Nigerian Scenario which is a country where asset management is novel and can be regarded as a steppingstone and progress towards the broader Sub-Saharan African context as lessons learnt are transferrable to other middle-income and low-income African countries. Successful completion of this research using the context Nigeria will contribute to existing asset management bodies of knowledge in countries in sub-Sahara Africa

like South Africa and Kenya which have applied formal asset management approaches successfully.

Focus on Nigerian Utilities only is because of how improvements in the Nigerian urban water sector could potentially impact the achievement of SDG goals of West African and Sub-Saharan African region; Nigeria is the most significant contributor to Sub-Saharan Africa ranking as the lowest in the world for access to improved drinking water and sanitation. Thus, the industrial rationale and contribution for this research are established because developing modern-day asset management practices for Nigeria has the potential to impact the overall performance of the Nigerian Urban water sector, the West African region and sub-Saharan African region simultaneously.

1.6 Thesis Structure

The thesis is structured in nine (9) chapters with the first Chapter being the introduction chapter. Chapter 1 contains the background to the research, the aim and objectives of the study and the problem statement. Additionally, the justification for the research and the proposed contributions of the research are written in detail.

In Chapter 2, a critical review of the literature on modern-day asset management practices was carried out. The review addresses the emergence of asset management and the principles of asset management best practices looking at four high-income countries.

Chapter 3 provides an overview of African countries with good management practices. The challenges of utilities in the African context. It will establish characteristics of utilities with good asset management practices. The principles and prerequisite for good management practice.

Chapter 4 will examine the Nigerian context, the challenge of the Nigerian water context, the existing management processes in the Nigerian water sector.

Chapter 5 will develop the conceptual framework which is developed from the literature critically analyses the developed framework which a product of the data analysis chapter and the validation and verification of findings are described in great detail and the revised framework is also shown.

Chapter 6 elaborates on the methodology adopted for the research work and most importantly justifies the rationale supporting their choice.

Chapter 7 establishes the significant findings resulting from the research conducted in the four case utilities.

Chapter 8 discusses the verification and validation process for the framework and findings. The modification of the framework is also analysed in this chapter.

Chapter 9 discusses the implication of the findings to the wider body of knowledge. Comparisons of findings with existing literature will also occur in this chapter. Also, the revised framework will be discussed in this section.

Chapter 10 concludes the research by identifying how the aim and objectives of the research have been achieved, conclusions and recommendations for future works are stated and contributions to the body of Knowledge is carefully identified including publications which have been made during the research.

Chapter 2

Asset Management best practices in the urban water sector

2.1 Introduction

The urban water and sanitation industry is a complex environment characterised by issues such as population growth and urbanisation, climate change, deterioration and increasing complexity of infrastructure systems, emerging technologies, changing public priorities. However, novel management such as asset management is emerging and targeted at addressing the water demand gap existing in urban centres (Cooley et al., 2013).

Successful asset management practices and innovative systems continue to emerge in developed countries like UK, USA, South Africa, and Australia (Alegre and Coelho, 2012, Alegre and do Céu Almeida, 2009, Bhagwan, 2009, Lee et al., 2015, Schulting and Alegre, 2009, Vinnari and Hukka, 2010). Lessons can be learnt from Utilities with successful AM practices which in turn could be applied to Utilities characterised by low efficiencies and poor performance.

This chapter builds a foundation for justifying the need for AM in the Nigerian water industry where the required institutional stability, financial maturity, competencies and political stability for asset management may be absent or questionable. A detailed evaluation of asset management and its relevance in achieving sustainable water and sanitation services is crucial at this point as it builds a foundation for developing an AM system adaptable to the Nigerian context. Thus, this chapter will define asset management, critically review principles of good asset management and the Prerequisites for successful asset management. In addition to this, successful case studies with formalised asset management systems will be examined.

2.2 Asset management defined or unclear?

Lately, asset management has evolved from a concept mainly linked with the financial market to a widely accepted term and process utilised in different industries with varying perspectives, standards and service requirements (Marlow and Burn, 2008, Institute of Asset Management, 2015a). There is a lack of consensus on the definition of an asset, what constitutes asset

management and categories of assets that should be considered in asset management. This is as a result of the diverse nature of the various industries implementing asset management. Various industry professionals tend to adapt asset management to suit their needs and context. Popular definitions and some few cases are highlighted below in Table 2.1

Table 2.1: Definitions of Asset Management.

| School of thought | Definition |
|--------------------------------|--|
| (Brown and Spare, 2004) | “Asset management is the art of balancing performance, cost and risk”. |
| (IIMM, 2006) | “Asset management is the combination of management, economic, engineering and other practices applied to physical assets to provide the required level of service in the most cost-effective manner” |
| (BSI, 2008a) | “Asset management is described as systematic and coordinated activities and practices through which an organisation optimally manages its assets, and their associated performance, risks and expenditures over their lifecycle to achieve its organisational strategic plan” |
| (McElroy, 1999) | “Asset management is a ‘systematic process of maintaining, operating and upgrading physical assets cost-effectively” |
| (OECD, 2001a) | “A systematic process of maintaining, upgrading and operating assets, combining engineering principles with sound business practice and economic rationale, and providing tools to facilitate a more organised and flexible approach to making the decisions necessary to achieve the public’s expectations” |

(Alegre, 2008)

“Asset Management is a multidimensional approach that may be defined as the corporate strategy and the corresponding planning and systematic and coordinated activities and practices through which an organization optimally manages its assets, and their associated performance, risks and expenditures over their lifecycle”

(BSI, 2014)

“coordinated activity of an organization to realize value from assets”

Source: (AAMCoG, 2001, Alegre, 2008, Alegre, 2010, Alegre and Coelho, 2012, Alegre and do Céu Almeida, 2009, Brown et al., 2014, Brown and Humphrey, 2005, Brown and Spare, 2004, BSI, 2008a, BSI, 2008b, BSI, 2014, Institute of Asset Management, 2015a, IIMM, 2006, Katičić and Lovrinčević, 2012, McElroy, 1999, OECD, 2001b, Woodhouse, 2007, Woodhouse, 2013)

The definitions seen in Table 2.1 differ based on the type of assets in consideration, the type of activities required for coordinating and managing assets and finally the outcomes and deliverables expected from managing assets. Outcomes range from balancing risks, realizing value, meeting stakeholder expectations and cost management.

Professionals in various industries while trying to adapt asset management to suit their industry tend to describe asset management by using words specific to their industry to qualify the meaning asset management. Examples such as facilities asset management, transportation asset management, water asset management, oil and gas asset management are ways where asset management is defined to focus on a specific industry. (Amadi-Echendu et al., 2010). Concepts like integrated asset management, whole-life asset management, strategic asset management, tactical asset management, enterprise asset management are also definitions used when focusing on certain principles and characteristics required to meet specific service requirements. (IAM, 2014, Bhagwan, 2009).

Additionally, some terminologies focus on the types of assets such as infrastructure asset management, physical asset management, financial asset management, information asset management (Institute of Asset Management, 2015a). Also, asset management standards such as The International Infrastructure Management Manual (IIMM), IAM conceptual framework and ISO55000 most times are designed with reference to physical infrastructure.

The existence of industry-specific, asset-specific and attribute specific definitions have created issues such as a lack of clarity and understanding of the AM notion, existence of conflicting views about what AM entails. There is also the potential danger of organisations neglecting other assets, sectors or factors fundamental to the continuous sustenance of their business when asset management is only related to a particular sector, asset type, or principle. Also, asset management as a discipline loses very important attributes such as being holistic, integrated and adaptive when it is focused on specific asset types or specific industries. Drawing from the work of several contributors, (AAMCoG, 2001, Brown et al., 2014, Brown and Humphrey, 2005, Brown and Spare, 2004, BSI, 2008a, BSI, 2008b, BSI, 2014, Institute of Asset Management, 2015a, Katičić and Lovrinčević, 2012, Woodhouse, 2007, Woodhouse, 2013) state that asset management is relevant to all asset types; tangible and intangible, financial and physical assets.

Organisations invest in assets to achieve a major aim which is adding value to their organisation thus asset management as a concept should be centred more on “value” than on the asset, processes, operations or inputs. For this research, the ISO5500 AM guidelines by (BSI, 2014) definition is adopted because of its focus on achieving value rather than the asset solely. (BSI, 2014) in its ISO5500 family standard for asset management defines asset management as “coordinated activity of an organisation to realise value from its assets. (BSI, 2014) approach to asset management is not just focused on maintenance of physical assets or delivering profit from financial investments. Rather it takes a broader perspective by addressing all asset types, asset systems and individual components and activities which occur throughout the life cycle of an asset.

Most Asset Management (AM) scholars tend to link AM to the management of Physical assets only, however it is important to note that physical assets are only just a part of the asset types that impact the way organisational goals are achieved (Woodhouse, 2014). There are 5 asset categories identified by (BSI, 2008a) that have a significant impact on the organisational strategic plan. These 5 asset categories including physical assets and are shown in Fig 2.1 and discussed below:

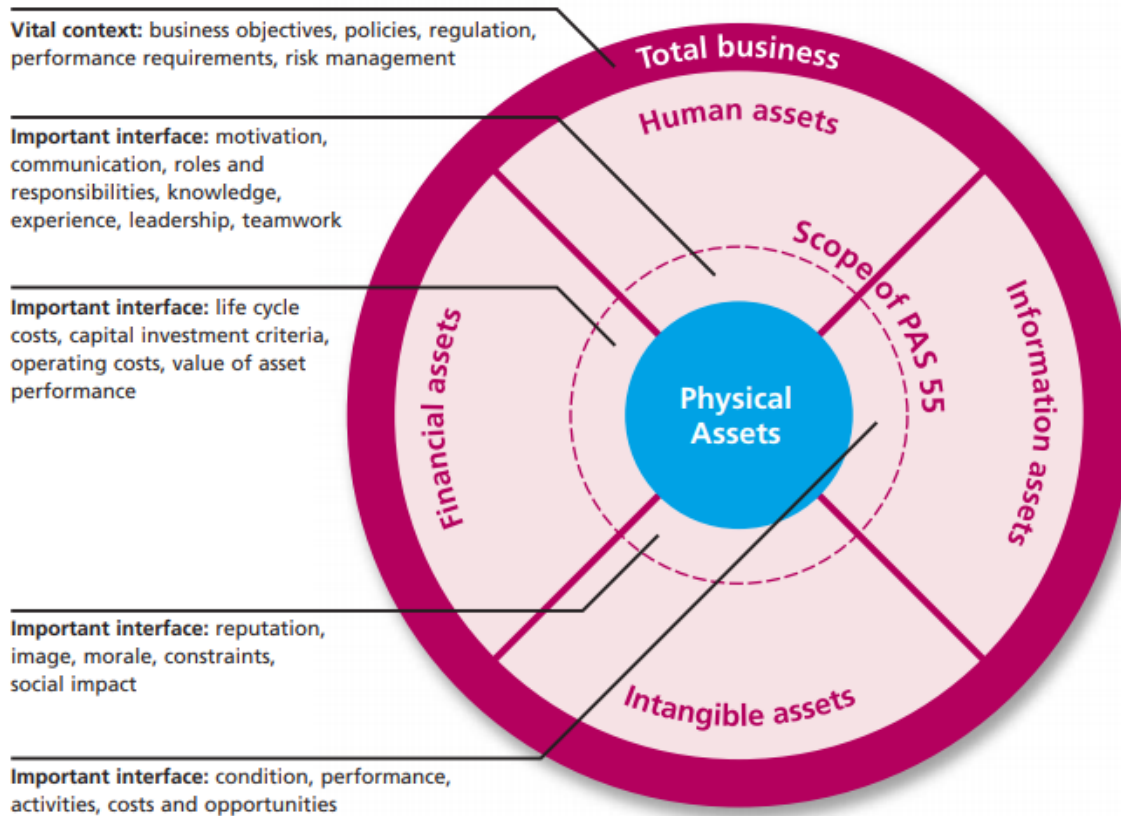


Figure 2.1: Broad Categories of Asset types and their interactions.

Source: (BSI, 2008a)

2.2.1 Physical Assets

(Davis, 2016) defines physical assets as items such as buildings, utility infrastructure such as electrical cables, water pipes, rail lines and metro tunnels, and industrial assets such as oil rigs, chemical plants and process plant conveyors. Features of physical assets include; deterioration in condition with use, value depreciation over time and benefiting from good stewardship,

2.2.2 Human Assets

Employees and staff of an organisation are said to impact an organisation's image because of the potential economic value and competitive advantage they can add to an organisation (Ananthram et al., 2013). Also, they are regarded as assets because competencies, knowledge, teamwork and leadership are human factors which impact the performance of physical assets, information assets and financial assets.

2.2.3 Information Assets

(Oppenheim, 1998) argue that information should be considered as assets because similar to intangible assets they are easily identifiable and controlled. (Engelsman, 2007, Wilson et al., 2000) also, assert that information assets have the potential to deliver value to an organisation just like employees. Information systems and data could also be considered as an asset given that quality data and information are key requirements for monitoring the performance of other assets effectively. (Gregory, 2011) state that an organisation without proper data governance is very likely to fail, hence the rationale for considering information as an asset is established.

2.2.4 Intangible Assets

According to the (International Accounting Standard Board, 2014) intangible assets are “controlled, identifiable, non-monetary assets without any physical substance. Intangible assets include goodwill, brands, licenses, patents, trademarks, reputation, image, morale and intellectual property and copyrights (Powell, 2003, Pucci et al., 2014). Intangible assets influence investment in other asset categories and operating strategies of an organisation. (Niculita et al., 2012) states that intangible assets have a very strong influence on the financial value and performance of an organisation. Hence intangible assets should be considered as part of the asset management process.

2.2.5 Financial Assets

The success of an organisation is sometimes determined by their ability to successfully secure financial assets such as bonds, loans, stocks and bank deposits. These financial assets are usually required for capital investments and investments in infrastructure projects, information systems and human resources which are other asset types.

From the definition of the various asset categories, it can be seen that each asset type performance is dependent on all the other asset types. Since all assets types depend on each other while delivering value to an organisation; there is a need to manage them together instead of as separate entities.

(BSI, 2014) define assets “An asset is an item, thing or entity that has potential or actual value to an organisation”.

This definition by (BSI, 2014) for an asset is adopted for the research purpose because it proposes a situation where asset management is adaptable to any organisation with any asset type both physical or intangible, any kind of business and any size of business. In general, (BSI, 2014) does not necessarily show how it should be applied to other asset categories such as human assets, information assets or intangible assets as particularity most times is placed on Physical assets.

The generic approach taken in describing assets and asset management can be considered as an attempt to link asset management to all types of assets and is expected that more guidelines of such nature would emerge over time (Woodhouse, 2014). In addition, (Woodhouse, 1997) also proposes that broadening the scope of asset management to accommodate other core elements like intellectual property, workforce capabilities which are of significant value to an organisation provides a good foundation for exploiting assets and managing assets effectively. The scope of Asset management is therefore applicable to all asset types, industries and professions even though this is not what occurs in reality.

In reality, asset management as a discipline is gradually gaining momentum in different industries globally. Notable asset management activities have occurred in various countries like US, Australia, New Zealand, Europe and UK where asset management frameworks and standards were developed and implemented successfully to meet the expectations of stakeholders (AAMCoG, 2001, CH2MHILL, 2013, Edwards, 2010, EPA, 2008a, Laue et al., 2011, Laue et al., 2014, BSI, 2008b, UKWIR, 2007, Woodhouse, 2010a, Woodhouse, 2013). The next section of this report will, therefore, consider the global emergence of the asset management discipline.

2.3 Global Asset Management best practices in the urban water sector

Research in asset management has developed within the last decade with reference to high-income countries while low-income and middle-income countries have received little attention (EPA, 2008a, EPA, 2014, Hukka and Katko, 2015, ICE, 2013, IIMM, 2006, Lee et al., 2015, Marlow et al., 2010, Vinnari and Hukka, 2010, Vinnari et al., 2009). However, middle income and low-income countries are also facing major challenges associated with the management of water and sanitation services and can, therefore, benefit from asset management. Asset management practices in countries and regions like Australia, New Zealand, Canada, European Union and the UK are described by (Alegre, 2008, Alegre and Coelho, 2012, Alegre and do Céu Almeida, 2009, Bhagwan and Wall, 2008, Hukka and Katko, 2015, Schulting and Alegre, 2009, Vinnari and

Hukka, 2010) as AM schools and best practices based on the levels to which they have advanced in developing their approach to asset management. A review of these AM schools will occur in the section of this research to provide several applicable principles of AM best practices for the water sector in middle-income or low-income countries. The countries with best practices will be assessed based on critical factors that have made them successful. See Table 2.2 for details.

Table 2.2: Comparison of international asset management practices.

Source: (Vinnari and Hukka, 2010)

| Leading Countries in Asset Management | Fixed asset ownership | Legislation and Policy drivers | Main organisations involved | Asset Management Planning | Bodies of Knowledge |
|--|---------------------------------------|---|--|---|--|
| England and Wales | Private | Water Industry Act of 1989 | National regulator | Required by a regulator. Five-year plans, anticipated future requirement 25 years | PAS55, ISO5500, IAM Conceptual framework |
| Australia | Public | Accounting Standard 27, CoAG principles | State regulators, professional associations, | Required by some of the regulators. Length varies according to state | IIMM, AMCOG |
| New Zealand | Public | Local Government Act 1989; 2002 | Local government, professional associations | Statutory minimum requirement of 10 years | IIMM |
| United States | Mostly Public | GASB 34 | EPA, professional associations | Not specified however financial statements are requirements from GASB34 | SIMPLE guide |
| South Africa | Government-owned / Municipality Owned | Green drop initiative, Blue Drop Initiative | DWA | | |

The 5 (five) countries in table 2.2 have been selected as countries with asset management best practices because they are rated highly and have years of continuous successful asset management implementation stories compared to other developed countries (EPA, 2008a, EPA, 2014, Hukka and Katko, 2015, ICE, 2013, IIMM, 2006, Vinnari and Hukka, 2010, Vinnari et al., 2009, Marlow et al., 2010, Lee et al., 2015). Additionally, the selected countries are leading practices in setting clear governance structures, effective assurance systems and systematic asset management plans that allowed for successful asset management.

Furthermore, countries like UK, Australia, New Zealand, USA have developed bodies of Knowledge such as IIMM, ISO55000 that serves as a major reference point for most countries implementing asset management (AAMCoG, 2001, Boshoff et al., 2009, Blankenship and Slaven, 2016, BSI, 2008a, BSI, 2008b, BSI, 2014, Institute of Asset Management, 2015a, Institute of Public Works Engineering et al., 2015, Stephenson et al., 2001). Additionally, these countries have also been innovative in developing training mechanisms for delivering high asset management competency levels (AAMCoG, 2001, BSI, 2014, BSI, 2008a, BSI, 2008b, Institute of Asset Management, 2015a, Institute of Public Works Engineering et al., 2015). A detailed look at the principles for best asset management practices based on selection of countries like UK, Australia, New Zealand, USA and South Africa are analysed below.

2.3.1 Presence of Clear Governance Structures

For countries like UK, Australia, New Zealand USA and South Africa, the presence of clear governance arrangements such as legislation, policies and regulator plays has played a major role in establishing asset management best practices. In New Zealand, water and waste services are provided by the local government sector and are subject to local government legislation. The principal legislation guiding local government in managing their infrastructure is the Local Government Amendment Act (No.3) 1996, the Local Government Act (LGA) 2002 and Institute of Chartered Accountants Financial Reporting standards. In New Zealand, Local government authorities are required by these laws to adopt and prepare 10-year financial statements every 3 years. These plans take asset creation, loss of asset service potential, and benefits and costs of different asset options into account.

In Australia, regulation of water and wastewater services differs based on jurisdictions. Regulatory functions are primarily based on price setting, licensing and third party access (Abbott et al., 2011). In Australia, legislation, regulatory licence requirements and accounting standards have been major drivers for implementing asset management. In the water industry, Sydney Water and Hunter Water were pioneers in implementing asset management after the New South Wales government passed legislation to restructure water boards as ‘state-owned corporations’ (Amaral et al., 2017, Jones et al., 2014). While Australian legislation requires water utilities to make a full recovery of capital and operational costs, New Zealand legislation requires utilities to depreciate their assets annually and use cost-benefit analysis (GAO, 2004).

In South Africa, The Department of Water Affairs (DWA) regulates the water sector under the jurisdiction of the two major water acts: the National Water Act (1998) and the Water Services Act (1997). It monitors the performance of water businesses and regulates drinking water quality and wastewater quality through three priority programmes. The blue drop and green drop initiatives are regulatory mechanisms for drinking water quality and effluents quality. The third initiative is a regulatory performance system which utilities have to comply with (Carden and Armitage, 2013, DWA, 2013, Zhuwakinyu, 2012). DWA is also proactive and well advanced in promoting Infrastructure asset management strategy to municipal water service authorities in South Africa (Wall, 2009).

Also, legislative drivers for asset management in the water sector in South Africa are the Municipal systems act and the Water Service Act. The 1998 Municipal structures act state that municipalities should ensure that communities should receive municipal services that are managed in a financially sustainable way (Boshoff et al., 2009). Sections 1 and 4 of the act stipulate the maintenance, repair and replacement of infrastructure assets. In addition, the drive for asset management implementation in South Africa is also based on the requirements of the Water Service Act of 2000 for water service providers to provide updates on development planning, their list of liabilities and assets (Boshoff et al., 2009, Stephenson et al., 2001).

In England and Wales, the operations private water companies are regulated by 3 independent bodies: The Office of Water Services (Ofwat), The Drinking Water Inspectorate and the Environment Agency. Ofwat functions as an economic regulator. The primary duty of Ofwat is ensuring water companies operate according to given statutory requirements and that these

companies remain commercially viable. (Engelhardt et al., 2003, Floate, 2014, Pollitt and Steer, 2012, Saal and Parker, 2001).

The regulatory model of Ofwat requires the water companies to submit Asset Management plans every 5 years so they can assess the performance of water companies and measure the extent to which the terms of the license are adhered to. (Edwards, 2010, Floate, 2014, Parsons, 2006, UKWIR, 2007). The Drinking Water Inspectorate monitors the quality of drinking water produced by utilities and the Environment Agency ensures the utilities comply with the quality of wastewater discharged to the environment. Powers are vested on these regulators under enacted legislation and water laws guiding the UK water industry are The Water Act 1989 and The Water Act 2003.

Unlike in the Australian, New Zealand and British contexts, there has been no centrally focused AM effort at the US Federal level – no national mandates and no formally designated national committees or task forces to set standards and define best practice. This is because the Federal Government has little direct authority in the day-to-day operations of most local water and wastewater infrastructure. This responsibility lies with state and local governments of various forms. However, the Federal Government has exercised considerable influence on local government decision making because of its massive grants and low-cost loans on local infrastructure investment. In addition, the Federal Government through regulation and investment in Knowledge transfer has played a huge role in developing AM initiative in the US water and wastewater sector.

The US Environmental Agency (USEPA) has a regulatory role in the water and wastewater industry in the US. Two federal statutes are the foundation for regulation carried out by EPA. These are the Clean Water Act and the Safe Water Drinking Act. EPA is required by the Clean Water Act to enforce a regulation that brings about the elimination of Sanitary Sewer Overflows. According to the Clean Water Act, National Pollutant Discharge Elimination System (NPDES) permits must include requirements for discharging facilities to develop and implement operations and maintenance procedures and financial plans sufficient to ensure their future operational integrity and help them comply with permit discharge conditions (EPA, 2017).

In 1999, the Governmental Accounting Standards Board issued Statement 34 (GASB34) which set out accounting principles to be used in preparing financial statements. GASB34, as it is known, was designed to ensure that the full cost of service provision by utility companies among others

was exposed to view for the benefit of interested parties. The statement encouraged companies to implement asset management practices through the provision of a specific method of accounting but did not define how asset management was to be carried out (Aikman, 2014, Institute of Public Works Engineering et al., 2015)

Even with different types of legislation, regulatory modes and modes of operation the following key points can be drawn from these countries. The legislation clearly establishes the jurisdictions of water companies and the regulators. Regulators like OFWAT in the UK, DWA in South Africa and state regulators in Australia are given a level of influence over the water utilities under their respective Water Acts and constitution/ bye-laws (Bhagwan, 2009, DWA, 2013, GAO, 2004, IWR, 2013). Secondly, Policies and Legislations are implemented and most of the legislations are designed to ensure that asset management is a requirement for licensing of water companies.

However, in the case of the US, it is worth mentioning that even without legislation, USEPA has been able to monitor even though regulators can adequately monitor the performance of water utilities. Because the Federal government have a level of influence the on local government decision making because of its massive grants and low-cost loans on local infrastructure investment. Finally, Effective monitoring schemes such as submission of respective maintenance plans or asset management plans for periodic reviews are also in place. These schemes make it possible for regulators to monitor performance.

2.3.2 Development of Systematic Asset Management Plans

Another critical lesson that can be drawn from countries with best practices is that the development of asset management plans by water utilities is very instrumental in implementing asset management in their various water industries. For instance, in the UK, Every 5-year Asset Management Plans are developed focusing on different performance targets such as water quality improvements, asset data improvement, understanding serviceability as depending on what is stipulated by Ofwat and the UK Water Industry Research Ltd (UKWIR) (Floate, 2014, Heather and Bridgeman, 2007, Machell et al., 2014, Ofwat, 2017b, Ward et al., 2014).

Also, there are Frameworks in the UK which serve as guides to utilities for developing the asset management plan. The most recent guideline for the UK water industry is the Expenditure Decision-Making (FEDM). The FEDM sets out a process for underpinning expenditure decisions,

from setting the strategy, assessing current and future risk, cost, and service, through to agreeing and delivering expenditure plans (UKWIR, 2014). The Framework is consistent with and even exceeds the expectations for risk-based planning as laid out in ISO 55000. Also, FEDM provides a basis for companies to evaluate resilience and asset health; understand how these factors influence service outcomes to customers and the environment and provide the ground rules for developing a compelling business case, based on an understanding of cost, risk and service now and in the future (Godin et al., 2012, OFWAT, 2015a, OFWAT, 2015b, Ofwat, 2017a, Ofwat, 2017b).

Similarly in the US, The United States Environmental Protection Agency (EPA) encourages stormwater, wastewater, and drinking water utilities to develop and implement AMP tools to provide the tracking and planning framework needed to meet these requirements (EPA, 2017). EPA also encouraged water utilities to use modern analytical planning tools to support the deployment of sustainable water infrastructure improvements to help implement NPDES permit requirements. EPA/WERF also has a 10 step guide for water utilities for developing asset management plans. The guide by EPA incorporates ideas such as risk, level of service (objective) and the use of business cases to analyse asset life cycle cost (Blankenship and Slaven, 2016).

In New Zealand as well, Local government authorities are required by these laws to adopt and prepare 10-year financial statements every 3 years. These plans take asset creation, loss of asset service potential, and benefits and costs of different asset options into account. Water Utilities in Australia are also are required by legislation to report extensive AM related information, develop AM plans and these utilities are externally audited (IWR, 2013, Alegre and Coelho, 2012).

Furthermore, the guiding principles for Infrastructure asset management in South Africa have made it mandatory for municipalities in south African to develop an infrastructure asset management plan for all sectors such as water and roads which should also be consolidated into a comprehensive municipal infrastructure plan that covers all infrastructure within the municipality. (DWA, 2013, Bhagwan, 2009, Bhagwan and Wall, 2008). These plans are needed for sound technical and financial decision making in regards to municipal infrastructure. They are also used as tools to show stakeholders that the municipality is proactive in managing new and existing infrastructure.

In conclusion, AMP is very crucial elements for asset management implementation in most utilities. These plans provide an avenue for implementing asset management systematically. The Asset management plans are also very key for obtaining permits and licenses because they show that utilities are complying to regulations and meeting set targets. Also, guidelines for developing asset management plans and financial statements are in place for water utilities to follow and adapt to their context. There are also reviews and continuous improvements made to plans based on trends in the water industry; for example, the UK is currently on the 7th Asset management plan.

2.3.3 Presence of an assurance system for measuring performance

Another important factor that can be inferred from analysing countries with best practices is that performance measurement systems and asset management maturity tools are core elements used for assessing asset management maturity and driving asset management improvements. International standards have established various asset maturity tools and benchmarking tools for measuring asset management performance.

In the UK for example, OFWAT has developed a guideline for Water and Waste Water companies to publish their performance in their price reviews. These KPIs are categorised under the following four broad themes. Customer experience, Reliability and availability, environmental impact and financial indicators (Godin et al., 2012, OFWAT, 2015a, OFWAT, 2015b, Ofwat, 2017a, Ofwat, 2017b). These KPIs are outlined in detail in Table 1 of Appendix 2.

The use of maturity models for assessing performance is also common in the UK. Asset management maturity is defined by (GFMAM, 2015) as the extent to which capabilities, performance and ongoing assurance of an organisation are fit for purpose to meet the current and future needs of its stakeholders, including the ability of an organisation to foresee and respond to its operating context. Asset maturity models are set of structured levels that determine how well the asset management processes and systems produce the desired outcomes in a reliable way (BSI, 2008a, BSI, 2008b, Kay and Roxburgh, 2011, Volker et al., 2011).

For example, the latest self-assessment methodology developed by the Institute of Asset Management IAM is a maturity tool for assessing the maturity levels of asset management systems and processes implemented in an organisation (GFMAM, 2014, GFMAM, 2015, Institute of Asset

Management, 2015a, Institute of Asset Management, 2015b, Godau and McGeoch, 2016). IAM maturity tool sets an evaluation criteria that ensure organisation conform to the 27 sub-clauses of the ISO55001 or the 28 elements of PAS55-2008 standard. See figures 2 and 3 for details of the key elements and clauses.

These sub-clauses and elements are assessed against a 6 tiered assessment tool. The ISO55001 maturity scale is a 6 tiered which organisations can use for benchmarking their asset management maturity. The 27 sub-clauses specified in ISO55001 (see figure 4 for details) are usually measured against the 6 level maturity scale. Level 1 represents a level of innocence which signifies the organisation in question has not recognised the need for asset management and shows no commitment towards it. Level 2 is an awareness level where the organisation recognises the need for asset management and there is evidence to show that arrangements towards implementing asset management are in progress.

Level 3 signifies the developing level where the organisation is seen to be at a transition phase. At this point, the organisation has identified a means of systematically and consistently achieving the requirements stated in ISO55000 and it is also in the process of implementing those requirements. Level 4 is defined as a level of competence. At this stage, it means the organisation conforms fully to the requirements of ISO55000.

Also, the organisation has a formal documented asset management system that is embedded within the organisation. Level 5 is the optimisation level where an organisation has moved beyond the requirements of ISO55000. At this point, the organisation demonstrates it consistently implements asset management in line with its organisational strategic plan. Level 6 is a level of excellence where an organisation can demonstrate that it employs best practices and it obtains maximum value from implementing asset management.

The PAS55 Maturity scale, on the other hand, uses 5 stages of maturity to assess how an organisation conforms to the 28 elements of PASS-55 as shown in Figure 3 in Appendix 2. The Maturity level scale is from 0 to 4 which denote the learning, applying, embedding and optimising and Beyond PAS55 phases. Details of each level are similar to ISO55000 but are shown in detail in Figure 2 of the Appendix.

In Australia and New Zealand, Performance measures from IIMM are used to establish targets against which the performance of infrastructure assets, in delivering service can be measured (GAO, 2004, Institute of Public Works Engineering et al., 2015), IIMM performance measures for Water and Wastewater services as shown in Table 2 of Appendix 2. The Water Services Association of Australia (WSAA) also has benchmarking projects co-sponsored with the International Water Association (IWA) used for assessing AM process maturity.

The (Institute of Public Works Engineering et al., 2015) has also developed an asset management assessment tool that serves as a guide for utilities for assessing their level of maturity in implementing asset management systems and processes. 16 key elements of the IIMM asset management framework are measure against 5 maturity stages see figure. There are stages include aware, basic, core, intermediate and advanced. IIMM incorporates similar requirements from ISO55000 for assessing asset management maturity. Level 0-20 signifies the organisation is aware meaning the organisation has not recognised the need for asset management requirement and there is no evidence of commitment to put it in place. Level 21-40 signifies the organisation is at a basic stage which means the organisation has identified the need for the asset management requirements, and there is evidence to progress it.

Level 41-60 is when the organisation is at the core stage. This means the organisation has identified the means of systematically and consistently achieving the asset management requirements, and it can demonstrate that these are being progressed with credible and resourced plans in place. Level 61-80 is the intermediate stage where the organisation can demonstrate that it systematically and consistently achieves relevant requirements set out by IIMM guidelines. Level 81-100 is the advanced stage. At this point, the organisation can demonstrate that it employs the leading practices, and achieves maximum value from the management of its assets, in line with the organisational goals and objectives.

In the US, The Water Research Foundation (WRF) developed a Microsoft Excel-based benchmarking tool to effectively manage water utilities (Ganjidoost et al., 2018, Matichich et al., 2014a, Matichich et al., 2014b). The WRF benchmarking approach identifies primer practice areas to support the ten attributes such as product quality, customer satisfaction, employee and leadership development, operational optimisation, financial viability, infrastructure stability,

operational resiliency, community sustainability, water resource adequacy, and stakeholder understanding and support.

Also, Infrastructure report cards (IRC) are implemented by the American Society of Civil Engineers as performance assessment tools. These report cards are centred on a simple A, B, C, D, E condition and performance-based rating. These ratings play a major part in raising awareness of the state of infrastructure assets. The IRC also indicate whether infrastructure assets are in an acceptable condition and shows that current levels of investments can provide the levels of service required by future generation (GAO, 2004, Institute of Public Works Engineering et al., 2015).

The following inferences can be made in regards to performance measurement systems; targets are developed by regulators and professional associations to address issues such as customer satisfaction, service reliability and infrastructure performance. All these depend on what the regulators feel should be the focus of the utilities. Also, asset management maturity is another common tool for benchmarking and there are international standards which have been developed for assessing asset management maturity.

2.3.4 Continuous Improvements and Training Schemes

An assessment of best practices shows that Asset Management Training workshops and initiatives for water utilities were also established in the UK, USA and Australia for continuously improving asset management capabilities and practices. Figure 2 and 3 in Appendix 2 highlights major milestones asset management which have occurred in the UK, Australia and New Zealand.

Reviews and Revision of Asset management plans and planning frameworks have occurred in the UK over time as shown in Figure 2 of Appendix 2. For instance, The UK Water Industry Research Ltd and Ofwat in 2002 made major revisions when the AM plans done by water companies were falling short of expectations. Research had shown that these plans needed to be developed based on sound principles. Another major change which has also occurred is in the development of long term strategic Direction statements. The improvement of the capital maintenance planning framework FEDM is also another way the UK has improved asset management related practises. Also, the PAS-55 standard suites have been improved to ISO5500 to incorporate all asset types (Institute of Asset Management, 2015a, BSI, 2014, BSI, 2008a, BSI, 2008b) There are also training workshops developed by the Institute of Asset Management.

In South Africa, utilities like Rand Water, for example, have full support for asset management implementation from top management officials who provide training for members. In the US, there are also a series of EPA Advanced Asset Management Workshops that are particularly important. Over 1,300 industry stakeholders have participated in 17 EPA sponsored AM workshops. Two notable workshops are the Asset management training work session and the asset management program Learning (Alegre, 2010). There are also other existing professional associations in the US water industry with initiatives and research programs focused on Asset management. The Water Environment Federation (WEF), Water Environment Research Foundation (WERF), American Water Works Association (AWWA), and American Society of Civil Engineers (ASCE) have published several kinds of literature and carried out research projects on AM practices.

The Water Environment Research Foundation (WERF) for example, developed the Strategic Asset Management (SAM) Challenge. This project also included the participation of the UKWIR and the Global Water Research Coalition. It is a multi-year research program that is developing guidance and decision support tools for communicating and implementing asset management programs for wastewater utilities (Godin et al., 2012). The research recognises the need that utilities have for useful products to support their focus on planning, acquiring, operating, maintaining, rehabilitating, and building water infrastructure to maximise performance while minimising the life cycle cost at an acceptable level of risk. The SAM challenge and other research programmes have strengthened the Sustainable Infrastructure Management Program Learning Environment (SIMPLE) as the leading reference for AM knowledge and guidance (Sneesby et al., 2012).

2.3.5 Development of guidelines and Bodies of Knowledge

Finally, lessons learnt, and asset management knowledge has been documented in standards and manuals which are internationally renowned. For example, in the UK, a standard specification for asset management was published in 2004 and revised in 2008 in response to demands from the water sector and other industries at large. PASS55 and ISO5500 are standards widely used by several water and sewerage companies in the UK as a guide for the development of good asset management practice. (Aikman, 2014, Harding et al., 2010, Kay and Roxburgh, 2011) . PASS 55

is a generic framework applicable to the management of physical assets, and it is limited only to the class of physical assets (Woodhouse, 2013, BSI, 2008a).

In the US as well, a range of guideline documents on asset management for drinking water and wastewater utilities have been developed by EPA. In 2003, EPA developed an asset management framework for water utilities. In 2008, EPA incorporated this framework into Asset Management: Best Practices Guide and Planning for Sustainability. (GAO, 2016, Alegre, 2010).

Australia and New Zealand are broadly known as world-leading schools in infrastructure asset management (Alegre and Coelho, 2012, Alegre and do Céu Almeida, 2009, Amaral et al., 2017, Institute of Public Works Engineering et al., 2015, Schulting and Alegre, 2009, van Heck, 2008).

Through the initiative of local government utility and recreational facility manager, under the National Asset Management Steering (NAMS) group the best types of AM information systems and predictive performance modelling systems were developed in the water industry. Also, the NAMS group in 1996 have produced the International Infrastructure Manual, and created a series of MA training workshop introducing AM techniques to local government staff. NAMS group have continued to update this manual and transfer AM Knowledge through training workshops with the aim of developing asset management best practices globally.

The International Infrastructure Management Manual (IIMM) is an Australian and New Zealand initiative for asset management implementation (Alegre and Coelho, 2012). It was established initially in 2000 through collaboration between New Zealand National Steering Group (NAMS) and the Institute of Public Works and Engineering of Australia (IPWEA) (IWR, 2013, van Heck, 2008). In Australia and New Zealand, the AM 'school' is synthesised in the International Infrastructure Management Manual (IIMM), revised and updated periodically which is dedicated to different types of public infrastructures and promotes the Total Asset Management Process. The 2015 edition has been driven largely by the introduction of the ISO 5500 standards and includes numerous new case studies. Besides, a range of training initiatives have also been carried out to develop asset management best practices within utilities and also assist with legislation or regulatory compliance. In South Africa, the Department for Cooperative Governance created the Local Government Infrastructure Asset Management guidelines 2006-2007. The guideline was

developed to create a holistic and enterprise-wide approach for asset management (Boshoff and Peters, 2013, Boshoff et al., 2009, Stephenson et al., 2001, Mothetho, 2018)

2.4 Core Elements of an asset management Framework

Over time, notable asset management activities for recording innovations and lessons learnt in asset management have occurred through the development of asset management standards that suit specific industries, asset types and country context. Critics of industry-specific AM guideline have stated that the non-exhaustive list of asset management standards and frameworks brings ambiguity and confusion in providing an avenue where lesson learnt from asset management application are transferable from one sector to another or one country to another.

Thus collaborations and participation between many countries and international organisations such as Global Forum for maintenance and asset management (GFMAM), have taken place for providing frameworks like ISO55000 which provides common understanding and consistency in applying underlying principles and terminologies of AM (BSI, 2014, Katičić and Lovrinčević, 2012, Woodhouse, 2007, Woodhouse, 2013). However, questions are raised regarding how successful these generic platforms could be in different industries, countries and asset types; based on their uniqueness, characteristics and other external factors which could be cultural, socio-economic, historical, and institutional as these factors have a great impact on the asset system.

However, amid these concerns industry professionals are said to have successfully implemented some of these asset management guidelines. Furthermore, Organisations have gained asset management competencies and certification in line with International AM standards. Reviewing common elements that are seen in a wide array of asset management standards is critical in informing the development of an asset management framework for the Nigerian Context. The key elements discussed below are based on a review of the common elements that constitute PASS 55, IIMM, ISO5500, AAMCOG and IAM Conceptual framework.

2.4.1 Contextual Understanding of the Organisation

Outside the scope of an asset management system, the analysed frameworks require explicit attention to understanding the contextual issues. See figures 7 to 10 in appendix two for details. The AAMCoG, PASS55, ISO 5500 and the IAM conceptual model clearly show the importance of issues such as stakeholder needs and expectations, legislation, policies, internal and external

business drivers. (Brown et al., 2014, Laue et al., 2011) also state that for asset management to be comprehensive, it must consider the whole range of social, environmental and economic factors.

Contextual factors are also critical in developing the organisational strategic plan or goals (Brown et al., 2014). The organisational strategic plan is a by-product of contextual analysis and it is found in AAMCOG, PASS55, ISO 5500 and the IAM conceptual model. The organisational strategic plan constitutes the goals, vision, mission and values and policies of the organisation. The OSP defines what the organisation is about and what it seeks to achieve (Institute of Asset Management, 2015a, BSI, 2014, BSI, 2008a, BSI, 2008b).

These elements are considered to be important because, in reality, an asset management system does not work in isolation of the context. Also, an asset management system is deemed successful when it can deliver the strategic plan of the organisation. (in the case of ISO5500) effectively (Mardiasmo et al., 2008). Assets add value to an organisation and its stakeholders. The focal point for successful AM for every organisation is the value an asset delivers rather than the asset itself. An organisation usually defines what constitutes value in line with the organisational strategic plan (GFMAM, 2014, Institute of Asset Management, 2015a, ICE, 2013).

The OSP usually take stakeholder interests and requirements and sustainable outcomes (environmental, economic, social outcomes) into consideration. The decision-making processes for AM must reflect stakeholder needs and define value. This is why the contextual understanding of an organisation and the organisational strategic plan appears in all the analysed framework even though they are stated to be outside the scope of the asset management system and hence is not considered as the starting point or foundation of asset management even though these factors influence the successful outcome for asset management. As shown in Asset management policy as shown in figures 7 to 10 of the appendix.

2.4.2 Asset Management Policy

Following the review of IIMM, ISO5500, PAS55, AAMCoG and IAM conceptual framework, the Asset management policy was the next key element that was prevalent across all the reviewed frameworks. The asset management policy is considered to be the starting point of the asset management system (Brown et al., 2014, Laue et al., 2011). The Asset Management policy is usually derived from the organisational strategic plan. Please refer to figures 7- 11 for details. It is

a mission statement or vision showing the principles and requirements of an organisation for managing its assets (AAMCoG, 2001, BSI, 2008a, Institute of Asset Management, 2015a). The AM policy is aligned with the organisational strategic plan.

The Am policy lays a clear foundation for the asset management strategy and acts a link between the asset management system and the organisational strategic plan as shown in Figures 3, 4 and 6 in Appendix 2. According to (Davis, 2016, ICE, 2013, Institute of Asset Management, 2015a, GFMAM, 2014) alignment or line-of-sight centres around on how Asset Management can effectively translate the objectives of the organisation with the Asset Management System.

When alignment occurs, the risk of acquiring a particular asset can be fully understood since this is assessed with how the asset can effectively achieve the set goals of the organisation. The organisation is also able to determine whether an action is essential. Finally, alignment stimulates innovation and creativity(GFMAM, 2014, Institute of Asset Management, 2015a, ICE, 2013).

2.4.3 Strategic asset management Plan

The asset strategy is also known as strategic asset management plan (SAMP) in ISO55000, was a common element from the reviewed asset management frameworks. (BSI, 2014, Institute of Asset Management, 2015a, AAMCoG, 2001, BSI, 2008a, BSI, 2008b). The asset management strategy is the sustainable approach the organisation uses to manage its assets and asset portfolio throughout their life-cycle.

It is documented information that clearly should articulate important aspects of asset management. According to (BSI, 2014, Institute of Asset Management, 2015a, AAMCoG, 2001, BSI, 2008a, BSI, 2008b) the asset strategy form the basis for developing the asset management objectives. It also determines how the asset management system meets the organisational strategic plan. The structures, roles and responsibilities necessary to establish the asset management system and to operate it effectively are also included in the strategic asset management plan. Sometimes the timeline for the strategic asset management plan could be longer than the timeline for the organisational strategic plan because of the requirements for, the asset management system to address the whole life cycle of assets (BSI, 2014, Institute of Asset Management, 2015a). The asset management objectives are subsequent outcomes from SAMP and are considered in the next section.

2.4.4 Asset management objectives

The next common element which emerged from the reviewed frameworks developed by (BSI, 2014, Institute of Asset Management, 2015a, AAMCoG, 2001, BSI, 2008a, BSI, 2008b, Institute of Public Works Engineering et al., 2015) is the asset management objective. The asset management objectives are linked directly to the asset strategy. They are defined by (AAMCoG, 2001, BSI, 2008a, BSI, 2008b, Davis, 2016, ICE, 2013, Institute of Asset Management, 2015a, GFMAM, 2014) as specific and measurable outcomes essential for running the asset management system. The AM objectives provide a link between the strategic plan of the organisation and the asset management plan. The asset management objectives transform the required service needed from the assets, into activities that are defined in the asset management plan (BSI, 2014).

The asset management objectives must be adapted to an organisations context, its business needs and stakeholder requirements. The way of adapting the asset management objectives to the organisational context is aligning it to the corporate strategic plan. AM objectives need to be specific, measurable, achievable, realistic and time-bound. The asset management plan which is a direct output from the asset management objectives is identified in the next section.

2.4.5 Asset Management Plan

Another common element identified from the reviewed frameworks shown in figures 4, 5, 6 of appendix 2 is the asset management plan. It is described by (BSI, 2014, Institute of Asset Management, 2015a) as documented information specifying activities, timescales, processes, human and financial resources, roles and responsibility and competencies required for the achievement of the AM objectives. It normally follows through from the asset strategy.

The asset management plans define the lifecycle activities required for managing the assets. (Institute of Asset Management, 2015a, GFMAM, 2014, BSI, 2014, AAMCoG, 2001, BSI, 2008a, BSI, 2008b) require asset management plans require objectives like time frames and resources to be specific and measurable objectives. The asset management plan also defines asset management objectives.

2.4.6 Implementation of asset management

Another element identified from a review of AM frameworks is the asset implementation stage or life cycle delivery phase stated by (Institute of Asset Management, 2015a, GFMAM, 2014, Brown

et al., 2014, Laue et al., 2011, Institute of Public Works Engineering et al., 2015). This stage focuses on activities carried out during the whole asset life cycle from the acquisition phase to the disposal phase as shown in Figures 7 to 11 of appendix 2.

At this point in the framework, the activities outlined in the AM plan are fully in operation. These are life-cycle activities and processes that occur from when the asset is acquired until when it is decommissioned which is its disposal stage when it no longer renders value to the organisation. Lloyd (2010) describes asset management as a holistic system that manages the whole life of assets, from their inception through to their disposal, which involves looking forward as well as backwards, outwards as well as inwards, and balancing the needs of all stakeholders – those of today and those of the future. This is why this phase covers all life cycle activities related to an asset.

Implementing an asset management plan is a change that moves from the conventional way of thinking and working to an integrated and innovated approach. This integrated approach is about understanding that interdependencies and mutual effects are essential for success (BSI, 2008a, BSI, 2008b, BSI, 2014, AAMCoG, 2001, Institute of Public Works Engineering et al., 2015).

Additionally, during the implementation stage, (Institute of Asset Management, 2015a, GFMAM, 2014, Institute of Public Works Engineering et al., 2015) emphasise the inclusion of concepts such as Technical Standard and Legislation, Asset creation and Acquisition, Systems Engineering, Configuration Management, Maintenance delivery, Reliability Engineering, Asset Operations, Resource Management, Shutdown and outage management, Fault and incident response and Asset decommissioning and Disposal.

2.4.7 Enabling elements supporting the asset management system

Enabling elements such as information management, organizational management and risk management were observed across the reviewed AM frameworks (Institute of Asset Management, 2015a, GFMAM, 2014, Institute of Public Works Engineering et al., 2015). Please refer to Figures 7 to 11 in appendix 2.

Asset data and information are major enabling elements for any activity with the asset management scope. Asset information is typically an input to asset management processes, it can be created by

a process and also be an output of a process (Institute of Asset Management, 2015a). Typically, organisations find it hard to get the relevant information they need for carrying out activities during the life-cycle delivery phase. This is why (AAMCoG, 2001, GFMAM, 2014, Institute of Asset Management, 2015a, Institute of Public Works Engineering et al., 2015, Laue et al., 2011, Laue et al., 2014) requires organisations to focus on concepts such as asset information standards, asset information strategy, asset information systems, and data and information management. These activities go a long way in improving the quality and accuracy of asset data and ensuring effective data management.

Factors dealing with the organization and people within the organization are common enabling elements that were observed across the reviewed AM frameworks (AAMCoG, 2001, BSI, 2008a, BSI, 2008b, BSI, 2014, GFMAM, 2014, Institute of Asset Management, 2015a, Institute of Public Works Engineering et al., 2015, Laue et al., 2011, Laue et al., 2014). Figures 7 to 11 in appendix 2 shows the influence organisational elements like people, good leadership, competencies and corporate culture have on the entire asset management system. Additionally, enabling organizational elements determine how the asset management objectives will deliver the strategic plan of the organisation. This is why (AAMCoG, 2001, BSI, 2008a, BSI, 2008b, BSI, 2014, GFMAM, 2014, Institute of Asset Management, 2015a, Institute of Public Works Engineering et al., 2015) make it a requirement for organisations to invest time and resources in areas such as organizational culture and structure, asset management leadership, Competence management and supply chain management

The final aspect for the enabling elements supporting the asset management system is risk management. Successful asset management can only occur when risk management is integrated into the asset management process. It deals with recognising the associated risks of assets at different phases of their lifecycle (ICE, 2013, BSI, 2008a, BSI, 2008b, BSI, 2014, GFMAM, 2014, Institute of Asset Management, 2015a).

Risk management is a core basis for proactive asset management and it integrated to enable the asset management system. It deals with trying to understand the cause, effect and likelihood of adverse events occurring, to optimally manage identified risks to an acceptable level, and to provide an audit trail for the management of risks (AAMCoG, 2001, BSI, 2008a, BSI, 2008b, BSI,

2014, GFMAM, 2014, Institute of Asset Management, 2015a, Institute of Public Works Engineering et al., 2015, Laue et al., 2011, Laue et al., 2014).

In the IAM conceptual model and IIMM model, a performance review was part of enabling elements and continuous improvement were part of the control systems for while evaluation and improvement were elements separate from the enabling elements. Overall, an overview of the AM frameworks shows subject areas such as Risk Management, Contingency Planning, Stakeholder engagement, Change management, AM performance monitoring, AM system monitoring, Management review and assurance and asset costing and valuation.

2.4.8 Evaluation

The next element pertinent to all the review AM frameworks is performance evaluation. Please refer to figures 7 to 11. This the continuous or periodic quantitative and qualitative evaluation of the actual performance of the asset management system compared with the strategic plan of the organisation (AAMCoG, 2001, BSI, 2008a, BSI, 2008b, BSI, 2014, GFMAM, 2014, Institute of Asset Management, 2015a, Institute of Public Works Engineering et al., 2015, Laue et al., 2011, Laue et al., 2014). Evaluation involves assessing, reviewing and adequately documenting the asset performance against the Asset Management objectives and organizational strategic plan. Additionally, non-conformities and conformities to the asset management plan are identified and remedial actions are taken so the necessary changes can occur. (BSI, 2008b).

The need for evaluation arises from the need to ensure that assets, asset management and the asset management system aligns with the strategic plan. Evaluation is required for successful asset management because it shows the asset is delivering value and achieving the purpose it was created for (AAMCoG, 2001, Barton et al., 2002, BSI, 2008a, BSI, 2008b, BSI, 2014, Institute of Asset Management, 2015a, Leitão et al., 2016, Too and Too, 2010, Institute of Public Works Engineering et al., 2015). Secondly, it demonstrates AM activities are consistent with the organisation strategic plan and delivering sustainable outcomes (AAMCoG, 2001, Barton et al., 2002, BSI, 2008a, BSI, 2008b, BSI, 2014, Institute of Asset Management, 2015a, Leitão et al., 2016, Too and Too, 2010). Finally, it allows for continual improvement and change management.

2.4.9 Improvement

Following the review of asset management frameworks developed by (AAMCoG, 2001, BSI, 2008a, BSI, 2008b, Davis, 2016, ICE, 2013, Institute of Asset Management, 2015a, GFMAM, 2014) a final element that emerged was continual improvement. The IIMM and IAM conceptual models had continuous improvement and change management as part of the enabling elements for the asset management system while PAS55, AAMCOG and ISO55000 had performance as separate elements. However, a critical factor that can be learnt from the review of the asset management frameworks is that all the asset management systems had ways for improving the asset management system. This is because the asset management system complex and continually evolving to match the adaptive nature of the organisational context.

Continual improvement is a concept that applies to the assets, the asset management activities and the asset management system (AAMCoG, 2001, BSI, 2008a, BSI, 2008b, BSI, 2014, GFMAM, 2014, Institute of Asset Management, 2015a, Institute of Public Works Engineering et al., 2015, Laue et al., 2011, Laue et al., 2014). It deals with identifying nonconformities or potential nonconformities of the asset management system through management reviews or audits checks. The nonconformities require corrective action and the potential nonconformities require preventive action.

2.5 Strengths and Limitations of asset Management Frameworks

There were major strengths and weaknesses which could be drawn from the review of 5 predominant frameworks for asset management. A major strength from PAS 55 was the fact that it was a major route through which asset management was successful in most organisations (Woodhouse, 2013, Wade, 2012, Woodhouse, 1997, Woodhouse, 2007, Woodhouse, 2010a, Woodhouse, 2010b)

There are also limitations to using PA55 which have been highlighted by industry practitioners and academic critics. Firstly it is criticised for being limited to articulating principles and requirements for asset management rather than clearly outlining how to implement an asset management system (Davies et al., 2011, IWR, 2013).

It also does not highlight how asset management can be implemented for a specific type of physical assets as a different physical asset are unique in their feature and characteristic. Secondly, the framework does not detail how to carry out activities, methods or strategies necessary for meeting the requirements and outcomes of asset management. There also appears to be an assumption of a static external and internal environment of an organisation, however, in reality, these environments are dynamic, and relations exist between the organisation and its environment, and it also relates with environmental factors (El-Akruti and Dwight, 2013).

Thus, details of the relationships and interactions between the asset management system and organisational process are not provided in the guide. Various organisations possess different maturity levels in asset management. However, the guide does not establish how to improve on, review or audit on asset management strategies at different maturity levels. Thus, the case is the implementation of the PAS55 guide with AM maturity level tools as well as other frameworks like IIMM. Furthermore, the PAS55 is superseded and has now been replaced with ISO55000.

ISO5500 is a generic framework which retains some elements from PASS55 and applies to organisations wishing to realise value for their organisation through the management of their assets (Institute of Asset Management, 2015a). Unlike PASS55 it is focused on generic types of assets and not physical assets like PAS55. The elements and structure of ISO5500 are similar to PAS 55 the only difference is the change from asset management strategy to a strategic asset management plan. The detailed identification of different life cycle activities (such as create/acquire, operate, maintain, renew/dispose of) has also been dropped to accommodate more diverse life cycle stages of different asset types. ISO 55001 does guide organisations on how well they need to utilise Asset Management as the decision is assumed to depend on the business and the operating context in which it operates (Institute of Asset Management, 2015a).

ISO 5500 has most of the aforementioned limitations pertaining to PAS55 however it is regarded as a platform for providing a common understanding of asset management as it is a generic framework applicable to all types of assets. Though the question may arise as to how effective it is in addressing the unique characteristics and factors associated with managing various types of assets. Regardless it is an international standard which is widely accepted in many countries and industries and has replaced the PASS55 suite of standards.

Similar to ISO5500 and PAS55, The IAM model and the supporting 39 subject areas does not necessarily establish how organisations should implement asset management. However, it is a system that clearly articulates what needs to be in place for developing the asset management system and the scope of activities within asset management. It also helps people in organisations understand how their work function and fits and interacts with elements of the asset management system.

IIM articulates to what to do and how to do asset management. It also details approaches for developing and measuring service levels for various types of assets. IIMM also allows organisations to establish a hierarchal system for ranking critical assets

Table 2.3: Strengths and Limitations of asset Management Frameworks.

Source: (Davies et al., 2011, IWR, 2013, Mardiasmo et al., 2008, Gay and Sinha, 2014)

| | Strengths | Limitations, |
|----------|---|---|
| aamcog | <ul style="list-style-type: none"> - suited for a multi-agency environment - assesses the relationships that exist between an organisation that manage assets jointly - focuses on the relationships and the linkages of environmental factors and asset management elements | <ul style="list-style-type: none"> - only limited to built and engineering assets - consideration of intangible assets are not prescribed in the framework - prescribes what needs to be done for introducing/ implementing asset management but does not give details of how to implement AM - the underlying characteristics and uniqueness of various types of assets/ sector-specific assets are not considered - contextual issues are outside the scope of the asset management system |
| PASS 55 | <ul style="list-style-type: none"> - An internationally renowned standard used in UK and utilities in the US - One of the first avenues through which asset management allows for the integration of various cross-functional disciplines | <ul style="list-style-type: none"> - It has been superseded and is replaced by the ISO5500 suites - Limited to physical assets and doesn't consider the management of intangible assets - limited to articulating principles and requirements for asset management rather than clearly outlining how to implement an asset management system - contextual issues are outside the scope of the asset management system |
| Iso 5500 | <ul style="list-style-type: none"> - regarded as a platform for providing a common understanding of asset management as it is a generic framework applicable to all types of assets - Has replaced the PASS55 suits and is widely accepted | <ul style="list-style-type: none"> - limited to articulating principles and requirements for asset management rather than clearly outlining how to implement an asset management system - It also does not highlight how asset management can be implemented for a specific type of asset as different assets are unique in their feature and characteristic. - does not detail how to carry out activities, methods or strategies necessary for meeting the requirements and outcomes of asset management - highlights the importance of contextual understanding however it is still outside the scope of the asset management system |

| | | |
|--------------------------|--|---|
| IIMM | <ul style="list-style-type: none"> - An internationally renowned standard used by utilities - It articulates the “what to do” and “how to do” of asset management - It details approaches for developing/ measuring service levels for various types of assets - It gives thorough information about the data requirements for documents such as asset registers and risk consequence rating systems, asset registers - It allows organisations to establish a hierarchy system for ranking critical assets - It establishes potential monitoring techniques that can be used depending on the type of assets - Lessons can be learnt on how to implement asset management from case studies in different countries and sectors outlined in IIMM. | <ul style="list-style-type: none"> - Limited to infrastructure and engineering assets and does not consider the management of intangible assets - Only addresses performance/measures but does not articulate resilience and sustainability issues in details - contextual issues are outside the scope of the asset management system |
| IAM conceptual Framework | <ul style="list-style-type: none"> - clearly articulates what needs to be in place for developing the asset management system and the scope of activities within asset management. - It also helps people in organisations understand how their work function and fits and interacts with elements of the asset management system. | <ul style="list-style-type: none"> - does not necessarily establish how organisations should implement asset management - Limited to physical infrastructure |

2.6 Benefits of asset management systems

There are many benefits water utilities experience while implementing asset management practices here are some examples of outcomes that can be realized:

2.6.1 Demonstrated Compliance to statutory laws and regulating bodies

Water utilities which have formalised management systems in place can demonstrate to regulatory bodies and statutory authorities their ability in meeting stringent regulatory requirements clearly and transparently (EPA, 2008a). Whatever the requirements may be i.e. environmental, social or economic, regulatory bodies and authorities can understand plans presented by utilities based on the clear evidence gotten from the information provided from various assessments. These plans or budgets help utilities show the regulatory stakeholders that they are focused on activities and processes critical to continuous and improved performance (CH2MHILL, 2013, EPA, 2008a).

Asset management has helped US utilities with their compliance with existing regulations. Specifically, among other things, asset management practices such as identifying and maintaining key assets led to fewer violations of pollutant discharge limitations under the Clean Water Act (GAO, 2004, Institute of Public Works Engineering et al., 2015).

2.6.2 Focus on Priorities

Asset management provides a holistic and proactive approach for meeting the needs of the water utility as well as its stakeholder's needs. It is a discipline which takes not just financial factors into consideration but other factors like customer satisfaction, social responsibility, health and safety, environmental and sustainability issues which are major priorities that are necessary for attaining a desirable service level and performance (AAMCoG, 2001, BSI, 2008a, BSI, 2008b, BSI, 2014).

2.6.3 Improved financial efficiency

With asset management, utilities are able to set rates based on sound operational and financial planning. This allows them to benefit from improved returns on investments while preserving the water asset's worth without compromising short or long term goals. Utilities are also able to reduce overall costs for both operational and capital expenditure (Ofwat, 2013, Floate, 2014). Asset management can also be considered a business improvement tool. Maximising the utilisation of existing assets and operating in the most cost-effective manner is among the aims of all businesses. (Kellick, 2010, GAO, 2016, Alegre, 2010).

2.6.4 Improved risk management

An element of asset management and approach which is usually integrated into asset management practices is risk management. The integration of risk management helps Utilities define and target assets with greater risks. Therefore the efficient allocation of asset management resources is in place allowing utilities improve responses to emergencies, improve health, safety and security (EPA, 2008a) This in turn results in reduced financial losses and reduced liabilities such as insurance premiums, fines and penalties;

2.6.5 Enhanced service management and customer satisfaction

Asset management provides a medium for ensuring the performance of water infrastructure assets can lead to improved services that sustainably meet stakeholder demands. With asset management focus moves from processes, water assets or technology to the main reason for the existence of such assets or processes which is meeting the demands of water consumers. AM also allows utilities to demonstrate they are socially responsible and ethical while carrying out asset management practices (CH2MHILL, 2013, EPA, 2008a).

2.6.6 Improved efficiency and effectiveness

The implementation of formalised asset management system allows water utilities to carry out maintenance activities like rehabilitation, repairs and replacement more efficiently and effectively. Constant reviews and improvements are made on processes and procedures to ensure the maintenance and operational plans are being achieved (BSI, 2008a, BSI, 2008b, BSI, 2014, EPA, 2008a, EPA, 2014). Furthermore, Infrastructure assets are managed to preserve the investment of utilities in infrastructure assets and therefore the existing levels of service provided by these assets. What this implies is that asset management could be a potential solution for water utilities that are looking for ways to improve performance while satisfying expectations of customers and managing any challenges they find within the industry.

2.7 Summary

This chapter set out to successful asset management practices. This was achieved by first of all understanding the concept of asset management and establishing its relevance and emergence globally. Features of successful asset management practices and principles of good asset management practices were also established. Also, International Standards and Guidelines predominantly used in the water industry were explored to identify what key elements are required for successful asset management.

However, the literature established that the scope of asset management should apply to all asset types including people, information, financial and intangible assets. The review of international asset management standards also revealed that these standards only identified what needs to be in place for successful asset management and thus did not establish how asset management can be implemented successfully.

Furthermore, the literature revealed best practices were predominantly in developed countries. Additionally, the literature showed that best practices for asset management occur when there are clear governance structures, effective performance assessment systems, training schemes and existing bodies of knowledge for continuous learning and improvement.

However, countries regarded as AM schools were seen to be predominantly high-income countries. The question of whether asset management can impact the performance of water utilities positively in middle-income and low-income African countries like Nigeria at this point is

uncertain. But it is important to note that developing countries also face water challenges that can benefit from implementing modern-day asset management practices. However, some middle-income and low-income African countries like Uganda, Senegal and Burkina Faso have good urban water management practices with similar characteristics as asset management best practices. The next chapter of this research will, therefore, explore good urban water management practices in developing African countries.

Chapter 3

Good Practices in Urban Water Management in developing countries

3.1 Introduction

The purpose of this chapter will, therefore, be to critically review good urban water management practices in countries. The structure of this chapter first presents the impact of water on sustainable development. Next, the context of water and sanitation in middle-income/low-income countries and challenges impacting urban water management in middle-income/low-income countries will be explored. Also, Characteristics of good urban water management practices will be highlighted. Then, Successful cases of urban water management through PPP reforms in Africa will be discussed. Enabling factors for delivering good management practices will also be identified in the next section. Finally, a comparison between good management practices in middle-income/low-income countries and asset management practices will occur to establish a rationale for integrating lessons learnt from asset management best practices and good management practices in sub-Saharan Africa to develop an asset management framework for the Nigerian Urban water sector.

3.2 The Challenging context of water and sanitation in Africa

According to (Akpabio and Takara, 2014, Kayaga et al., 2018, Vairavamoorthy et al., 2008, Wang et al., 2014) middle-income/low-income countries face the greatest challenge in achieving improved access to water and sanitation services.

Despite recorded successes in achieving the MDG target for water and sanitation globally, people living in urban Africa, lack access to improved water and sanitation services. (Adams et al., 2018, Adams, 2018, Banerjee et al., 2008). From 2000 and 2010, 83 million urban Africans gained access to improved water, and 42 million gained access to improved sanitation (Jacobsen et al., 2012).

However, the combined effects of population growth and rapid urbanisation reduced the impact of an increase in improved water and sanitation service, leaving the share of the population with

access to improved water and sanitation unchanged at 83% and 43% respectively (Dos Santos et al., 2017, Jacobsen et al., 2012). Informal settlements and high concentration of slums are also predominant in the urban areas of Africa where water supply and sanitation services are virtually non-existent and waterborne diseases are prevalent. (Moe and Rheingans, 2006, Nhapi, 2015). Population growth and urbanisation cause a significant increase in agricultural and industrial demand and domestic use for water (Sdiri et al., 2018, UNESCO, 2012, UNESCO, 2015).

Also, water demand in African urban cities is increasing at a higher rate than population growth as income levels, and the standard of living rises, and the demands for improved services grow. Water demand is projected by Jacobsen et al. (2012) to increase by more than 100% for many African countries by the end of the century. There is an existing gap between water demand and supply as water availability is also threatened by the complexities of pollution, and uncertainties in climate change.

The quality of water resources is at risk, due to issues such as inadequate sanitation, resulting from solid waste management, drainage, and wastewater management issues (Bloch et al., 2012, Jacobsen et al., 2012). The groundwater in most mega African cities (e.g. Dakar, Abidjan, Lomé, Lagos, and Dar es Salaam) is contaminated and polluted mainly by the discharge of untreated wastewater and unregulated industrial pollution. Therefore, Utilities spend significant sums to treat the water whereas these resources could be used to provide basic services to citizens. In Dakar, Senegal for example, where about 80% of water comes from groundwater, contamination from nitrates and seawater intrusion is posing a serious threat to water quality (Bloch et al., 2012)

Also, water availability is decreasing due to competing demands from agriculture, mining, and industry, deteriorating water quality and flood hazards. With respect to urban water management (Howe et al., 2011, Khatri and Vairavamoorthy, 2008) identifies other issues as shown in Fig 3.3 in addition to population growth and urbanisation, climate change as key issues affecting the future on water management in cities.

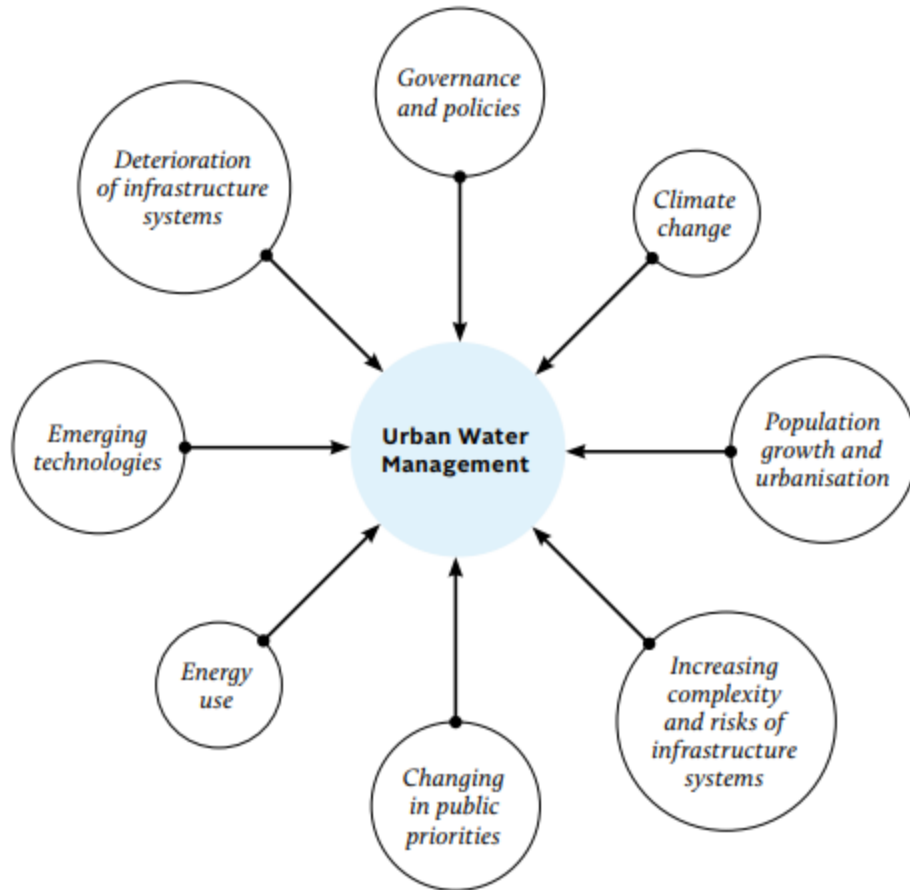


Figure 3.1: Issues and Future Challenges in Urban Water Management.

Source: (Howe et al., 2011)

However, (Baietti et al., 2006, Ballance and Tremolet, 2005, Bayliss, 2003, Budds and McGranahan, 2003, Cosgrove and Loucks, 2015, Dos Santos et al., 2017, Evans et al., 2004, Howe et al., 2011, OECD, 2014, Khatri and Vairavamoorthy, 2008, Marlow et al., 2010, Moe and Rheingans, 2006, Parienté, 2017, Sdiri et al., 2018, Silvestri et al., 2018, Tucker et al., 2010, van den Berg and Danilenko, 2017b) in their studies on African countries attribute poor performance in water and sanitation sector to a combination of many factors such as issues such as population growth urbanisation, climate change, lack of infrastructure, political interference and institutional issues such as low-cost recovery, inadequate governance and lack of adequate investment. These challenges pertinent to African utilities are discussed in detail below.

3.2.1 Population growth and Urbanisation

Population growth and urbanisation is a significant issue affecting urban and water and sanitation in Africa. Between 2000 and 2015, the urban population increased by more than 80% from 206 million to 373 million people. Africa is urbanizing more quickly than any other region in the world and has faster-growing urban slums. With a growth rate of 3.9% per year, the African urban population is expected to double by 2030; the Urban population growth rates in Africa have and will always be the highest in the world (IDEV and AFDB, 2015, Jacobsen et al., 2012).

Although access to piped water increased over the period (from 82 million urban dwellers with piped water in 2000 to 124 million in 2015), African utilities were not able to keep up with the rapid urbanization as reflected in the decline of piped water as a primary source of water supply in percentage terms. The situation is worse in sub-Saharan Africa, where urbanisation is happening most rapidly. In this region, the percentage of people who enjoyed piped water on their premises, which is the preferred option for urban areas, actually decreased from 42% to 34% (WHO and UNICEF, 2014). Population growth and rapid urbanisation threaten the already inadequate infrastructure, and poor access to urban water and sanitation in African cities (Dos Santos et al., 2017).

African cities have and will continue experiencing one of the most rapid urbanisation processes in the world, with an urban population projected to double by 2050 (Jacobsen et al., 2012). This unprecedented urban growth is largely characterised by unplanned settlements and slums where poor sanitation, overcrowding, poverty and insecure housing tenure, among many other challenges, complicate an already dire situation of poor water access. Adams (2018) states that over 71% of the current urban population of SSA, more than any other middle-income/low-income region by proportion, reside in informal urban settlements

As a consequence, unplanned urban population growth remains a serious threat to water security in cities and informal settlements of sub-Saharan Africa. In the urban areas of SSA, most especially, water access is woefully inadequate and low compared to other developing regions. Because of increasing urbanization and the development of informal settlements that do not have access to basic water services, more than half the urban population depend on alternative sources usually a standpipe, a pump, a well or services from independent providers delivered to households

by cart or truck, or from public collections points such as standpipes or cisterns (Dos Santos et al., 2017, Collignon and Vézina, 2000).

Depending on informal sources compared to piped networks in households is less favourable because of the large amount of time and money required. There are more tasks involved when depending on informal sources this includes travelling to the water collection point, waiting at the water source, transporting the water and storing it.

3.2.2 Poor governance and political interference

According to (Bréthaut and Schweizer, 2017, IDEV and AFDB, 2015, Montgomery and Elimelech, 2007, Silvestri et al., 2018, Estache, 2017), institutional issues such as low-cost recovery, political interference, poor governance, and as major factors responsible for impeding urban water and sanitation services in African water utilities. Most African water utilities are run by public utilities struggling with inefficient management, corruption, political interference, low financial investments. (Adams et al., 2018, Evans et al., 2004, Brugger, 2007).

Thus, the performance of African utilities is characterised by poor operational and financial efficiencies such as non-revenue water as high as 60%, low tariff rates which cannot recover total costs, a large number of employees lacking the required competency, and water service interruptions.

For instance, Tariff setting decisions most times are majorly political as governments try to find a balance between providing free services to the poor and sustaining the financial viability of the water utilities (Baietti et al., 2006, Brugger, 2007). Secondly, (Banerjee et al., 2008, Banerjee and Morella, 2011, UNESCO, 2015, Brugger, 2007, IDEV and AFDB, 2015) state that African governments do not give priority and financial investment to the water sector as much as they do with other poverty reduction oriented strategies.

Most times, urban and water sector management are considered at the regional and local level of African regions which most time lack the technical and financial capacity to sustainably run the sector. Another institutional issue is the fragmented governance structure in urban water management in Africa. There are several actors and ministries for managing water across the entire urban water cycle consisting of water supply, sanitation, stormwater and waste. There is usually a

lack of coordination amongst actors and ministries responsible for urban water management (Brikké and Vairavamoorthy, 2016, Brugger, 2007).

More importantly, PPP reforms which were aimed at improving utilities like Nigeria, Kenya and Congo, for example, are stated by (Adams et al., 2018, Fall et al., 2009) to have failed due to the institutional context of the African countries. (Wu and Ching, 2013) states that strategies like private sector participation and concession projects can only be successful in middle-income/low-income countries if an appropriate regulatory mechanism is established.

Contract awards and tender negotiations were influenced by politicians and developed based on politically inclined reasons. In addition, pro-poor services were neglected and instead services were more inclined to richer communities even though most of their urban population were associated with slums and informal settlements (World Bank, 2014 , van den Berg and Danilenko, 2017a).

3.2.3 Climate change

Climate change is having a multitude of immediate and long-term impacts on water resources in African countries. These include flooding, drought, sea-level rise in estuaries, drying up of rivers, poor water quality in surface and groundwater systems, precipitation and water vapour pattern distortions, and snow and land ice mal-distribution (IDEV and AFDB, 2016). Impacts are already felt in African Countries around all regions (e.g. Nigeria, Cameroon, Kenya, Swaziland and Egypt) coupled with selected trans-boundary water resources (Lake Chad and Lak Victoria).

Water is expected to be the main sector impacted by climate change as, it causes water scarcity, water quality degradation, decreases ecosystem functions and hinders economic growth (IDEV and AFDB, 2016, Vairavamoorthy et al., 2008). Uncertainties in climate change will severely impact the urban water cycle and how we manage it. Components of the urban water cycle, like water supply, wastewater treatment, and urban drainage will, therefore, need to be managed with climate change issues in mind. (Jacobsen et al., 2012)

Extreme weather events, from prolonged droughts to violent storms, are poised to overwhelm urban water infrastructure and cause extreme suffering and environmental degradation. Climate change is likely to affect the quantity and quality of water supplies and water infrastructure, primarily through flood damage, increasing treatment requirements and reduced operational

capacity. Many slums lack drainage networks or existing drains are choked with garbage. Heavy rainfall can trigger flooding with untreated wastewater from overflowing sewers.

Climate change is likely to affect water infrastructure services and technologies, primarily through flood damage, increasing treatment requirements and reducing availability and operational capacity. Extended dry periods will increase the vulnerability of shallow groundwater systems, roof rainwater harvesting, and surface waters (Bahri, 2012).

3.2.4 Lack of financial resources / inadequate financial investment

One major reason why sustainable water and sanitation service is difficult to achieve is the lack of financial resources. (Banerjee et al., 2008, Banerjee and Morella, 2011, Brugger, 2007, Montgomery and Elimelech, 2007) state that African countries would need to increase their current investment levels by 50% to meet urban water and sanitation challenge.

In a recent study of 37 countries in Africa by (WHO, 2015), 82% of the government in the studied countries stated the financial investments made in the urban water and sanitation sector were not enough to achieve national water targets. The total expenditure required for reaching the sustainable development goals in African cities is estimated at \$22.6 billion per year, or 3.5% of Africa's gross domestic product (Banerjee et al., 2008, Banerjee and Morella, 2011). Compared to the rest of the world, water and sanitation are underfunded.

Funding for the expansion and regular maintenance and replacement of ageing water infrastructure is also inadequate and causes a lot of strain on the sector (Andres et al., 2018). Investing in new infrastructure in the region will require up to 1.5% of the African GDP per annum; while OPEX requirements are estimated at 1.1% of the GDP of Africa, or 31% of overall costs (Banerjee and Morella, 2011).

In addition, African urban utilities are unable to fully recover capital costs and maintenance costs as tariff rates set are not financially sustainable. African utilities depend on subsidies and government transfers because they have more people concentrated in slum areas compared to well-planned urban areas (Brugger, 2007).

In most African countries, capital costs have been almost entirely subsidized by the state or by donors, but these subsidies are degenerating, especially in the megacities. (Banerjee and Morella, 2011)

3.2.5 Deteriorating infrastructure systems

Utilities in Africa operate ageing infrastructure for delivery urban water and sanitation services (African Development Bank et al., 2017). The dilapidated and ageing infrastructure of most African utilities cannot meet the growing demand for water. Together with their inefficient management, African water utilities are unable to deliver continuous water service or adequate water quality.

In most African cities, infrastructure for urban water supply has either reached or exceeded the end of their asset life-cycle. Because of a lack of regular maintenance schedules, insufficient data on the value (and extent) of the infrastructure asset and a lack of efficient decision-support tools, these assets have not received the needed attention for maintenance and replacement. Water losses of between 30 and 50 per cent, high energy costs for pumping because of corroded pipes and valves, and ingress of contaminants through cracks in pipes are among the manifestations of ageing infrastructure (Brikké and Vairavamoorthy, 2016).

For African cities to provide water and sanitation services to meet social and economic demands, they need investments. Yet most African countries lack adequate local funding to expand or renew their utilities and current investments in urban services are insufficient given urbanization rates. In Nigeria for example, 46% of all their water schemes are non-functional, and around 30% are likely to fail in the first year of their operation. In addition, about 60% are projected to fail after a life span of 10 years (Andres et al., 2018).

3.3 Fundamentals of good management practices – lessons from identified success stories in African utilities

While issues such as political interference, population growth, lack of infrastructure and poor governance may be widely responsible for impacting sustainable urban water and sanitation services in African cities, there are still countries considered to have good management practices. For this research, Utilities in Uganda, Burkina Faso, Senegal and Cote d'Ivoire have been analysed in this section to determine what good management practices means in the African urban water sector.

Section 2.4 and 2.5 has clearly shown that prominent asset management frameworks consider contextual issues and factors as external to the asset management system and hence an asset management policy is usually stated to be the starting point and foundation of asset management for any organisation as shown in figures 7 to 10 of the appendix. However, in the context of a middle-income or low-income African country as shown in section 3.2, the performance of water utilities and a middle-income/low-income African urban water sector is influenced greatly by challenges that are asset-related and contextual.

Hence, the need to incorporate contextual issues within the scope of the asset management system is critical in developing an asset management system that is adaptable to an African middle-income/low-income context. To achieve this, four countries like Uganda, Senegal, Cote d'Ivoire and Burkina Faso were selected to identify how to attain good asset management using lessons learnt from successful good management practices in a middle-income/low-income African urban water context. The rationale for the selection of these countries as good cases for studying how to successfully implement asset management can be premised on the following factors.

Firstly, the prevalence of factors such as population growth, political interference and poor governance, climate change, deteriorating infrastructure and lack of financial resources in each case before establishing success was critical for selecting the 4 African countries as good case studies. According to (Adams et al., 2018, Evans et al., 2004, Brugger, 2007) all four countries dealt with issues ranging from flooding, urbanisation and prevalence of illegal slums and intricate funding systems hence clearly representing the context of African utilities and middle-income countries. NSWC is a public corporation that provides water and sanitation services to 23 cities in Uganda. Their service population is 2.2 million and Uganda has a high concentration of its population in urban areas. Cote d'Ivoire is an example of a utility that had a lot of urban poor people and majority of their services cover slum areas.

Secondly, the ability for these African case utilities to find innovative ways for simultaneously and successfully managing contextual issues and asset-related issues mentioned in criteria was another selection criteria for making them good case studies. This was critical for understanding how the management practices developed were able to consider and adequately deal with contextual issues and asset-related issues simultaneously. Following reforms of their governance system, all four

countries developed successful governance models that contributed massively to their ability in meeting operational and financial efficiencies (Baietti et al., 2006, Chiplunkar et al., 2012, Collignon, 2002, Collignon and Vézina, 2000, Kayaga et al., 2018, Mugabi et al., 2007, World Bank, 2011b, World Bank, 2011c, World Bank, 2011 , World Bank, 2014 , World Bank, 2016).

Senegal implemented successful governance in 1995 by setting up an affermage contract between its national utility SONES, SDE and its government. The innovation can be seen in the strong incentives introduced for SDE to reduce non-revenue water and increase collection efficiency drastically. Cote d'Ivoire also had similar affermage contract formed by SODECI the utility and the government like that of Senegal.

Another successful initiative with governance can be seen with NWSC in Uganda through their incentivised management contracts. These were internally delegated management contracts where branch managers were held accountable when it came to achieving certain performance-based targets. Where business units and managers had bonuses where they exceeded targets and received penalties for missing targets. What is interesting about Uganda as a case when it comes to governance was their ability to retain public management process and adapt it to work in their favour.

The strategy of ONEA which is Burkina Faso is also an interesting case study where performance-based service contracts existed between ONEA and Veoila. The contract with Veoila was only for providing financial and commercial management system services and setting up customer management systems (Joffe et al., 2008, World Bank, 2014 , van den Berg and Danilenko, 2017a). This system helped stop illegal connections, increase metering and improve customer service. Additionally, a multi-stakeholder supervision committee was set up to monitor the contract between ONEA and the government so both parties fulfilled their obligations. This multi-stakeholder committee was made up of stakeholders like customers, NGOs and donors. The committee had annual reviews using independent financial and technical audits.

The third criteria used to build a case for selecting the four African countries as good case studies was the fact that the good management practices within these countries were developed through the interaction and management of diverse asset types such as people, infrastructure, information and financial assets, unlike the asset management frameworks that have physical assets as the focal

viewpoint. Concerning managing funds, Uganda, ONEA and SDE received World Bank donor supports on concessional terms given at very low-interest rate with long grace periods for repayment. All four countries also set subsidised tariff structures for certain levels of consumption, certain types of customers and residents of their countries. For example, Senegal had lower tariffs for consumption levels less than 20m³ while there were high tariff rates above 20 m³. This system was developed to encourage efficient water consumption (Joffe et al., 2008). Cross-subsidy systems were also used so they could have a good trade-off between affordability and cost recovery. For example, in Uganda domestic tariff structures are relatively lower than commercial and institutional customers. However, there were existing packages where commercial customers who were above a certain level of consumption received lower tariff rates to encourage them to patronise their services. All four utilities were able to recover operational and maintenance costs and generate more funds to cover asset depreciation and some levels of debt repayments.

Cote d'Ivoire has been able to successfully support pro-poor services compared to the other studied utilities through the innovative development of the FDE funding tool, licensing water vendors and resellers in the informal sector and a block rising tariff surcharge (Collignon, 2002).

Finally, the 4 case countries were selected because of how well they rated for key performance indicators in the urban water sector when compared to other African countries. As shown in Tables 1 to 4 of Appendix 3, all four utilities had very high figures for most of their performance indicators. Also, within 20 years, NWSC, ONEA and SONES were able to improve their water coverage, reliability, financial performance and operational efficiencies drastically.

According to World Bank (2014), these four countries all surpassed the operational benchmark for African countries in terms of collection ratio, non-revenue water, staff productivity, cost ratio recovery and hours of supply. Burkina Faso is ranked as one of the top-performing countries in urban water supply provision in Sub-Saharan Africa. The operational management capacity of ONEA is very good with staff productivity of 2.9 staff per 1000 connections.

Currently, Cote d'Ivoire is an example of a utility that has been the most successful in providing services to a lot of urban poor people. Water coverage to the urban population in Cote d'Ivoire is 91.5% while sanitation coverage is at 31.75% (Angoua et al., 2018, UNECA et al., 2014, World Bank, 2016). Senegal is also used as a major reference for good practices in water service delivery

in West Africa. Their technical and financial management is regarded as sound because of their ability to deliver high-quality water, continuous service, maintain non-revenue water at 20 %, and maintain good collection and billing efficiency ratios. (World Bank, 2011)

NSWC is a perfect example of a sub-Saharan African nation that is characterised by good urban management practices as they have a good assurance system and area managers that are highly skilled and empowered. The success of NWSC has also extended to other African countries by lending Public Utility partnerships with countries like Kenya, Rwanda, Tanzania and Zambia (Sansom et al., 2018).

Based on the analysis of the four utilities as suitable cases for establishing good management practices in Africa, the following factors are the fundamentals of good management practices which were common with our four successful utilities.

3.3.1 External Autonomy

(Baietti et al., 2006, Chiplunkar et al., 2012) argues for creating a level of external autonomy for utilities to fulfil their water and sanitation responsibilities. External autonomy is concerned with the degree of independence from external interference that is provided to utility managers for important decision making that could significantly affect the results achieved by the utility, such as setting tariffs, assumption of debt, and procurement (Baietti et al., 2006, Chiplunkar et al., 2012, Kayaga et al., 2018, World Bank, 2012a).

From the studied countries, Burkina Faso (ONEA), Uganda (NWSC) and Senegal (SDE) lack the financial autonomy to set tariffs however, NSWC and ONEA are empowered to prescribe tariff recommendations to the government however their tariffs have been lower than inflation and are unable to recover full costs (Joffe et al., 2008). SDE on the other hand, benefit from tariffs with good financial structures that can cover all costs in terms of CAPEX and OPEX.

In respect to the assumption of debt, ONEA and NWSC are subject to restrictions for borrowing. ONEA are unable to service debt requirements which exceed CFA 1 billion and terms of payments over one year (Joffe et al., 2008). ONEA and NWSC also rely majorly on government subsidies for cost recovery, which dissuades commercial investors and banks from supplying loans to the water utilities.

For Senegal, SONES which monitors SDE is directly responsible for raising and servicing debts. SDE is a healthy and well-managed company. SONES is well on its way to meeting the objective of financial equilibrium in 2003 and has proved itself capable of borrowing funds on private capital markets and repaying them in a timely fashion. Success in this latter regard is evidenced in SONES being able to freely access future loans from lenders (World Bank 2014). Cote d'Ivoire, on the other hand, has a water development fund for social connections and renewal expenditures while there is a National Water fund for servicing long-terms debts for water investment.

However, (ONEA) is corporatized and reformed into a financially viable and self-sustaining utility. It is an autonomous company providing water and sanitation services covering 35 cities and urban areas. Currently, ONEA funds between 20 and 30% of its rehabilitation and expansion work requirements on the piped water network from their generated income, while the remaining funds come from international donors like World Bank.

3.3.2 Presence of an assurance system for accountability

External accountability refers to the obligation for the water utility to account for performance results to key external stakeholders. Aligning varying interests from external stakeholders in line with aims such as financial sustainability, improved operational efficiencies and effective management as opposed to management systems impacted by political interference can only occur with effective governance frameworks (Baietti et al., 2006, Chiplunkar et al., 2012, Kayaga et al., 2018, World Bank, 2012a).

From the utilities with good management practices, there were existing governance arrangement and performance contracts that formed an institutional framework that clearly defined roles and responsibilities and interactions between utilities and their external stakeholders. Performance targets and incentives were also set up for the various contracts and most utilities benefited from high-efficiency rates especially in regards to urban water supply (Baietti et al., 2006, Chiplunkar et al., 2012, Kayaga et al., 2018, World Bank, 2012a).

Another important factor for increasing accountability stated by World Bank (2012a) is decentralizing responsibility for service provision to the urban local bodies or community levels. In Cote d'Ivoire and Uganda, for example, the decentralisation of services to informal settlement vendors (who had a better local knowledge of the terrain) and to regional areas in the case of

Uganda increased the accountability levels of both countries. However (Adams et al., 2018, World Bank, 2012a) believe that decentralization to the lowest levels sometimes could lead to loss of economies of scale and access to professional staff. In such cases, urban local bodies can consider grouping through Special Purpose Vehicles (SPVs) to provide regional, multi urban local bodies services.

(Baietti et al., 2006) also states the importance of accountability within the organisation which occurs by ensuring management and staff are held accountable for effectiveness (the degree to which the utility realizes its goals) and efficiency (the cost-effectiveness of resources used to produce its water services). A perfect example can be seen clearly in the case of Uganda which developed performance contracts that have triggered the involvement and engagement of staff and motivated them to seek to deliver uncommercial performance targets which is beyond what financial incentives would deliver.

The Performance measurement system and targets used in Uganda is customer-oriented and linked to processes and outputs. Key performance indicators used for this system include working ratio, cash operating margin, non-revenue water, collection efficiency and connection ratio. The area offices of Uganda carryout monitoring routines which are proactive and consistent. Performance incentives are both commercial and uncommercial (World Bank, 2014 , van den Berg and Danilenko, 2017a). Commercial incentives include penalties for not meeting performance targets while uncommercial incentives include trophies for the highest achieving areas, a publication of monthly, quarterly and annual top and lowest performances.

The performance of NWSC in comparison to its African peers has been substantial and impressive as there have been high achievements and improvements within the period of 1998-2008 in financial efficiencies, operational efficiencies and service extension. SONES has the ability and capacity to effectively monitor SDE through Performance targets such as reducing non-revenue water, increasing water quality and customer services. (Ballance and Tremolet, 2005, Tucker et al., 2010). Notable performance targets achieved include increased service coverage and a major rise in operational efficiency which emanated from a decrease in nonrevenue water (NRW) and better water quality. For Cote d'Ivoire, water vendors are licensed and legalised and SODECI is able to successfully influence and monitor the tariff rates for water vendors (World Bank, 2014 , van den Berg and Danilenko, 2017a).

3.3.3 Focus on Customer needs and expectations

(Baietti et al., 2006) Refers to how utilities can listen to clients, work to meet their needs, solicit their views regarding standards and level of service, and respond to complaints on time. Important measures of customer orientation include friendliness of the customer billing and collection system, orientation toward seeking opinions and views of customers, availability of options for service delivery, timely information to customers on developments about water services, and response to customers' complaints

Uganda shows a very good example for developing customer orientation with their established strategic alliance meetings. All NWSC areas of operations have mapped out stakeholders among the customer base (customer segments). These include water vendors, water kiosk and public standpipe operators, urban authorities, large government consumers, poor urban communities, restaurant operators, industries, educational academic institutions, and so on (World Bank, 2014 , van den Berg and Danilenko, 2017a). The NWSC area management teams conduct regularly scheduled strategic alliance meetings with different customer segments. At the strategic meetings, customers can state what they require from the NWSC.

3.3.4 Governance

The presence of an enabling governance arrangement was evident in the studied African countries which are Senegal, Burkina Faso, Cote d'Ivoire and Uganda. However a quick definition of Governance and what incorporates good governance is briefly described to throw light more light to Governance is defined by GWP (2000) as the *“range of political, social, economic and administrative systems that are in place to develop and manage water resources, and the delivery of water services, at different levels of society”*.

There are different school of thoughts regarding what incorporates good governance. Advocates of good governance such as (ARARAL, 2008, Shirley, 2002, Rogers and Hall, 2003, Ménard and Saleth, 2013, OECD, 2015, Akhmouch and Correia, 2016, OECD, 2016a, OECD, 2018) state that good governance should encompass functional institutional framework should encompass issues such as consumer protection, enabling regulatory framework, equity, efficiency, transparency, engagement, communication, sustainability and capacity.

The reviewed countries demonstrated some level of good governance while implementing urban management practices in the following ways.

The water sector in Senegal has benefited from the PPP route and are a major forerunner in Private sector participation in West Africa. Private sector participation in the water sector was set up through the country's "*affermage*" contract. An *affermage* contract is a management delegation contract where a public authority makes a private company responsible for marketing and running a public service (Brocklehurst and Janssens, 2004). The private company is paid a fee known as the operator's water supply rate, which is the price for the volume of water the company has to produce and sell to recover all his costs from running the system.

In Senegal, the urban water and sanitation sector reform initiated in 1996 helped establish a well-performing institutional and contractual framework with:

- the creation of a public holding company (SONES) in charge of managing the sector assets and the development of urban water services under a concession agreement with the Government (World Bank Group, 2014);
- the recruitment of a private operator Senegalaise des Eaux (SDE) to operate the urban water facilities and deliver water services under a lease agreement (World Bank Group, 2014);
- the establishment of ONAS, a public parastatal in charge of managing urban sanitation (World Bank Group, 2014).

Since the initiated reform in 1996, urban water service provision has occurred through the *affermage* contract with the private company SDE, primarily owned by Saur a French company.

One of the most important successes is the existence of a good working relationship between the players, and this relationship is perceived as a partnership. SONES concentrates on overall sector development and contract enforcement and leaves the day-to-day operation of the system to SDE.

The existence of an appropriate governance framework and policy that clearly defines the responsibilities of stakeholders also contributes immensely to the successful water service and sanitation provision in Burkina Faso. The Office National de l'Eau et de l'Assainissement (ONEA) is responsible for water service provision. ONEA is a limited liability company owned by the government since the nationalisation of the utility in 1977 (Baietti et al., 2006). ONEA compared to other utilities in African countries is ranked as one of the top-performing utilities. The water

supply and sanitation sector in Burkina Faso is also characterised by an enabling institutional and political context (World Bank, 2011b).

Unlike Senegal's PPP route which was successfully achieved by transferring water service provision to a private company using affermage contracts. ONEA did not transfer the provision of water supply services to private companies completely. ONEA was innovative in engaging the private Sector using performance-based contracts for commercial and financial management only (World Bank, 2014 , van den Berg and Danilenko, 2017a).

The National Water and Sewerage Corporation (NWSC) is an autonomous utility solely owned by the government of Uganda (Banerjee and Morella, 2011). Performance-based contracts are established between the NWSC head office and area managers. The Head office is vested with the responsibility of carrying out oversight functions, regulated tariffs, rates and charges and set up capital investments. While the area managers function as operators by carrying our management operations such as operation and maintenance of water and sanitation services, revenue generation and collection and finally rehabilitation and extension works.

SODECI has also been successful because the government has fulfilled its regulatory function efficiently by analysing the annual accounts of SODECI and FDE, making funds available from FDE to SODECI. The Société de Distribution d'Eau de Côte d'Ivoire (SODECI) is a private company responsible for providing water supply services to urban areas in Cote d'Ivoire. SODECI works under a concession contract, managed by the government's Water Directorate, which provides regulation and is responsible for tariff setting and negotiation. In reality, the contract resembles a lease contract because it does not require the company to invest directly in capital works. Instead, a surcharge on water sales finances a water development fund (FDE) controlled by the Water Directorate, to which SODECI can apply for capital finance (Collignon, 2002).

3.3.5 Financial sustainability

Mugabi et al. (2007), (Chiplunkar et al., 2012, Baietti et al., 2006, Collignon, 2002, Collignon and Vézina, 2000, Kayaga et al., 2018, World Bank, 2011b, World Bank, 2011c, World Bank, 2011 , World Bank, 2014 , World Bank, 2016) argue that water utilities need to be commercially viable if they intend to consistently provide services to their customers. Financial viability deals with how a utility is able to stand on its own financially because it has steady revenues flowing in. It is

a management philosophy that introduces market-style incentives and promotes greater use of markets for the delivery of water services. It involves setting tariff rate and user fees that will increase revenue so operational costs can be covered fully and urban services can also be extended to the poor. (Mugabi et al., 2007, Chiplunkar et al., 2012) argues for service providers relying majorly on user fees and loans as their main sources of financing than on subsidies thus making them revenue-generating organisations.

However, if utilities have to depend on subsidies, (Baietti et al., 2006, Collignon, 2002, Collignon and Vézina, 2000, Kayaga et al., 2018, World Bank, 2011b, World Bank, 2014 , World Bank, 2016) asserts that such allocation should correspond to the responsibilities conferred upon the utilities by their government. Also, subsidies should be only applied and used for supplementing urban poor services. Bayliss (2013) states that subsidies should be designed to ensure they reach the intended beneficiaries and are not captured by the middle and upper-income groups connected to the networks.

Financially, most African city governments or water companies are not fiscally strong or self-sufficient, and for many, the transfers of tax revenues they receive from higher tiers of government are not adequate or sufficiently predictable to compensate for insufficient tariff revenues. The result has been underinvestment, inadequate maintenance, and deterioration of assets. In the absence of clear incentives to deliver responsive services, utility financial sustainability has also been weak.

African countries such as Burkina Faso, Cote d'Ivoire, Senegal have achieved some level of financial sustainability. These utilities have found innovative solutions that make the utilities meet the needs of the poor without affecting their ability to remain financially viable. The innovation of employing SDE through the affermage contract for the financial management of the utility is part of the reasons Senegal is able to achieve high financial efficiencies.

ONEA (Burkina Faso) can fully recover capital and operational costs. Burkina Faso is also funded majorly by the World Bank thus contributing immensely to the success of the urban water sector. The success of the Burkina Faso urban water sector is as a result of factors such as sustained commitment from the central government, competent public management at ONEA and

willingness from international donors in sponsoring water project (World Bank, 2011b, Fall et al., 2009, Newborne et al., 2015).

At various levels, utilities in the case studies look for opportunities to lower costs through outsourcing certain functions, gradually making greater use of market forces and the introduction of market-style incentives within their organizations. In doing so, water utilities have been defining the core functions and activities that they prefer to perform themselves, which is in line with the rationale for the organization of modern market-sensitive corporations. Cote d'Ivoire has been able to successfully support pro-poor services compared to the other studied utilities through the innovative development of the FDE funding tool, licensing water vendors and resellers in the informal sector and a block rising tariff surcharge (Collignon, 2002).

Additionally, Senegal also is considered to be one of the utilities in Africa that have been able to fully recover all costs. However, tariff setting for most of the utilities is still restricted and below the inflation rate. Dependence on government subsidies still occurs which is no longer a sustainable means of financing the water sector in the long run as governments are continually reducing investments and budgeting for water and sanitation.

3.3.6 Capacity Building and Training

Good governance policies and strong finance must be accompanied by the tools and capacities with which to make the policies work (Baietti et al., 2006, Chiplunkar et al., 2012, Kayaga et al., 2018, World Bank, 2012a). Utilities need to employ, train and sustain talents so they can build a competent workforce. Also, as many of the decisions affecting water resources take place outside of the water sector, water education and capacity building at all levels are required to ensure adequate capacities among all stakeholders.

In addition, an increase in the number of adequately trained water professionals will be needed to efficiently expand water supply and sanitation, increase water efficiency, adopt water rights and improve resilience to water-related disasters. Along with the strengthening of human capacities, particular focus is also provided to institutional capacities and to other forms of acquisition of the information and knowledge needed for informed and efficient decision-making.

World Bank (2012a) even with good policies, institutions and financing frameworks in place, the delivery of service to the customer relies on a well-trained and motivated workforce and

management. Building the Capacity of the Various Actors could be achieved through a combination of classroom and on-the-job training, networking between professionals, twinning and public-private partnerships (PPP). Knowledge and capacities on managing people and processes and mediation will be critical to improving water governance (Tropp, 2007, Budds and McGranahan, 2003, Uchegbu, 2009).

In addition to staff training, (Chiplunkar et al., 2012) also argues for visionary and dynamic leadership that can motivate staffs to achieve required productive levels and performance targets. SDE, ONEA and NSWC were stated by (Dominguez Torres, 2018) to have created training platforms for increasing capacity through employee training.

3.3.7 Pro-Poor solutions

An important enabling factor for success is being able to develop innovative solutions that allow utilities meet the needs of the poor without affecting their ability to remain financially viable. Serving low-income communities can only be fully achieved when incentives promoting pro-poor services are set up (Chiplunkar et al., 2012, Baietti et al., 2006, Kayaga et al., 2018, World Bank, 2012a).

Between 2001 and 2007 development partners supported ONEA in developing the Ouagadougou water supply Project. This project was developed to increase water storage capacity, developing social connections thereby increasing access to water supply in poor areas and encouraging private sector participation (Newborne et al., 2015).

Utilities in Uganda, Cote d'Ivoire and Burkina Faso were able to find innovative ways to provide pro-poor services to slum areas and the urban poor thus increasing service coverage. They exhibited the managerial and financial capacity to successfully implement the pro-poor strategies in slum areas and to the urban poor.

Cote d'Ivoire, unlike other African countries, is recognised for its success in investing tremendously in services for poor people. In Cote d'Ivoire, The water services in small towns, and peri-urban areas exceeds that of surrounding African countries like Ghana, Mali, Sierra Leone, Burkina Faso (Collignon, 2002). Informal settlements are predominant in the urban areas in Cote d'Ivoire especially in the capital city of Abidjan. The increase in informal and unplanned settlement in Abidjan is as a result of high migration from rural areas and northern and central

zones of the nation impacted by war, civil unrest and inadequate infrastructure. (Angoua et al., 2018)

SODECI applies three mechanisms for providing pro-poor services

- subsidised household connections
- a rising block tariff
- Licensed water resellers in informal settlements.

The subsidy for the household connections comes from a surtax on water bills administered by water development fund FDE. This internal cross-subsidy avoids dependence on external funding sources and can be maintained in the long term. The rising block tariff is another type of cross-subsidy from large consumers to small. Since the tariff is fixed across the country, it also boosts the finances, and hence the services, in the small towns form the stronger economic base of Abidjan (Collignon, 2002).

To make it easier for the poor to receive safe water, Cote d'Ivoire legalized household resellers in informal settlements. Legalization enabled the water utility, SODECI to indirectly influence the price and quality of water sold in these areas. It issued about 1,000 licenses to water resellers, many of whom have invested in last-mile network extensions to cater to the demand of the urban poor. SODECI reduces the risk of non-payment by charging a high deposit and invoicing resellers monthly (Banerjee and Morella, 2011, Collignon, 2002).

Although similar subsidised connection policies exist in other African cities such as Dakar and Cotonou, they generally use subsidies funded by external support agencies. So those policies are not based on the viability of the company itself but depend completely on external factors. In such cities, the number of subsidised connections tends to be small and they mainly benefit the middle class. In contrast, SODECI does not focus on the rich and middle class alone but is a service provider to both the poor, rich and middle-class areas.

Sodeci has been successful because it has been able to develop a demand-responsive approach, keeping pace with the growth of the urban population. Another success factor for the pro-poor services of SODECI is the fact that the customer base and people connected to their service is massive. The effectiveness of FDE as a tool to finance subsidised connections depends on the

relative numbers of existing and new customers. In Abidjan, for example, the surtax paid by over 200,000 existing customers can easily finance the 15,000 new annual connections (Collignon, 2002).

Finally, Abidjan is SODECI's largest supply area. There are 72 listed informal settlements in Abidjan, but they are generally small in size because the city was more systematically planned than most other large African cities (Collignon, 2002, Banerjee and Morella, 2011). It is thus possible to supply each informal settlement with only a few hundred metres of pipe extended from the existing network. The good condition and high water pressure of the existing piped network also help the cost-effectiveness of such extensions. In Senegal, major improvements to service levels also occurred with many of the urban poor receiving service for the first time and more reliable service in low-income neighbourhoods.

NWSC has also set up various pro-poor strategies such as affordable connection, a pro-poor tariff, and special projects targeted at the poor. (World Bank, 2014 , UNESCO, 2015) NWSC also created an urban pro-poor branch in 2007 and provided a variety of service options including household connections, prepaid public water points/kiosks, and shared yard taps. As a result, NWSC was able to significantly expand services to the urban poor while increasing its revenue. The pro-poor branch was also able to reduce the proportion of inactive public water points and yard taps from 40% in 2007 to less than 10% in 2009 (World Bank, 2014 , UNESCO, 2015).

3.4 Prerequisites for good urban water management practices

This section explores in detail, principles of good urban water management practices making reference to Integrated Urban water management (IUWM) principles identified by (Bahri, 2012, Closas et al., 2012, Furlong et al., 2016, Kirshen et al., 2018, Whitler and Warner, 2014).

IUWM is defined by (Furlong et al., 2016, Closas et al., 2012) as an efficient management process which considers all water services, sources, stakeholders and factors impacting water management in an urban area. IUWM is widely adopted by African countries for urban water management based on the following attributes discussed below.

3.4.1 Holistic urban water management system

For an effective and efficient urban water management strategy to occur (Closas et al., 2012, Whitler and Warner, 2014, Bahri, 2012, Kirshen et al., 2018) indicate the need for implementing a holistic approach in delivering successful urban water management.

A good urban water management approach should incorporate

- All water sources: conventional and alternative water sources: freshwater (surface water, groundwater, rainwater, desalinated water), wastewater (black, yellow, brown, grey, and reclaimed water), and stormwater.
- Supply and demand management issues
- Environmental, economic, social, technical, and political aspects of water management (Wade, 2012).
- Water service systems within the urban water cycle which include water supply, sanitation and wastewater (black, yellow, brown, grey, and reclaimed water), and stormwater (Bahri, 2012, Whitler and Warner, 2014)
- the different interactions among users and stakeholders in the watershed outcomes (Furlong et al., 2016, Closas et al., 2012)

Managing the aspects of the urban water cycle holistically is stated by (Furlong et al., 2016, Closas et al., 2012) to achieve improved environmental, social and economic outcomes

3.4.2 Integrated urban water management system

Urban Water supply cuts across a wide array of systems and institutions, both within the city and at the river basin level. IUWM incorporates issues such as stormwater management and wastewater management, institutional issues, supply and demand management and PPP and research and development where necessary as previously described in section 3.5.1 (Chiplunkar et al., 2012, Closas et al., 2012, Bahri, 2012). Furthermore, urban water management is also about institutions and processes as just the same way it is about infrastructure and investments which is why environmental, social and economic and financial aspects of water are also key to its successful implementation. Thus it requires moving away from segmented, linear thinking towards a more interdependent and integrated process where the interactions and relationships between

elements of the urban water cycle and the water use sectors are analysed to deliver the best environmental, social and economic outcomes.

3.4.3 Adaptive urban water management system

Urban water management approach needs to be flexible, adaptive and transitional for successful implementation in the particular urban water sector studied. Adaptive and transitional approaches are required because different urban context vary depending on institutional arrangements, stakeholder expectation or unique dynamic challenges impacting the particular urban context (Closas et al., 2012, Wandiga, 2015, World Bank, 2012b, Garrick et al., 2017)

Also, there are growing uncertainties and changes occurring in urban water sectors due to issues such as climate change, population growth (Kirshen et al., 2018). Hence rigid systems like conventional and traditional management systems can no longer address the changing context of urban water sector globally. Thus the need for long term, proactive and adaptative strategies that accommodate major uncertainties is required so necessary changes can be made in the future.

3.4.4 Iterative and Strategic urban water management strategy

There is a need for utilising management approaches that are iterative and able to operate as long-term processes (Bahri, 2012). An iterative approach is necessary because the characteristics and challenges of urban centres change over time. Therefore iterative approaches are required for continuously re-examining urban area challenges and priorities, and relevant mitigation actions (Closas et al., 2012, Furlong et al., 2016) also states the need for strategic long-term planning approach to urban water management which considers all water services, sources, stakeholders, and impacts to create the best possible community outcomes that accommodate both current and future stakeholder needs.

3.5 Summary

This chapter examined urban water management practices in developing countries with a major focus on specific African countries with good urban water management practices. The first section of literature explored the context of developing countries and the literature showed that the urban water sector in developing countries faced challenges such as population growth, urbanisation, lack of infrastructure, political interference, low-cost recovery, inadequate governance, were also found to be common among developing African countries. The factors impacting the African urban

water sector were both contextual and asset-related (people, infrastructure, financial resources). Finally, a comparison of countries with good management practices showed that these countries recorded success because the management of contextual factors such as autonomy, governance, population growth and urbanisation (prevalence of slums) was considered with asset-related issues such as financial viability and capacity building and increase in resilient infrastructure. The lessons about integrating contextual issues and asset-related issues from the studied African countries with good management practices can be transferred to the Nigerian urban water and sanitation sector which is considered in the next section for asset management adaptation.

Chapter 4

Nigerian Urban Water Sector

4.1 Introduction

In the previous chapter on good urban water management practices in developing countries, access to improved water and sanitation services was found to be a major problem facing developing countries. A lot of developing countries especially in the Sub-Saharan Africa region are yet to achieve the newly established target for drinking water by 2030 as only a low percentage of its total population which is 24% precisely have access to safely managed drinking water as at 2015 (WHO and UNICEF, 2014). Challenges such as rapid urbanisation and increased population growth, governance, lack of infrastructure and emerging technologies were stated to be key challenges impacting water and sanitation services in developing countries.

Nigeria, for example, is a sub-Saharan African country which is not on track in meeting the SDG target for drinking water. The Nigerian context will be an interesting context to explore being a developing country which is impacted by most of the key challenges and characteristics pertinent to developing countries which have been analysed previously in chapter 3. The purpose of this chapter will, therefore, be to critically review the Nigerian urban water sector and its impact on the performance of Nigerian urban water utilities.

The structure of this chapter first presents the socio-economic context of Nigeria and how it has emerged over time. Next, an in-depth investigation of the Nigerian urban water industry will be done to establish its characteristics of the Nigerian urban water sector, challenges affecting its context and existing management processes. Finally, the feasibility of developing an asset management framework adaptable to the Nigerian context. This will occur through a comparison with the Nigerian water sector, countries with asset management best practices and developing African countries with good urban management practices.

4.2 Socio-economic context of Nigeria

The Nigerian economy has been receiving a lot of global attention lately due to the major impact it has on the African economy and the Sub-Saharan African region. Also, Nigeria is regarded as a major player in the African Union, the New Partnership for Africa's Development (NEPAD), and in the Economic Community of West African States (ECOWAS) (African Development Bank et al., 2017).

The Nigerian economy, currently estimated at US\$ 375.77 billion is stated to be one of the largest in the continent of Africa (World Bank, 2017c, AFDB, 2014, AfDB, 2018). Nigeria is also recognised as the largest African country with an estimated population of 191 million (World Bank, 2014a). The Nigerian population accounts for 1/5 of the African population and 47% of the West African population (NEPZA, 2014). Nigeria as a nation is ethnically diverse with about 200 ethnic groups, 500 cultural languages and two major religions which is Christianity and Islam.

The Nigerian economy experienced major growth in 2018 compared to 2017. The Gross Domestic Product (GDP) for the nation grew by 1.81% (year-on-year) in real terms in the third quarter of 2018. Compared to the third quarter of 2017 which had estimated growth of 1.1 per cent, depicting an increase of 0.64 per cent. The second quarter of 2018 had a growth rate of 1.50 per cent showing an increase of 0.31 per cent. (NBS, 2018b) This is a major improvement following the recession in 2016 with a GDP growth of -1.6%.

The recession occurred due to the continued decline in oil prices, foreign exchange shortages, disruptions in fuel supply and a sharp reduction in oil production, power shortages, and insecurity in some parts of the country, as well as low capital budget execution rate (51%) (African Development Bank et al., 2017). Despite its strong economic progress and achievements, these achievements need to be translated into social welfare and human development as Nigeria still faces major social challenges.

Poverty in the heart of abundance is a popular paradox which describes the Nigerian economy (Sulaiman, 2008). Despite its strong economic progress and achievements as a nation, these achievements do not reflect on its social welfare and human development (AFDB, 2012, AFDB, 2014, CIA, 2014). Social indicators show that poverty is significantly experienced with about 62%

of its population living in abject poverty. In addition to this, the rate of unemployment which previously at 5.3% in 2006 has increased to 23.9% as of 2011 (World Bank, 2014b).

The country falls under the low Human Development category in the Human Development Index (HDI), with an HDI of 0.527 and ranked 152 out of 188 countries in 2016 (African Development Bank et al., 2017, AfDB, 2018). The unemployment rate has also risen from 18.8% in the third quarter for 2017 to 23.1% in the third quarter of 2018 (NBS, 2018a). This occurs because the country absorbs 500,000 new entrants into the labour market annually since the collapse in oil prices. The percentage rate of poverty in Nigeria, unfortunately, is significantly high. 80% of 190 million Nigerians live on less than \$2 per day (African Development Bank et al., 2017, AfDB, 2018).

Moreover, the nation is also characterised by institutional deficiencies such as lack of infrastructure, a slow and defective legislative environment, an inefficient property registration system, restrictive trade policies, an inconsistent regulatory environment, government and political instability, insecurity, and pervasive corruption (Ojo, 2012, Ajibolade and Oboh, 2017) Nigeria is making significant progress towards improving most of its infrastructure in comparison to many African peers (Foster and Pushak, 2011b). Reforms are taking place in power, road, and rail sectors and information and communications technology (ICT).

In recent years, Nigeria has conducted several important infrastructure sector reforms. The ports sector, for example, is gradually becoming an attractive resort for private investors. The power sector is also experiencing major structural transformation, creating an avenue for improving performance and recovering major cost recovery through raised tariffs.

The water sector compared to other sectors in Nigeria has not made as much progress. Additionally, Nigeria may have increased its water and sanitation target in 2015 to 69% however it did not meet the 75% Millennium Development Goals (MDGs). (Foster and Pushak, 2011b, The Woodhouse Partnership limited, 2012, WorldBank, 2011a, World Bank, 2014b, World Bank, 2000).

Nigeria ranks among the top 5 countries globally for having a large population of with citizens lacking access to safe water and sanitation practices and practising open defecation and the most

significant contributor to Sub-Saharan Africa ranking as the lowest in the world for access to improved drinking water and sanitation (Oluseyi Abdulmalik et al., 2016, WHO and UNICEF, 2014, WHO and UNICEF, 2015, WHO and UNICEF, 2017). Every year, an estimate of 124,000 infants under the age of 5 have deaths associated with diarrhoea resulting from unsafe water and sanitation practices. According to the World Bank (2012) report, Nigeria loses NGN 455 billion or US 3 billion due to poor sanitation practices.

The water and sanitation sector also performs poorly compared to other infrastructure sectors. For example, piped water network coverage from water utilities is only a fraction of the energy network of the nation. Also piped water network coverage which represents services supplied by state water agencies declined from 32% to 3% (WHO and UNICEF, 2015). This is by far the worst decline for water and sanitation coverage in Nigeria.

The poor performance of water corporations in Nigeria has led to a rise in informal service provision and private sector involvement. Informal service providers get water from the state water agencies, private boreholes, tube wells and other sources. Also, 80 per cent of boreholes in Nigeria are privately-owned and are selling water to the public (NBS, 2018c). The Nigerian urban water sector will, therefore, be an interesting context to study given its large population, the influence of sub-Saharan African low ranking for water and sanitation, coupled with being a major contributor to the African Economy.

4.3 Overview of the Nigerian Urban Water Sector

Nigeria is considered by (Federal Ministry of Agriculture and Water Resources, 2007, Federal Ministry of Agriculture and Water Resources, 2016) to be endowed with abundant water that can meet the water needs of the nation. The groundwater sources of Nigeria sums up to 267 billion cubic meters while its surface water resources are about 52 billion cubic meters (Akpabio, 2007). Additionally, inland water bodies consisting of lakes, rivers, ponds, stagnant pools and floodplains covers an area of about 149,919 square kilometres (Adeoti, 2007, Adetunde et al., 2011).

Despite being blessed with natural water resources, 71 million people in Nigeria are without improved water supply facilities and 130 million people lack basic sanitation facilities (World Bank, 2017b). As shown in Fig 4.1, the MDG water for Nigeria was met with an increase from 40

percent to 69 percent from 1990 to 2015. There was no progress in sanitation as coverage reduced from 38% to 29%.

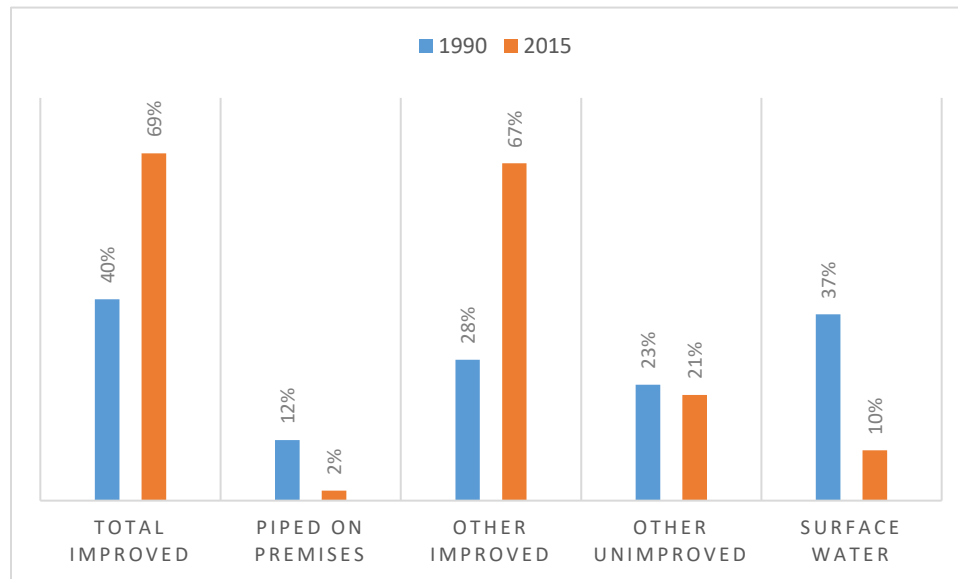


Figure 4.1: National Service Coverage (Rural/Urban).

Source: (WHO and UNICEF, 2015)

The 69% national water coverage occurred as a result of an increase of 81% water coverage for the urban population as shown in Fig 4.2. (WHO and UNICEF, 2014, WHO and UNICEF, 2015, WHO and UNICEF, 2017). Water coverage is considerably low in the rural communities because of the lack of resources and capacity to maintain rural water schemes, boreholes and water points. The rural communities resort to using untreated surface water and unprotected dug wells.

Despite the 81% increase for water coverage experienced by the urban population in Nigeria, piped water on premises which represents services supplied by state water agencies declined from 32% to 3% as shown in Fig 4.2 (WHO and UNICEF, 2015). This is by far the worst decline for water and sanitation coverage in Nigeria.

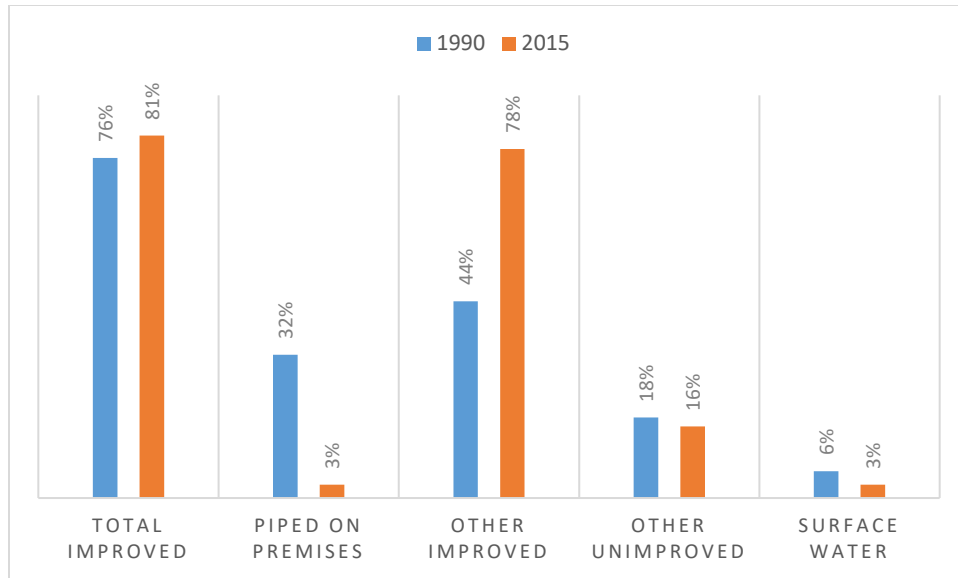


Figure 4.2: Use of drinking water sources in urban settlements in Nigeria.

Source: (WHO and UNICEF, 2015)

Urban water service coverage ideally is the responsibility of water utilities as is the case of most countries. 36 State Water Agencies were commissioned to provide sustainable water services to the nation's population and some have been in existence as far back as 1970 (Ali, 2012). However, the existing reality of urban water supply in Nigeria is that most of its urban settlers are responsible for their domestic supply of water (NBS, 2018c).

The 81% water coverage for urban areas in Nigeria is as a result of the 78% dependence on groundwater sources, wells, boreholes and private vendors. People in Nigerian urban cities depending on their income level, resort to digging wells, sinking boreholes in their compounds, rain harvesting and patronising private water vendors. NBS (2018c) states that 50 per cent of rich households sink boreholes or have access to tube wells which serve as either sole sources of potable water supply or are supplementary to water corporations supply.

Furthermore, (Akunyili, 2003, Oyegoke S. O., 2012) observes that an explosion exists in 'pure water' (sachet water but is known as pure water by Nigerians) and bottled water manufacturing in Nigeria as must urban population spend about ten to twenty times more on water from pure water / bottled water vendors than on piped water connections.

Hitherto water utilities have over 30,000 qualified indigenous engineers and other professionals, and an average of 427 US million dollar has been invested in the water sector between the year

2003 and 2014 (see fig 3.4 for details), water utilities in Nigeria are only able to supply water to 3% of its urban population (Ali, 2012, World Bank, 2017b, WHO and UNICEF, 2014, WHO and UNICEF, 2015, WHO and UNICEF, 2017).

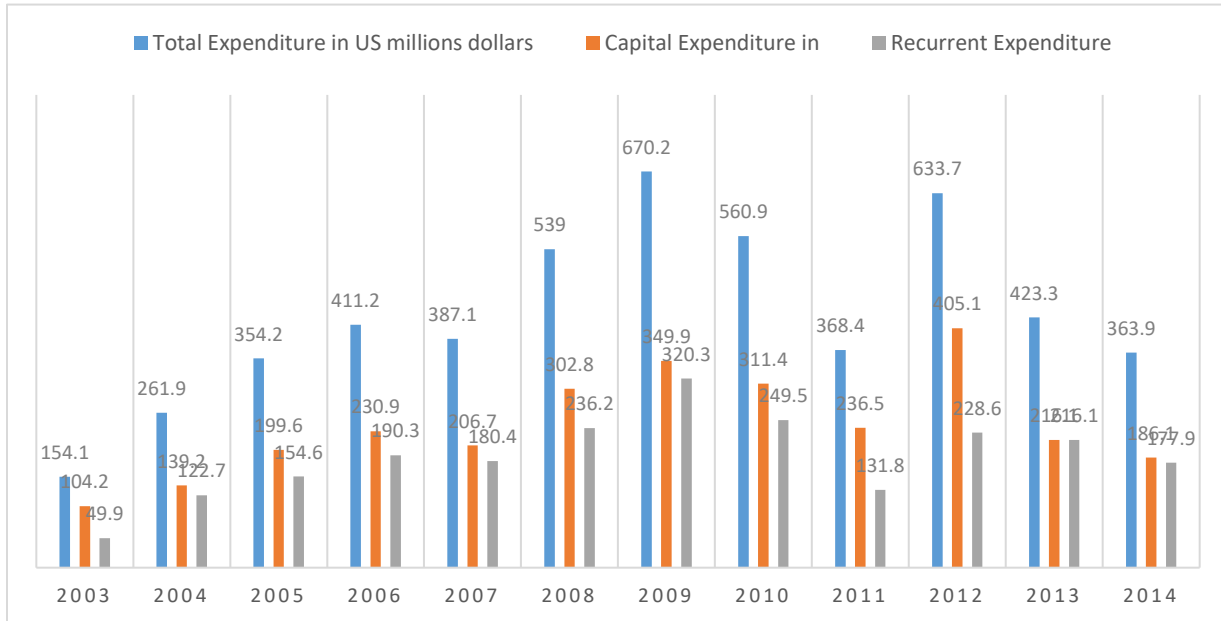


Figure 4.3: State Government Expenditures in the Nigerian Urban water Sector from 2003 -2014. Source: (World Bank, 2017b)

Urban water utilities in Nigeria have low operational efficiencies associated with poor service levels, customer complaints, limited service coverage, and high levels of distribution losses as high as 80% in some states, poor water quality. The Nigerian urban utilities perform as poorly, and in some areas worse, than utilities in the sub-Saharan region (World Bank, 2017b). The poor performance of SWAs is as a result as 7 critical factors identified by (Auriol and Blanc, 2009, Bayliss, 2003, Halkos and Tzeremes, 2012, Jaglin, 2002, Oyegoke S. O., 2012, Tatlock, 2006, Whittington et al., 2008, Ohwo, 2016) which are discussed below.

4.3.1 Poor Governance structure and environment

As previously outlined in section 3.7.1, the level of success achieved by water utilities depends principally on the existence of sound governance structures (laws, policy and organisation) and an enabling governance environment (Hodge, 2007, Durokifa and Abdul-Wasi, 2016, Oyebande, 2006).

However similar to challenged governance systems in most African utilities analysed in section 3.3.2, the Nigerian water sector typifies a context where poor water governance exists. According to (Iliyas, 2000, WaterAid, 2006, Water Aid, 2007), the implementation and enactment of water policies and laws in Nigeria have been very slow when compared to countries like Uganda, Cote d'Ivoire and Senegal with good governance structures and institutional environments.

The overall water act and policies established to guide the nation's water resources management are the national water resources bill 2007 and the National water resources policy 2016. The National act and policy are meant to serve as guides for delivering sustainable water resource management. The guidelines and framework for water supply and sanitation for Nigeria are clearly spelt out in this document. The existence of a national act is necessary to form a common thread for building sound water policies and legislation for all the Nigerian states ministries and agencies. It is also necessary for clearly defining the roles and responsibilities of all stakeholders within the water industry. In addition, the institutional organisation across the 3 tiers of government in the Nigerian water sector was clearly outlined in the National Water Resources Bill.

Compared to Australia, USA and UK in section 2.4 where there were established national policies and acts being implemented successfully, the implementation of the National act and policy for Nigeria has been slow. These governance instruments have been draft documents for 16 years and initiated as far back as 2000 but were only recently passed into law in 2016 by the federal executive council the highest legislative body of the country (Akpoy and Muchie, 2011, Water Aid, 2007, Akpabio, 2007). With this situation, governance and accountability are difficult to implement as there is no common framework to guide urban water stakeholders on how to ensure their activities are accountable and transparent and in line with sound principles.

The slow implementation of the national law and policy has also impacted the progress and process of developing policies and laws across the 36 states of Nigeria (Nwankwoala, 2014, Owolabi, 2014, Omole, 2013, Iliyas, 2000, WaterAid, 2006, Water Aid, 2007, Akpoy and Muchie, 2011, Akpabio, 2007). Some states have developed laws and policies while some states have either established water laws without water policies and some are without an act or policy. Besides, the existing institutional organisation for most Nigerian states differs from the roles and responsibilities of the various agencies across the 3 tiers of government stipulated in the National Act.

The Nigerian water sector is highly politicised. Even though state water agencies were established to act as autonomous entities under the supervision of state water ministries they are still run like civil service agencies in Nigeria (Ohwo, 2016). Senior management officials lack the necessary autonomy to hire and fire staff the risk of hiring incompetent staff is likely the case (Water Aid, 2007, WorldBank, 2011a, World Bank, 2014a, World Bank, 2000). Senior management officials are also unable to make a business decision related to tariff setting. Tariffs are approved by the executive state government officials (Auriol and Blanc, 2009, Bayliss, 2003, Halkos and Tzeremes, 2012, Jaglin, 2002, Oyegoke S. O., 2012, Tatlock, 2006, Whittington et al., 2008).

The approval process is usually slow and based on political principles rather than sound financial principles. Tariffs set most times are usually low and unable to recover capital and maintenance cost completely (Akpabio, 2007, Akpabio, 2012b, Akpor and Muchie, 2011, Ariyo and Jerome, 2004, Water Aid, 2007, WorldBank, 2011a, World Bank, 2014a, World Bank, 2000). Furthermore, the poor sector coordination occurs across the 3 tiers of government as role and responsibilities of different ministries and water agencies are duplicated due to a lack of clarity.

In section 2.4 of the literature on asset management best practices, independent regulatory bodies from water utilities like OFWAT, EPA and DWA were in existence for monitoring the asset management activities of the water utilities. However, the situation in Nigeria has some states with independent regulatory commissions or regulated by different ministries with some ministries performing duplicated and similar functions.

With varying regulatory and legislative systems, a common basis for measuring the performance of water utilities is not an easy task as the perception of what is considered as valuable service delivery is different. The legislative and regulatory environment in Nigeria has hindered the accountability in the urban water and sanitation sector. In general, lack of clear institutional objectives, poor sector coordination, poor clarity on roles and responsibilities occurs (Olajuyigbe, 2010, Nwankwoala, 2011).

The corruption that happens in the Nigeria water supply sector takes the form of bureaucratic, or petty, corruption, in which a vast number of government officials embezzle government funds and revenues meant for water schemes (Nwankwoala, 2014, Ohwo, 2016, Nwankwoala, 2011, Adah and Abok, 2013, Chukwu, 2015, Oyebode, 2014). Corruption also occurs in the procurement of contracts by staffs within utilities where contracts are won not by credibility but by bribes, also it

occurs at the point of service delivery where utility staffs are bribed by customers to carry out illegal connections. (Shah and Schacter, 2004, Plummer and Cross, 2006)

The lack of autonomy present in Nigerian water utilities could pose a great challenge to the support required for developing asset management systems. Utility managers are restricted in making decisions with regards to funding for adequate information systems. A lack of autonomy also exists with hiring and firing personnel leaving the possibility of having personnel that lack the right competencies for asset management, risk management, information management and other technical processes.

Nigerian water utilities are still run like public organisations and their inability to raise revenues for operation leaves them to depend on state governments for funds. Other sectors in the states such as power, transport and health will be competing with the water utilities for scarce funds. Finally, with the presence of corruption and politics, funds which are to be allocated to support asset management systems will be syphoned and exploited by corrupt managers. The support for asset management development is limited.

These top management officials in Nigerian utility companies depend on state governments for funds and they also do not have the autonomy to fire and hire staff because these utilities are run as civil service/ public organisations. The impact of leadership is negated by the lack of governance framework and institutional framework. To address this gap the research will try to distinguish between decision-making powers that are internal and within the control of the utilities which can be improved on and external decision-making powers which are beyond the organisations control most especially those impacted by external key stakeholders.

4.3.2 Population growth and Unfavourable Climate Change

Environmental issues although external to the context of the organisation of having great impacts on the activities of state water agencies in Nigeria (Okoye and Achakpa, 2007, Talabi, 2010). Unlike other countries that lack adequate water resources and have to develop initiatives for water recycling, Nigeria is said to be endowed with abundant water resources which can adequately meet its population's water needs (Bugaje, 2006, Uluocha and Okeke, 2004, Okeola and Raheem, 2016).

However, unsustainable industrial and domestic practices in the urban areas of Nigeria, have affected the ability for water utilities to harness water resources to meet the needs of its population (Ekiye and Zejiao, 2010, Ezeabasili et al., 2014a).

Dumping of refuse in water bodies, oil spillage and emission of effluents from industries, construction of septic tanks and soak away and sewer near water pipes which lead to the pollution of water in water pipes due to infiltration from these septic tanks when they get flooded are examples of such practices (Talabi, 2010, Orubu, 2006). As lack of access to clean water has a great impact on the health and livelihood of people which could lead to deaths due to water-related diseases like diarrhoea and cholera which in turn greatly reduces the required man-hours and labour force for other sectors which affect the country's economy.

In addition to this adverse weather conditions also impact water supply the Nigerian water context. The geographical spatial distribution also exists in arid areas of Northern Nigerian which have a precipitation level of 500 mm compared to a 4,000 mm precipitation in Southern Nigeria which are coastal cities (Akpore and Muchie, 2011). Droughts, therefore, occur in the northern parts leading to scarcity while heavy floods occur in the southern parts of Nigeria which lead to damage of water pipes and disruption of water supply in affected areas case studies in developing countries assert that 50% of the water in water distribution systems is lost due to leakages, illegal connections and vandalism (Hall, 2006, Olajuyigbe, 2010).

Studies show that poor health, high population growth, human underdevelopment and high poverty rate put major strains on the structural transformation of Africa despite its rapid economic growth (OECD, 2013). The case of the African water sector for example, Population growth and rapid rate of migration to urban settlements, rising level of poverty are major determinants for water scarcity, in African countries (OECD, 2013).

Being the most populated nation in the African continent, the confines of Nigeria vividly exhibit these characteristic as most of its urban settlements like Lagos and Abuja for example, experience rapid population growth due to migration from rural areas and high birth rates. There have been cases of increased investment on water infrastructure and increase network coverages however it doesn't measure up to the demands of its urban population as coverage has reduced from 32% network coverage to 3%(WHO and UNICEF, 2005, WHO and UNICEF, 2006, WHO and UNICEF, 2014).

Most urban cities in Nigeria are infiltrated with slum and Shanti settlements which are marginalised from water service coverage due to the difficulties, and cost of providing water supply networks in areas which are not properly planned (Water Aid, 2007). These slums and shanties settlements are occupied by poor people who do not have enough money to pay their water bills hence the case of marginalisation from water services in SWA exist.

Given that most households in Nigeria live below the poverty mark, their lack of the necessary financial capacity to be connected and integrated into available public water services means they must spend the greater part of their income on commercial water services to cope with associated daily existential and livelihood concerns (Akpabio, 2012b). In addition to this, Population growth in Nigeria has created a scenario where some urban areas which are well planned and occupied by the affluent people do not have piped connection access (Danladi et al., 2014).

4.3.3 Capacity and Competency issues

Water Aid (2007) asserts that the urban water sector in Nigeria needs to invest more in capacity building rather than focusing looking for capital investments alone because they lack the manpower and technical skills required for a successful reform. Akhionbare et al. (2012) also state that utility management and staff have competency issues because of a high level of political interference and retrenchment activities. The necessary incentives for motivating staff were also unavailable because of low salary structures. In some cases, issues of overstaffing or understaffing exist where personnel are either over pressured with too much work thereby not being able to meet the required water service or the reverse is the case where staff are idle, duplication of efforts exists.

4.3.4 Financial issues

There is ample evidence that middle-income countries do not have financial platforms to harness the available water resources required to meet the water supply needs of their urban population (Olajuyigbe, 2010, World Bank, 1994, WorldBank, 2011a). From the previous literature in section 3.5 on challenges in the African water sector, funding was identified as a major challenge impacting African utilities. Financial investments required for improving access to water and sanitation are typically insufficient in meeting water demands.

For example, (World Bank, 2011b) states that Burkina Faso as at 2010 required US\$ 1,085 million between 2007 and 2015 for meeting the national drinking water target and US\$250,000 for meeting the sanitation target. However, Burkina Faso was only able to mobilise 50% of the funding requirements and will still need to source for more income to fund the gap. To meet the funding gap, it means Burkina Faso will need to source for an addition US\$83 million annum between 2010 and 2015 for drinking water and 17 million per annum for sanitation. 50% gap for funding

Concerning the urban sector for Burkina Faso, 50% of the ONEA program has been financed. However, US\$150 million is still required to cover 2010 to 2015 which is estimated at US\$28 million per annum to fully fund the investment program. In addition to the investment requirements, US\$7 million per annum is also needed to cover OPEX costs. In addition, ONEA is currently able to finance 30% of its rehabilitation and expansion works requirements

In the case of Senegal, (World Bank, 2011) states that US\$624 million is required for water supply and US\$638 is required for sanitation to cover the period of 2005 to 2015. These estimates were required for investment program for water and sanitation to run successfully in Senegal for meeting their national water and sanitation coverage targets.

However, is only able to raise 60% for water and 54% for sanitation. To meet the funding gap, it means Senegal will need an additional US\$41.2 million per annum for water and US\$49.3 million for sanitation per annum between 2010 and 2015. Also, US\$16 million per annum is also required for funding operational and maintenance cost for their current and future water infrastructure. While US\$6 million is required for sanitation. With respect to the urban water sector, an additional US\$17 million per annum is required for meeting the urban water national target.

Development partners support both Burkina Faso and Senegalese water and sanitation investment programmes. Senegal especially has about 85% of water sector finances coming from international development aids (World Bank, 2011 , World Bank, 2011b). Operational and Maintenance costs are expected to be mainly covered by user fees.

Uganda currently has a Sector investment plan and a strategic sector investment model for water and sanitation (World Bank, 2011c). In Uganda, a funding gap of US\$125 million per year also exists for meeting the rural water and sanitation target of 77% and the 100% target for urban water and sanitation. 4.1% of the national budget is allocated for water and environment which is around US\$220 million.

For water supply, construction of water infrastructure is funded majorly by the government while operation and maintenance costs are covered by user fees. Capital investments made by the government is only about US\$51 million per annum with an annual deficit of almost US\$74 million. Additional operational and maintenance cost requirements for water supply in Uganda is US\$65 million for both rural and urban water supply and US\$11 million for urban and rural sanitation. With respect to the urban water sector, an additional US\$38 million per annum is required for meeting the urban water national target.

(World Bank, 2011a) assumes that the financial requirements for meeting the MDG targets for water supply and sanitation for Nigeria is estimated at US\$1.7 billion and US\$2.3 billion respectively. However, an average annual national spending of about US\$550 million per annum can be inferred from Figure 3.1. Which details the total of investments made by the Nigerian Federal and State government in the water sector from 2006 to 2010 and annual investment are below 6 billion US dollars. While about US\$200 million is expected from donors and NGOs for water supply.

However, a funding gap of over US\$839 million still exists for meeting the 82% MDG target for water. Regarding the urban water sector, however, a funding gap of US\$669 per annum exists for meeting the MDG target as only US\$449 public expenditure for urban water supply is anticipated. In addition, (Independent Evaluation Group, 2017) states that the Nigerian government would need invest 3 time more than the current government expenditure on water and sanitation to meet the SDG targets which is estimated at 8 billion US dollars.

These estimates are not certain as these estimates are inferred by World Bank due to a lack of detailed spending and reporting at various government levels. In addition, annual Operational and maintenance requirements for water supply is estimated at US\$325,000 per annum. Compared to Uganda, Senegal and Burkina Faso, the funding gap required for meeting the MDG target for water and sanitation in Nigeria is massive. Inadequate funding for water and sanitation by the government occurs because other sectors such as transport, power and health are given greater priorities than the water sector.

Despite the crucial role for international institutions, compared to other African countries, the involvement of international institutions in the Nigerian sector has reduced tremendously (World Bank, 2004). This is because they have found the urban water sector in Nigeria to be especially

difficult due to the size, the nascent stages of decentralization, lack of regulation and low levels of cost recovery. The World Bank, however, is the only large development institution that remains active in the Nigerian urban water sector.

Table 4.1: Comparing Coverage and investment figures for urban water supply in Nigeria, Senegal, Burkina Faso and Uganda

| Countries | Coverage 2008 | Target 2015 | Population requiring access '000/year | Capex requirements US\$ million/ year | Anticipated US\$ million/ year | Total Deficit US\$ million/ year | Annual Opex requirements US\$ million/ year |
|------------------|--------------------------|------------------------|--|--|---|---|--|
| Senegal | 98% | 100% | 205 | 26 | 9 | 17 | 7 |
| Burkina Faso | 75% | 87% | 222 | 56 | 25 | 28 | 15 |
| Uganda | 91% | 100% | 201 | 62 | 24 | 38 | 46 |
| Nigeria | 79% | 95% | 4,927 | 1113 | 444 | 669 | 233 |

Another major problem is that citizens believe that water is a social good and a basic human right which should be free to all and react negatively to paying for water (Ajai, 2012a, Water Aid, 2007). Consequently, the costs of infrastructure are met largely by stipends from governments, donations and irregular grants from International Donor agencies rather than revenue generated from tariffs, thus preventing the full recovery of capital and operational expenditures as internally generated revenue are unable to recover production cost fully (Odigie and Fajemirokun, 2005).

Also, The tariff setting system done by the government officials is rigid and are not enough to cover capital costs and operational costs which include maintenance cost or water infrastructure, cost of energy generation (amount spent on diesel), annual salaries and wages of staff (Nwankwoala, 2014, Oyebode, 2014).

Because SWAs do not have the freedom to adjust water tariffs regularly and adequately and are also not able to recover their operating costs, they depend on inadequate stipends and irregular grants from the state Government (Owolabi, 2014, World Bank, 2000).

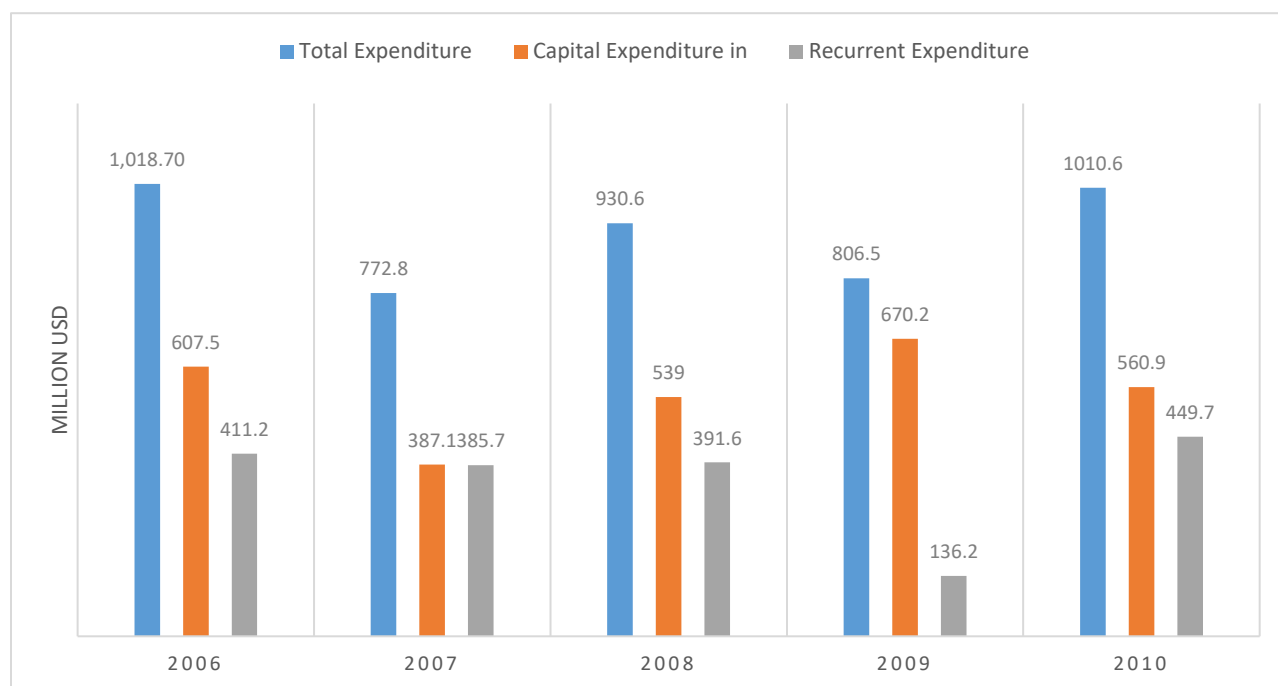


Figure 4.4: Federal and State Government Expenditure in the Water Sector.

Source: (World Bank, 2017b)

Furthermore, (USAID, 2010, WaterAid, 2006) describes the spending of the Nigerian water sector as unsustainable due to the absence of monitoring structure, the existence of corruption, lack of human capabilities, poor contract management and poor project design.

4.3.5 Inadequate and ageing Infrastructure

Taking the technical aspects into consideration, obsolete and rusty piped water reticulations, persistent facility breakdowns, constant power outage, inadequate water treatment and distribution facilities, low use of decision support systems and data management systems like WASHIM, GIS, are typical to most SWAs (Owolabi, 2014, Oyegoke S. O., 2012, World Bank, 2000).

Most SWAs are currently trying to produce as much water as they can, in a very constrained operating environment and with a production capacity insufficient to meet existing needs. The water industry relies heavily on infrastructure for sustaining its business. Thus utilities tend to invest in infrastructure (Kang and Lansey, 2012). Most utilities cannot supply water up to the design capacity of their water systems because of lack of water infrastructure and erratic public

energy supply. Some of the states had enough infrastructure for one aspect of service provision for example in a utility, may have the new infrastructure for production but ageing and inadequate infrastructure for distribution.

The result of this will mean they will have to operate below the production capacity of the new plants to avoid wastage. Some offices that are in a deplorable state which were not conducive for working effectively. Maintenance is virtually non-existent as a result of financial restrictions, incompetent technical crews. Preventive maintenance is lacking, what happens, in reality, is that repairs are made when breakdowns and occurs which is an ineffective system that can disrupt the water supply. Some state ministries employ the services of external consultants to carry out major parts of operational tasks. Some of these consultants fail to deliver based on contract terms because governance and assurance frameworks are non-existent (Aduda, 2007, Oyeboode, 2014, Ajibade et al., 2015).

Furthermore, maintenance and operational strategies are hindered by low generated revenues and lack of funding and financial resources (World Bank 2000). As a result of this, various white elephant water supply facilities such as the Nkissi waterworks in Onitsha are prevalent due to the inability of Nigerian utilities to recover costs from low tariffs for maintaining facilities and operating facilities efficiently. In addition, state water agencies like Lagos are only able to utilise a low percentage of their water infrastructure capacity (NTWG, 2009, Olajuyigbe, 2010, WorldBank, 2011a, Ohwo, 2016, Ajibade et al., 2015).

Most of the pipe connections are not metered, information systems used for billing are outdated, accurate data about the no of customer served is not available thus making it difficult to adequately price the amount of water used. Data management processes such as monitoring of the performance of systems in terms of leakages of pipes and breakdown of pipes, household surveys are still done by people in some cases as against using information management systems like Wash Information management systems.

Some utilities still run unmetered piped networks and thus are embarking on installing metering systems that will improve their asset data management however it most times is prohibitive (Durokifa and Abdul-Wasi, 2016). Hence resulting in the slow establishment and development of effective data management systems, infrastructure capacity and human capacity that aids

sustainable water service delivery. There have also been cases of theft and vandalism of pipes due to activities of miscreants, a rise of illegal settlements and construction activities (construction of roads, building) accounting for high leakage rates, continuous incidence of pipe bursts, increased maintenance costs and disruption of water supply (Hall, 2006, Olajuyigbe, 2010).

4.3.6 Power outage

Operational activities in water utilities are affected by the power crisis in Nigeria. Since most SWAs depend greatly on the energy services of Power holding Company of Nigeria (PHCN) for providing energy for the production and delivery of water (World Bank, 2000, Oyedepo, 2012). In addition to this electrical equipment like pumping machines are usually damaged due to irregular voltage and constant power outages. Furthermore, standby power generating plants which are alternative energy supply sources are too expensive to procure, operate and maintain (Owolabi, 2014, Oyegoke S. O., 2012, Chukwu, 2015, Oyebode, 2014, Odaro, 2012).

4.3.7 Customer issues

Typical customer complaints in the Nigerian urban water sector are associated with intermittent water supply, excessive and inefficient billing, poor water quality and appalling customer service (Ohwo, 2016, Ohwo and Agusomu, 2018, Water Aid, 2007, Balogun et al., 2017, Ugbah et al., 2017). Because of a lack of poor customer engagement, and proper means for customers to voice their queries, these complaints are usually not dealt with on time or left unattended to.

Furthermore, some citizens see water as a social good and not an economic good and will and can be classed as debtors who default regularly paying their bills as they see water as a civil right. (Odigie and Fajemirokun, 2005). In addition, states that a lack of trust exists amongst citizens when it comes to public water services due to failed water projects and the inability of the government to provide basic water infrastructure, empower less privileged with stakeholder engagement initiatives and corruption (Balogun et al., 2017, Ugbah et al., 2017, Water Aid, 2007). The resultant impact is that customers refuse to pay their bills, government agencies and customer have owed large amounts of money due to non-payment and major capital and operating costs are not recoverable (Odigie and Fajemirokun, 2005, Macheve et al., 2015, Ohwo, 2016, Ohwo and Agusomu, 2018, Water Aid, 2007).

Urban utilities regardless of the limited context they operate in, continue to deliver water services within the confines they find themselves.

4.3.8 Lack of data and information for accurate Planning

A key factor in ensuring the development of viable, accurate and realistic plans is access to up to date information. According to (Goldface–Irokalibe, 2006, Chukwu, 2015, Adah and Abok, 2013, Onugba, 2009, Ajiboye et al., 2012) the Nigerian water sector lacks an effective information management system and data stream for assessing water resource allocation, allocation of funds and monitoring project performance.

Most Water Utilities in Nigeria lack data and information about the functional status of water infrastructure, collection efficiency, groundwater abstraction, cost recovery and other performance-related data (Foster and Pushak, 2011a, Nwankwoala, 2014, Nwankwoala, 2011, Chukwu, 2015, Ajibade et al., 2015, Omole, 2013). A major challenge is that most of the population are served by other water sources apart from piped connections. Water utilities are therefore unable to know the accurate number of people within their areas+ they have and the type of customers.

The consequence of this is that most budgets and plans end up being unreliable and limited. Therefore, the production of inaccurate budgets, project timelines, proposals, maintenance plans, financial plans are normal practices (Balogun et al., 2017, Ugbah et al., 2017, Water Aid, 2007). These are major contributory factors which result in abandoned projects.

4.4 Institutional framework

The responsibilities for water resource management and sanitation in Nigeria is shared amongst three tiers of government, federal, state and local government (WaterAid, 2006, Water Aid, 2007, World Bank, 2014b, Goldface–Irokalibe, 2006). Water governance arrangement and the nation’s governance structure are pretty much the same. Where the Federal Government is the principal government. The next line of authority is the federal capital territory (FCT) and the 36 state governments at the state level and finally the Local Government Authorities (LGAs) at the local level. There are various agencies which perform specific water-related and sanitation tasks are presented in Figure 3.1 and Table 3.1 respectively.

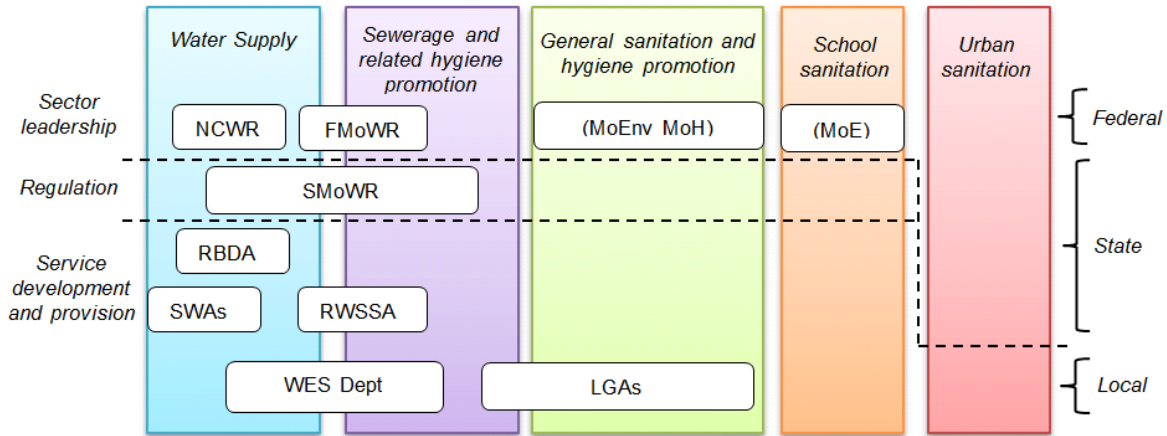


Figure 4.5: Institutional arrangements for Water Supply and Sanitation in Nigeria.

Source: (WorldBank, 2011a)

The water supply and sanitation sector in Nigeria is a large sector thus analysing all agencies responsible for water supply and sanitation functions will be extensive for the research. Various ministries for health, water and sanitation perform oversight and leadership functions and delegate state ministries and agencies for service provision functions as shown in Fig 3.1 and Table 3.2. The National Council for Water Resources and Federal Ministry of Water Resources are situated at the Federal level tier and are responsible for formulation of laws and policies and governing water resource management in the country while Ministry of Health and Ministry of Environment formulate policies associated with drinking water and sanitation and hygiene education.

State ministries of water resources, on the other hand, regulate and oversee urban water supply in Nigeria. And finally, service provision lies in the hands of river basin development authorities, State Water Agencies (Urban water provision), Rural Water Supply and Sanitation Agencies (Rural Water Supply provision and Local governments are responsible for Sanitation Services. The research focuses on urban water supply thus agencies responsible for water supply related activities are discussed in detail under the three tiers of government in the next section.

4.4.1 Federal Government Level

The Federal Ministry of Water Resources (FMWR), established in 1976, is the central agency at the national level which carries out the following strategic function: developing policies, collating data, managing, regulating and allocating of inter-states water resources, approving water resource

development activities and sponsoring research and development (USAID, 2010). FMWR through the administration of the minister ensure sustainable potable water supply is sufficient to meet the cultural and socio-economic needs of Nigerians through a sustainable way that improves public health, food security, and poverty reduction, without destroying the ecosystem. Agencies which are established under the administration of FMWR include:

Table 4.2: Federal Agencies Under FMWR's Administration.

Source: (Ezeabasili et al., 2014b, WorldBank, 2011a, Usaid, 2006, USAID, 2010)

| Agency | Date established | Description |
|--|------------------------------------|--|
| The River Basin Authorities (RDBAs) | 1976 | Harnesses the Nigerian water resources to support activities like irrigation, energy generation, navigation, tourism and urban water supply(Ezeabasili et al., 2014b). |
| The National Water Resources Institute Kaduna | 1985 | Responsible for Education, research and development related to water resources projects. undertakes training courses in water resources |
| Utilities Charge Commission | 1992 (but is no longer functional) | Regulate tariffs of water boards and state water agencies |
| National Council of Water Resources | 1980 | Highest Water Resources policy making body in Nigeria |

4.4.2 State Government Level

In Nigeria, the State government is responsible for urban and peri-urban water supply (Olajuyigbe, 2010). State governments through respective State water ministries responsible for water resources (SMoWRs) perform an oversight function for monitoring the urban and peri-urban water supply in Nigeria. SMoWRs also oversees the affairs of State Water Agencies. (WaterAid, 2006, Water

Aid, 2007, WorldBank, 2011a, World Bank, 2014b). State water agencies are established either as water boards or water corporations to:

- develop, operate and maintain water networks
- monitor and control the quality of water supplied.

4.4.3 Local Government Level

There are 774 Local Government Authorities (LGAs) responsible for rural water supply and sanitation services. Rural Water Supply and Sanitation Agencies (RWSSAs), Water and Environmental Sanitation are major authorities in charge of water and sanitation services in rural areas and they support communities with sanitation promotion and hygiene education. Only a few LGAs have rural water supply departments which have the ability to build small water systems such as open wells and small impoundments of surface water.

4.4.4 Institutional Reforms

4.4.4.1 National resource management bill draft 2007 (the National Law)

The National resource management bill draft 2007 is an act designed to provide for the equitable, beneficial, efficient and sustainable use and management of the surface water and groundwater resources of Nigeria; to establish a new institutional framework for the Nation's water resources, defining functions and powers of the institutions; to license water use, regulate construction and safety of dams, monitor compliance and provide dispute resolution procedures; and provide for the repeal or amendment of certain laws and other matters incidental to the foregoing. (Federal Ministry of Agriculture and Water Resources, 2007)

With regards to water supply and sanitation in the Nigerian urban sector, the National resource management bill draft 2007 establishes roles and responsibilities, for policy formulation, sector coordination, regulation and service provision across the 3 tiers of government.

4.4.4.2 National water resources policy draft 2016 (the national water policy)

The Water Resources Policy of Nigeria is a statement of the philosophy and objectives of the Federal government in managing the freshwater and possibly marine water resources including its strategies for achieving its set goals (Federal Ministry of Agriculture and Water Resources, 2016)

The 2016 Water Resources Policy of Nigeria takes into account the new developments in the sector since including the review of the 1993 Water Resources Master Plan and the current Water Resources Master Plan prepared in 2011.

The underlying philosophy of NWRP is the recognition that water is a key to sustainable socio-economic development.

There are two principal goals of this policy which are

- (1) Protecting and enhancing the quality of the nation's water resources;
- (2) Promoting the wise and efficient management and use of water.

The National Water policy 2016 establishes clear strategies and principles related to water and sanitation in Nigeria as shown in Table 4.4. The policy requires State governments to develop their policy instruments in line with the national water policy (Federal Ministry of Agriculture and Water Resources, 2016, FRN, 2007, Water Aid, 2007).

4.4.4.3 Water Investment Mobilisation and Application Guidelines (WIMAG)

The WIMAG framework can be considered to be another institutional output which occurred from the national urban water sector reform in Nigeria. WIMAG is a framework for monitoring capital investments from the federal government in the urban water sector of respective states (Federal Ministry of Agriculture & Water Resources, 2006a). WIMAG framework is based on a Memorandum of Understanding contract entered into with each state in Nigeria and the Federal Government.

The rationale behind WIMAG is to encourage continued financial support from the federal government based on the ability of the states to improve their service levels and operational performance according to outlined targets in WIMAG. The responsibility for monitoring is vested in the WIMAG Implementation Unit (WIU) which will contract out specific monitoring services to an independent consultant. WIMAG requires the preparation and adoption of an operational management plan. The operational management plan is to be prepared by the water service provider in consultation with the WIU within a specified time-frame after the signing of the MOU.

Table 4.3: Assessment of the National Water Resources Policy.

Source:(Federal Ministry of Agriculture and Water Resources, 2016, Federal Republic of Nigeria, 2004, FRN, 2007)

| Policy Document | Objective | Strategies | Implications |
|---|--|--|--|
| National Water Resources Policy 2016 | “To increase the quantity and quality of water supply and sanitation services to meet the level of socioeconomic demand nation-wide in an effective, equitable and efficient manner through a clear participatory role for all tiers of government, communities, the private sector, civil society organizations and external support agencies”. | <ol style="list-style-type: none"> 1. facilitate Increase in service coverage for water supply and sanitation to meet the desired level of socio-economic demand, national and international targets; 2. Promote the right of access to clean water and basic sanitation for all citizens; 3. support initiatives towards affordable water supply and sanitation services for all citizens; 4. Promote separation of organizational responsibility for regulation from service provision and the establishment of accountable, independent, effective and financially viable water service providers operating under a regulated policy framework; 5. Ensure national water quality standards are maintained and monitoring systems established; 6. Promote the involvement of water users through a consultative forum; 7. Encourage private sector participation in the provision of water services and sanitation; 8. Mobilize funds for water supply and sanitation facilities improvement and development through participatory investment among three tiers of government and other alternative sources. | <p>Funding impacts policy strategies related to increased service coverage, and financially viable water utilities. Utilities will thus have to look for innovative ways for generating revenue.</p> <p>Autonomy issues are linked to strategies 8 and 4. When state governments invest in improving and developing facilities there is a potential for them to control the decision making regarding how the facilities will be run.</p> <p>Informal service providers are a form of private participation however their activities are not controlled (issuing licenses for abstractions) due to issues such as funding and autonomy.</p> <p>The Model water sector regulation law and WIMAG which is designed in line with the National water policy exempt the regulation of most vendors and focus solely on state water agencies</p> <p>Hence illegal activities such as illegal connections and infrastructure vandalism tend to impact the provision of clean water which is strategy 5.</p> |

9. Promote appropriate technology and innovation for efficient water supply and sanitation service delivery.

4.4.4.4 Model Water Supply Services Regulatory Law

The model State Water Supply Services Regulatory Law (WSSRL) is intended to function as a basis for reforming water legislation in various states in the nation most especially participating states in the National Urban Water Sector Reform Project(Federal Ministry OF Agriculture & Water Resources, 2006b).

The composition of the model WSSRL is majorly centred on the establishment of the State Water Regulatory Commission; the setting of standards and norms for Water Services Regulatory Functions; the requirements for Water Services Providers; and the gathering of information in a State Information System. It also incorporates important issues highlighted in the National water resources policy, the WIMAG framework and the National water resources draft bill. The purpose of the model WSSRL is to promote sound water laws and policies consistent with the National Water Policy.

4.4.4.5 Establishment of a State Water Regulatory Commission

The establishment of a State Water Regulatory Commission is required by the state water supply services regulatory law. In line with the state water regulatory law and WIMAG framework, the jurisdiction for state water regulatory commission is confined to the principal urban water supply agencies. It is anticipated that secondary service providers will effectively operate in an environment regulated by market forces (vendors) or community structures (rural schemes). However, as the capacity of the regulator improves the regulatory activities could expand to include the regulation of secondary service providers (vendors) within the supply area of the WSP. According to (Federal Ministry of Agriculture & Water Resources, 2006a) the rationale for establishing a state water agency commission is for achieving benefits such as protecting service providers from interference from political and other interest groups; driving greater efficiency for the water supply service providers; promoting private sector participation, promoting national and state water laws and policies and reducing monopoly effects on customers.

4.4.4.6 Water Services Development Plan

The establishment of a Water Services Development Plan is required by the state water supply services regulatory law. According to (Federal Ministry of Agriculture & Water Resources, 2006a) State Water Services Development Plan should be prescribed by the SWRC, consistent with the WIMAG framework and is expected to cover the following aspects:

- Details of the existing water supply situation in the Water Services Provider's service area
- Development planning objectives and priorities of the Water Services Provider;
- A five-year investment plan in the form and substance prescribed by the SWRC;
- An operational management plan in the form and substance prescribed by the SWRC.

The situation on the ground as at when this research was conducted is that even though the various institutional instruments is seen as a potential solution for delivering sustainable water services in Nigeria. The implementation process for the various institutional reforms has been slow. The slow implementation of the identified institutional reforms is as a result of the delay in passing the water bill by the National Assembly. Since the overall national water bill which is meant to provide a basis for enforcement of laws and policies has not been approved, the level of institutional enforcement differs in various states as stated by (Ajai, 2012b, Akpabio, 2012a, Goldface–Irokalibe, 2006, Macheve et al., 2015, World Bank, 2011a). Some states like Lagos and Rivers have regulatory commissions while others do not have. Some states have laws without policies while others have policies without laws.

4.5 Urban water management reforms in Nigeria

Previously, there have been reform strategies developed by the World Bank in collaboration with State and the Federal government targeted at improving the performance of a few selected urban water utilities in Nigerian. The National Urban Water Sector Reform Programme (NUWSRP) was developed by the federal government in partnership with the World Bank to support investment towards improving water services in Nigeria (World Bank, 2005, World Bank, 2004). This programme is referred to as the World Bank Urban water sector reform project and they are precisely three in number which have occurred. The first, second and third Urban water sector reform respectively (World Bank, 2004). Moreover, the project is considered as the platform for the development of Nigeria WASH sector action plan for the sector development to meet the Sustainable Development Goals (SDGs) of 2030 (Al-Jamal, 2017)

The 1st NUWSRP was implemented from September 2004 to September 2013 for 3 states namely, Ogun, Kaduna and Enugu (Monday, 2004). Enugu State was only included in 2010 after Kano State had dropped out of the project. The 2nd NUWSRP was implemented in Lagos and Cross River states from November 2005 till May 2016. (World Bank, 2005, Independent Evaluation Group, 2018). The third NUWSRP which is aimed at water utility performance improvement became effective in February 2015 (World Bank, 2014b) This project is divided into two tiers. Tier 1 is focused on Bauchi, Ekiti and Rivers State while Tier 2 Anambra, Abia, Bayelsa, Ondo, Benue, Plateau, Gombe, Jigawa and Kano)

Project development objectives for each project were majorly focused on increasing access to water supply services, improving the financial viability of the existing states and the investment placing capacity of the participating states (World Bank, 2014b, World Bank, 2005, Independent Evaluation Group, 2018, World Bank, 2004)

The project components for the 3 projects ranged from is aimed at financing large strategic investments in water supply, sector reforms, capacity building and operational development activities, utility performance improvement and planning towards promoting the investment-readiness of the participating states (Al-Jamal, 2018b). According to (Independent Evaluation Group, 2017, Independent Evaluation Group, 2018) the overall performance of the project on and two in meeting the set targets, development outcomes and objectives were rated as Moderately Unsatisfactory. Service reliability targets related to the number of people in the urban area provided with access to improved water sources and water delivered through existing and extended networks were not achieved.

While commercial viability targets such as Billing and collection efficiency, Non-revenue water and operational and maintenance coverage from revenue were also not met. In addition, most of the law had not been enacted in most of the participating states except for Kaduna and Port-Harcourt (Independent Evaluation Group, 2017). However, it is difficult to ascertain the full progress of the 3rd project because it is still in the initial stage of development (Al-Jamal, 2018a).

The project not achieving its aims fully was attributed to issues such as implementation delays and extension of projects, economic recession and political instability, lack of proper monitoring

systems, no proper feasibility studies, lack of autonomy and placement of SWAs within the civil services. Poor maintenance culture and lack of power was also another issue stated by (World Bank, 2014b, World Bank, 2005, Independent Evaluation Group, 2018, World Bank, 2004).

4.6 Arguments for Adapting AM for delivering management improvements

It was observed from the literature on asset management in chapter two that most of AM implementation was seen majorly in high-income countries compared to middle income and low-income countries. Successfully implementing asset management in middle income and low-income like Nigeria could potentially be contestable based on differing context with high-income countries.

However, a detailed analysis of good management practices in developing countries in chapter 3 suggested the presence of fundamental characteristics required for delivering good management practices that can improve efficiencies and effectiveness of water utilities. Some of these characteristics are highly relatable and linked to inherent attributes of an asset management system thus supporting the potential for success in Nigerian urban water utilities. Supporting evidence to show the potential success of AM in Nigerian water utilities wishing to gain improved efficiencies and effectiveness in service delivery is discussed in this section below.

4.6.1 Justification based on the Adaptive and transitional nature of AM systems

According to (Closas et al., 2012, World Bank, 2012b), urban water management processes needs to be flexible, adaptive and transitional for successful implementation in the particular urban water sector studied.

Adaptive and transitional approaches are required because different urban context varies depending on institutional arrangements, or unique dynamic challenges impacting the particular urban context (Closas et al., 2012, World Bank, 2012b). AM systems like ISO5500, AMCOG are very flexible tools which can be suited to any water sector because the organisational context is considered first before other components of the asset management system. Stakeholder needs, expectation, the vision and mission of the organisation, competency and leadership requirements and resource capacity are some of the factors which are considered.

Further, AM systems integrate risk management processes for mitigating risks and opportunities impacting the AM system. In addition, change management and monitoring tools are also inherent

in AM systems leaving room for evaluating the performance levels required and making necessary improvements to the AM system. The justification for using Asset Management to deliver management improvements in the Nigerian Urban water sector is therefore established since an allowance is made for assessing its culture and environment.

4.6.2 Justification based on the integrated and systemic attributes of AM

Discussions by (Bahri, 2012, Closas et al., 2012, World Bank, 2012b) identify two critical considerations for developing a management approach that incorporates in its scope all elements of the urban water cycle as well as the different interactions among users in the watershed. Urban Water supply cuts across a wide array of systems and institutions, both within the city and at the river basin level. Thus it requires moving away from segmented, linear thinking towards a more interdependent and integrated urban planning. In addition, service delivery incorporates issues such as stormwater management and wastewater management, institutional issues, supply and demand management and PPP and research and development where necessary (Chiplunkar et al., 2012).

Asset management is a systemic approach for considering the assets in their asset system context and optimizing the asset systems value (including sustainable performance, cost and risks) rather than optimizing individual assets in isolation; Also asset management fulfils the requirement of being an integrated approach because it considers the interactions and combined effects of social, environmental and economic factors influencing an organisation. A major factor of successful asset management is the ability to integrate asset management processes, activities and data with those of other organizational functions, e.g. quality, accounting, finance, safety, risk and human resources. Hence this justifies the use of Asset management in the Nigerian Urban water context because of its ability to integrate various processes, activities and systems within the water context.

4.6.3 Justification for AM being sustainable and iterative

Another significant factor previously identified by (Closas et al., 2012, World Bank, 2012b) is the need for utilising management approaches that are iterative and able to operate as long-term processes. This is necessary because the characteristics and challenges of urban centres change over time. Therefore, iterative approaches are required for continuously re-examining urban area challenges and priorities, and relevant mitigation actions. From the previous analysis of AM in

Chapter two (BSI, 2008a, BSI, 2008b) describes AM to be a systematic approach that promotes consistent, repeatable and auditable decisions and actions.

This is similar to the requirement for iteratively examining urban challenges and priorities and mitigating strategies. Additional requirements for successfully adopting management approaches for urban areas include considerations of future demands and requirements of urban cities. Asset management is described previously in chapter two by (AAMCoG, 2001, BSI, 2008a, BSI, 2008b) to be sustainable because reflections about long-term consequences of short-term activities occur to fully accommodate future requirements and obligations. These requirements sometimes include economic or environmental sustainability, system performance, societal responsibility and other long-term goals. The rationale for utilising AM in the Nigerian context is therefore established because it is a sustainable approach that considers decisions through an assets life-cycle.

4.6.4 Argument for AM based on inherent Enabling systems

Previous discussions made by (Baietti et al., 2006, Chiplunkar et al., 2012, Evans et al., 2004, Kingdom et al., 2008) in section 3.3 state that utilities in developing countries are usually characterised by issues such as political interference, unwillingness to pay for water, ageing infrastructure and poor maintenance, climatic changes, population growth, emerging technologies and rapid urbanisation. These issues are major determinants of poor performance, hence if utilities intend to succeed, they must institute enabling systems for delivering management improvements. Some of these systems stated by (Baietti et al., 2006, Chiplunkar et al., 2012, Kayaga et al., 2018, Kingdom et al., 2008) earlier on in section 3.6 of the literature include systems that allow for autonomy, corporatisation, financial viability, accountability, building a competent workforce and collaborating with customers while meeting their demands.

AM systems like ISO5500, AMCOG are very flexible tools which have inherent support systems that consider factors such as Stakeholder needs, expectation, the vision and mission of the organisation, competency and leadership requirements and resource capacity. Further, AM systems integrate risk management processes for mitigating risks and opportunities impacting the AM system. GFMAM (2014) states the need for AM systems to place great emphasis on monitoring performance and continuous improvement. Most AM systems thus have monitoring tools inherent in them which are policies and guides for addressing issues such as accountability and assurance that assets will perform to required service levels. Hitherto, not all aspects of the

stipulated factors are stated as enabling systems, AM systems can be successful because it can be adapted to suit the internal and external context of an organisation. The justification for using Asset Management to deliver management improvements in the Nigerian Urban water sector is therefore established since an allowance is made for assessing its culture and environment.

4.6.5 Justification for AM application as a holistic system

Discussions made by (Bahri, 2012, Closas et al., 2012, World Bank, 2012b) identify the need for urban water management to progress from segmented, linear thinking to a more holistic approach. A holistic and integrated approach is required to address issues such as stormwater and wastewater management, supply and demand management. Furthermore, since urban water management is also about institutions and processes as just the same way it is about infrastructure and investments consideration of environmental, social and economic and financial aspects of water is also key to its successful implementation.

Lloyd (2010) described asset management as a holistic system that manages the whole life of assets, from their inception through to their disposal, which involves looking forward as well as backwards, outwards as well as inwards, and balancing the needs of all stakeholders – those of today and those of the future. Asset management is previously stated in the literature as a holistic system by (BSI, 2014, BSI, 2008a, BSI, 2008b) because it looks at the whole picture i.e. the mutual implications of managing all aspects this includes the combination of different asset types, their functional interdependencies and contributions of assets within asset systems, and the different asset life cycle phases and corresponding activities), rather than a compartmentalized approach; The holistic attribute inherent in asset management justifies the rationale for selecting asset management as a relevant management system for managing the urban water sector for Nigeria.

4.7 Summary

This chapter examined the context of the Nigerian urban water industry, to determine the requirements that were needed for successful asset management adaptation. The literature reviewed showed that Nigerian utilities performed poorly and were unable to meet due to factors which were related to the management of all asset types and contextual factors. The contextual factors were issues such as poor governance, population growth and rapid urbanisation. While

asset-related issues were related to ageing infrastructure, lack of competency and poor capacity building, customer issues, limited financial resources and lack of proper data management.

Three urban water management reforms had also occurred intending to improve asset performance such as the extension of piped connections, rehabilitation of water treatment plants, the financial viability of utilities and capacity building. However, these reforms had not succeeded due to the influence of contextual factors such as economic recession and political instability, lack of performance assessment systems, no proper feasibility studies, lack of autonomy and placement of SWAs within the civil services.

Therefore the following propositions can be taken from the review of the Nigerian water sector. Asset management can be adapted to the Nigerian urban water sector when all asset types are actively managed. Asset management can be adapted to the Nigerian urban water context when existing risk management processes can tackle contextual issues, stakeholders interest and risks related to managing all asset types simultaneously. Asset management can be adapted to the Nigerian urban water context when performance measures are in place to evaluate the management process outlined 1 and 2. Asset management can be adapted to the Nigerian urban water sector where contextual factors are integrated into the asset management system.

Chapter 5

A conceptual framework for implementing Asset management in urban water utilities in Nigeria

5.1 Introduction

The fifth objective of the research is to explore how modern-day asset management can be adapted to the Nigerian urban water sector. This chapter will focus on meeting objective five by developing a conceptual framework that will test the feasibility of adapting asset management theory to the Nigerian Urban water sector. The conceptual framework in Figure 5.1 is developed based on the synthesis of existing literature of asset management best practices, good urban water management practices in developing countries and the Nigerian urban water context.

From the literature on asset management, it was established that the scope of asset management needs to be broadened to address all asset types and industries. The literature on good management practices in selected African countries showed that these countries recorded success because the management of contextual factors such as autonomy, governance, population growth and urbanisation (prevalence of slums) was considered with asset-related issues such as financial viability, capacity building and increase in resilient infrastructure. The literature on the Nigerian context showed how the Nigerian Urban water sector operated and this was necessary to develop a conceptual framework that can proactively manage its challenges and enabling factors and stakeholders. The conceptual chapter will, therefore, look at the process of conceptualising key elements of the framework from the literature and actively analyse the core elements of the conceptual framework.

5.2 The Process of conceptualisation and synthesis of Literature for developing the conceptual framework

The framework was developed to achieve the aim of adapting asset management adaptable to the urban water sector of African middle-income and low-income countries. The framework was developed following a review of literature on asset management best practices, good management practices and the Nigerian urban water context. From the review of asset management frameworks in section 2.4, predominantly used frameworks such as AMMCOG, ISO5500, PASS55 and the IAM conceptual framework (as shown in Figures 7 to 10 in Appendix 2) had core elements showing that show the AM process starts from developing policies, lifecycle activities, evaluation and improvement elements for successfully implementing asset management (AAMCoG, 2001, BSI, 2008a, BSI, 2008b, BSI, 2014, GFMAM, 2014, Institute of Asset Management, 2015a, Institute of Public Works Engineering et al., 2015, Laue et al., 2011, Laue et al., 2014).

Hence the conceptual framework was developed to include similar core elements such as developing policies, lifecycle activities, evaluation and improvement since these were core elements in studied asset management frameworks in section 2.4. Also, the links between the elements of asset management common to the AM frameworks in section 2.4 showed a link from an asset management policy to AM objectives, Asset management plan, life cycle activities, evaluation and improvement.

The structure for the framework is based on a step and step guide to show what needs to be done for implementing asset management and how to implement asset management for a middle-income related context. This step by step guide is adopted based on the similarities with pre-existing asset management frameworks for best practices. The asset management frameworks in figures 7 to 10 of Appendix two which were also analysed in section 2.5 were developed as step by step guides however they only showed the requirements for asset management implementation and do not necessarily show how to implement it.

Additionally, the importance of including contextual factors within the scope of asset management as opposed to it being excluded in the common AM frameworks for successful asset management implementation in the context of a middle-income country due to the effects of contextual factors in the review of literature on good management practices in chapter 3. The first section of literature explored the context of developing countries and the literature showed that the urban water sector

in developing countries faced challenges such as population growth, urbanisation, lack of infrastructure, political interference, low-cost recovery, inadequate governance, were also found to be common among developing African countries. The factors impacting the African urban water sector were both contextual and asset-related (people, infrastructure, financial resources).

Finally, a comparison of countries with good management practices showed that these countries recorded success because the management of contextual factors such as autonomy, governance, population growth and urbanisation (prevalence of slums) was considered with asset-related issues such as financial viability and capacity building and increase in resilient infrastructure. The lessons about integrating contextual issues and asset-related issues from the studied African countries with good management practices were transferred to develop a conceptual framework that incorporates contextual factors into the scope of asset management since it was mandatory for achieving good management practices for middle income and low income African urban water sectors. Furthermore, these factors were split as endogenous factors and exogenous factors as issues such as governance, autonomy, staff management seemed to be influenced more by stakeholders apart from the utility and staff. The inclusion of external stakeholders would also make the application of the framework cut across all stakeholders impacting the urban water context.

Also the conceptual framework was adapted to focus on all asset types and also incorporate life-cycle activities related to all asset types and not only focusing on physical assets like asset management frameworks in chapter 2 did because the African utilities had adopted management practices that were related to all asset types and also had challenges associated with all asset types and not only physical assets as shown in section 3.1. Hence the need to incorporate practices such as information management, stakeholder management, management of infrastructure and management of finances were included in the life cycle activities stage. The risk management processes were also adapted to focus on endogenous and exogenous factors.

Finally, from the literature on the Nigerian urban water sector-specific challenges, stakeholders and enablers were analysed to populate the conceptual framework that could create a framework that suits the Nigerian context. The specific stakeholders following the review of literature which ranges from customer to informal service providers, International donors, State government and

Federal government represented through dedicated ministries were external stakeholders while state water agencies were internal stakeholders. The specific challenges were both asset-related and contextual factors. Governance and political interference, poor information management, staff capacity and competency issues and poor infrastructure. Some of these issues were within the utilities' control while others were outside their jurisdiction which is the rationale for splitting challenges and enablers and stakeholders under endogenous and exogenous categories. (IDEV and AFDB, 2015, Jacobsen et al., 2012, Owolabi, 2014, Oyegoke S. O., 2012, World Bank, 2000). Though they may be external, the level of influence on the urban water sector on middle income and low-income African countries is tremendous and should not be ignored or excluded.

The rationale for embedding some broader ideas of good management processes which include focusing on contextual issues and holistically looking at the whole picture and considering stakeholder issues with Asset management practices is an attempt to modify it to fit the context of middle-income countries. In section 4.6, a comparison occurred between key good management features and characteristics of AM that were associated with being systemic, a holistic management tool, a systematic process, and risk-oriented and dynamic. These AM features were found to be similar to characteristics of the broader good management practices. For example, AM considers the interdependencies of assets, it also manages assets throughout their life cycle, it is risk-oriented. asset management is as broad as good management practices and should be considered as a management system by itself rather than being grouped as a branch of good management practices. This is why AM was the focal point of the research and the core elements of the asset management system were retained but modified slightly to include the ideas of good management practices in African utilities.

In conclusion, the following propositions from the review of literature in chapters 2, 3 and 4 form the basis of the conceptual framework. Asset management can be adapted successfully to the Nigerian urban water sector when

- all asset types are proactively and holistically managed.
- existing risk management processes are able to tackle contextual issues, stakeholders' interest and risks related to managing all asset types simultaneously.
- Management systems and reform simultaneously contextual factors and asset-related factors

- performance measures are in place to evaluate the management process outlined in 1 and 2.
- where contextual factors are integrated into the scope of the asset management process.

Based on these theory propositions, the conceptual framework will be developed into 7 key elements which will be discussed the remaining sections of this chapter.

5.3 Identifying the Key Stakeholders

The first element of the framework is identifying the key stakeholders impacting the utility and understanding their level of impact and roles they play in ensuring the utilities succeed as shown in Figure 5.1. Reviewed frameworks like AMMCOG, ISO55000, IIIM and the IAM conceptual model in section 2.4.1 established that the needs of stakeholders impact the development of the organisational strategic plan (Institute of Asset Management, 2015a, BSI, 2014, BSI, 2008a, BSI, 2008b). However, this element on key stakeholders is considered within the scope of the asset management system, unlike other frameworks that consider stakeholder interests as contextual factors external to the organisation.

The rationale for this adaption is because influence from stakeholders like the National Assembly, defaulting customer, miscreants vandalising pipes and the staff of state water agencies were stated by (IDEV and AFDB, 2015, Jacobsen et al., 2012, Owolabi, 2014, Oyegoke S. O., 2012, World Bank, 2000) to have a major impact on the utilities in Nigeria and the African countries with good management practices. Another rationale for the adaptation assumed in this research was utilising the framework to accommodate the management of all asset types and related issues because the literature in chapter 2 had shown other assets apart from physical assets had equal value and influence they had on the performance of water companies.

Also Establishing the needs, interests, influence and expectations of key stakeholders is another important requirement stated by (Chiplunkar et al., 2012) for developing effective management practices which is why this is considered as the first element because all other activities are aligned to fulfilling stakeholder interest. Major outputs from this element are the ability to effectively develop an asset management system that delivers the required service levels for all stakeholders influencing the urban water sector.

In line with trying to understand the role of influential stakeholders, the respondents in the utilities will be asked to identify who their stakeholders are and how they impact the activities of the organisation. Understanding the role of stakeholders is key for developing a conceptual framework that addresses how an asset management system should be implemented in addition to listing elements that should contain an asset management system for the Nigerian urban water sector.

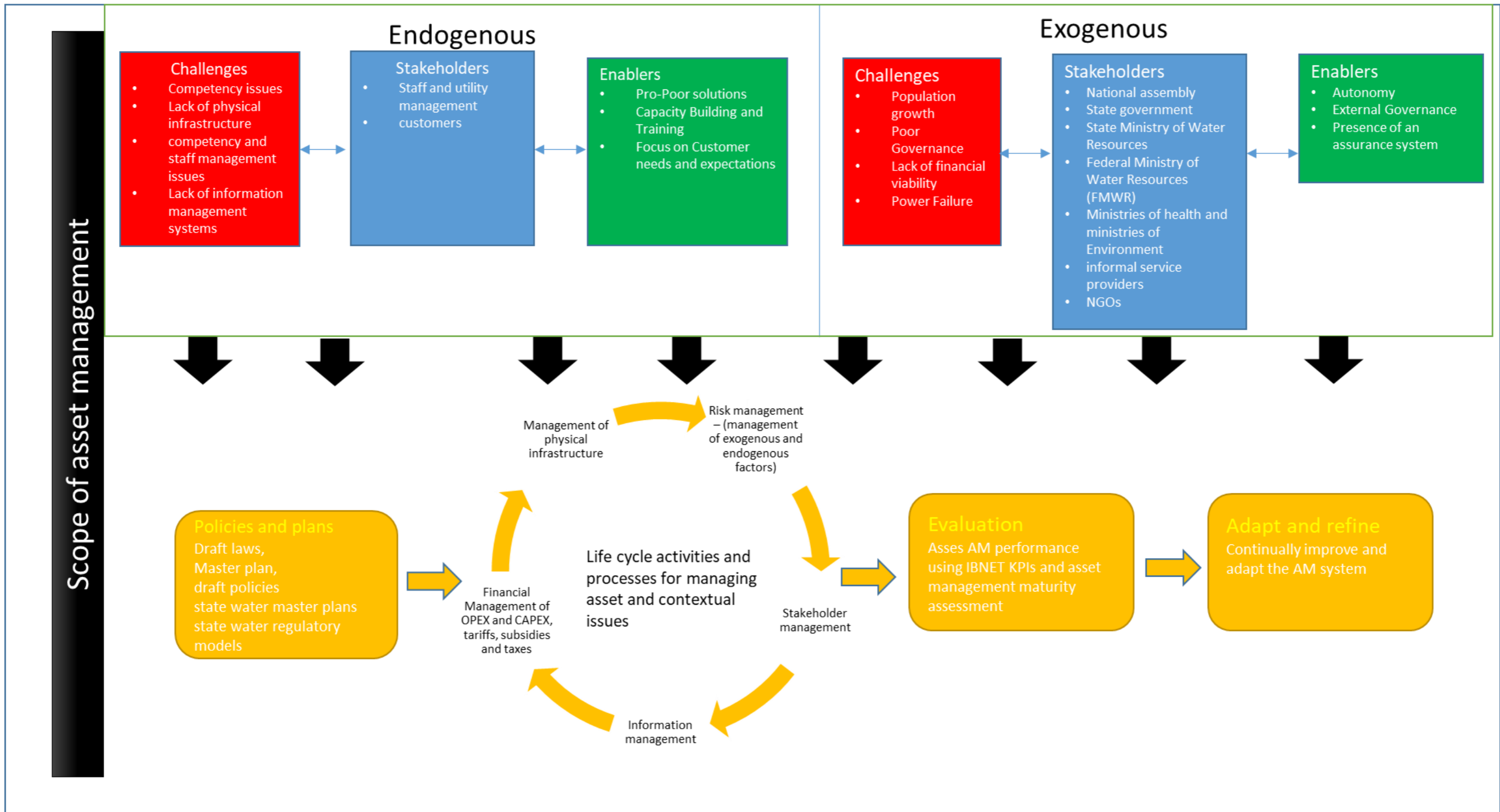


Figure 5.1: Conceptual Framework

5.4 Identifying challenges impacting the existing water context

The next element of the conceptual framework will be about identifying key challenges impacting the Nigerian urban water sector. The rationale for this is because contextual factors was a common element in reviewed asset management frameworks like AMMCOG, ISO55000 and the IAM conceptual model identified in section 2.4.1 by (Institute of Asset Management, 2015a, BSI, 2014, BSI, 2008a, BSI, 2008b). However like in the case of the first element, this is considered to be part of the asset management system and not separate from the asset management system. The rationale for this adaptation is because contextual factors from the literature in section 3.2 and 4.1 such as population growth, political interference, climate change, had an immense impact on the Nigerian urban water context (Hodge, 2007, Durokifa and Abdul-Wasi, 2016, Oyebande, 2006).

Also, there were asset-related challenges in section 3.2 and 4.1 of the literature such as competency issues, lack of infrastructure and financial viability, poor data management (Foster and Pushak, 2011a, Nwankwoala, 2014, Nwankwoala, 2011, Chukwu, 2015, Ajibade et al., 2015, Omole, 2013). Since this framework will consider all asset types hence the need for this section to be considered within the asset management system is established. This is also in line arguments from (Bahri, 2012, Baietti et al., 2006, EPA, 2008b, EPA, 2012, Kayaga et al., 2018, Khatri and Vairavamoorthy, 2008) advocating the need for considering financial, environmental, social and economic aspects of the water sector for developing effective management systems. The key challenges from the literature in chapter 4 were used for the proposed framework in section 5.4. In line with trying to understand the challenges impacting the Nigerian Water Utilities, the respondents in the four case utilities were asked to analyse key challenges impacting their performance. Understanding the way in which the stated challenges impacted these utilities was key for developing a conceptual framework that addresses how an asset management system should be implemented in addition to listing elements that should contain an asset management system for the Nigerian urban water sector.

5.5 Identifying enabling factors impacting the existing water context

The next element for the framework is focused on establishing enabling factors for the conceptual framework. There were enabling factors which emerged from the reviewed asset management frameworks and best practices in the asset management chapter such as information management, risk management, legislation, change management, performance evaluation, capacity building. The literature on good management practices in selected African

countries also had enablers such as autonomy, governance, capacity building, accountability and financial viability which are both contextual factors and asset-related factors. According to (AAMCoG, 2001, BSI, 2008a, BSI, 2008b, BSI, 2014, GFMAM, 2014, Institute of Asset Management, 2015a, Institute of Public Works Engineering et al., 2015) it is a requirement for organisations to invest in areas such as organizational culture and structure, asset management leadership, competence management and supply chain management.

Similar to the challenges section of the framework, the enabling factors element is integrated into the asset management system because enabling factors encompasses factors related to managing the different asset types and contextual factors. The enabling factors from the good management practices review will be adapted for the conceptual framework in Fig 5.4. Also, this element will be tested by asking respondents in the four case utilities to analyse key enabling factors impacting their performance. Understanding the way in which the proposed enabling factors impact these utilities is key for developing a conceptual framework that addresses how an asset management system should be implemented in addition to listing elements that should contain an asset management system for the Nigerian urban water sector.

5.6 State Water Policy and State Water Master Plan

The starting point for most asset management systems is the AM policy which was previously identified by (Davis, 2016, ICE, 2013, Institute of Asset Management, 2015a, GFMAM, 2014, BSI, 2014, BSI, 2008a, BSI, 2008b) for establishing a basis for developing and implementing the asset management system. The strategic asset management plan was also stated by (Institute of Asset Management, 2015a, BSI, 2014, BSI, 2008a, BSI, 2008b) as an important element for asset management. The countries with best practices also developed asset management plans and financial asset management plans for systematically implementing asset management (Machell et al., 2014, Ward et al., 2014, Floate, 2014, Heather and Bridgeman, 2007, Ofwat, 2017b, Blankenship and Slaven, 2016, DWA, 2013, Bhagwan, 2009, Bhagwan and Wall, 2008). However, the conceptual framework developed will replace the asset management policy and asset plan with State Water Policies and State Water Master Plans. The rationale for adapting this is because in the literature on the Nigerian urban water sector (Ajai, 2012b, Akpabio, 2012a, Goldface–Irokalibe, 2006, Macheve et al., 2015, World Bank, 2011a) established the requirement for states to develop state water policies and Master plans. In addition, the asset management policy and asset management plans are premised on meeting stakeholder expectation and delivering value. Hence, if management policies are developed also based on delivering value, they can be adapted and used to replace asset management

policies and plans. Furthermore replacing state water plans and policies with asset management policies and plans provides a platform for ensuring policies and plans are developed to consider all asset types are managed appropriately. In line with this, the question asked will be to ask the 4 case utilities to identify existing policies and laws they have for delivery of good services. Additionally, utilities without plans or policies will be asked to state what they implement in place of non-existing policies and master plans.

5.7 Management Processes for all Asset types and contextual factors

The next element of the framework is focused on identifying the management process required for ensuring assets (stakeholders, infrastructure, finances and information), challenges and enabling factors to deliver value. The rationale for considering management processes related for all assets is supported by (Woodhouse, 2010b, Woodhouse, 2007, BSI, 2014, Whittington et al., 2008, Woodhouse, 2013, Woodhouse, 1997) that state all assets depend on each other and the optimal management of one asset type is highly dependent on the interactions between other types of assets. Hence this research adopts the notion that all asset types should be considered in an asset portfolio as against focusing only on physical assets.

However, the literature on the Nigerian water sector did not necessarily state in detail what types of financial assets and information systems were existing even though issues such as competencies, lack of infrastructure and dependence of subsidies and international donor grants were identified by (Goldface–Irokalibe, 2006, Chukwu, 2015, Adah and Abok, 2013, Onugba, 2009, Ajiboye et al., 2012). Assets under listed are based on the categorisation of assets made in PASS 55 guidelines for asset management. However, the financial assets and information assets adapted for this research are based on recommendations made by (OECD, 2010, OECD, 2011, David et al., 2013, NALAS, 2014, Prodanovic, 2014) shown in figures 5.1 and 5.2. These are the only works identified in the literature that attempt to explicitly establish mechanisms for managing financial assets and information assets related to urban water.

The success of an organisation is sometimes determined by their ability to successfully secure financial assets such as bonds, loans, stocks, and equity and bank deposits. Also, financial resources are required for capital investments and investments in infrastructure projects. Core financial assets associated with utilities are outlined in Figure 5. below is adopted from (OECD, 2010, OECD, 2011) for the research purposes. Emphasis on the importance of commercial orientation of utilities was stated by (Baietti et al., 2006, Kayaga et al., 2018, World Bank, 2011b, Fall et al., 2009, Newborne et al., 2015) in section 3.6 of the literature as key factors

that determine effective utility management in developing countries. This deals with how utilities can find innovative solutions and techniques that make that enables utilities to meet the needs of the poor without affecting their ability to remain financially viable.

AM is stated by (EPA, 2008a, EPA, 2014) to be a great way to improve financial management to make the best use of systems' limited resources. This is due to the inherent risk-based and optimal attributes of an asset management system. AM has a risk-based characteristic of aiming resources and expenditure and setting priorities, applicable to the predicted risks and associated costs and benefits. AM is also an optimal approach for considering whole life costing, future service demands and, a balance between capital expenditure and operational expenditure. It helps organisations establish the best value compromise between performance, cost and risk, associated with the assets over their life cycle. These facts establish the rationale for creating an Asset management framework element that is focused on developing management processes for financial assets.

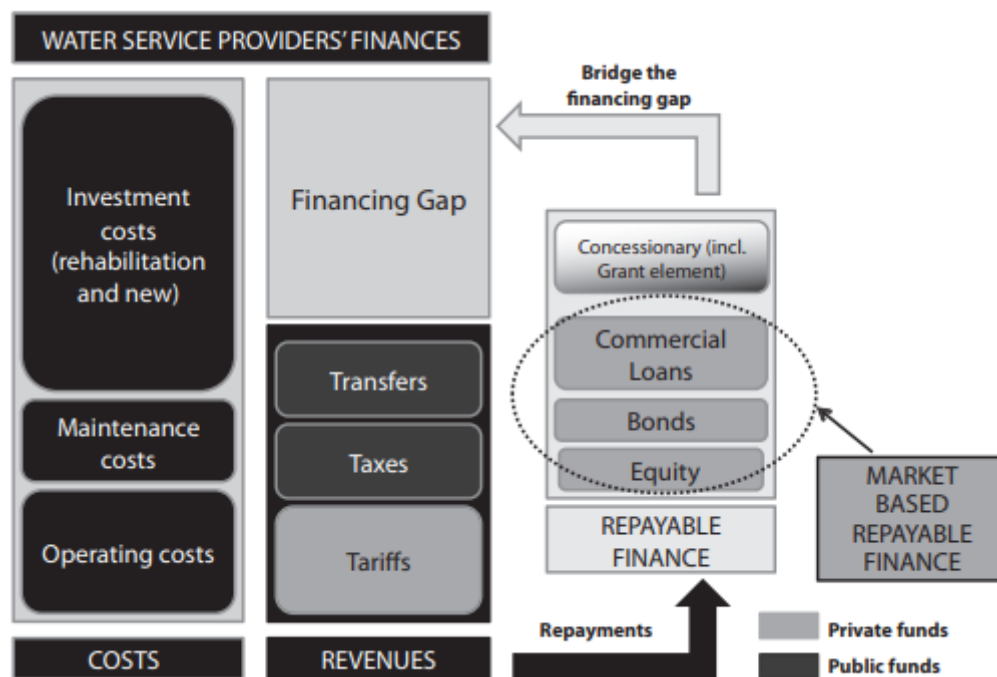


Figure 5.2: Innovative financing mechanism for water.

Source: (OECD, 2010, OECD, 2011)

Management processes for information assets

Asset management requires accurate asset information, but an asset management system is more than a management information system. Data and information requirements including quality requirements when clearly identified and articulated impact the performance of an

organisation. Information systems and data should be considered as an asset as quality data and information are key requirements for monitoring the performance of other assets effectively. Core utility information systems highlighted by (David et al., 2013, NALAS, 2014, Prodanovic, 2014) are adapted for the research purposes.

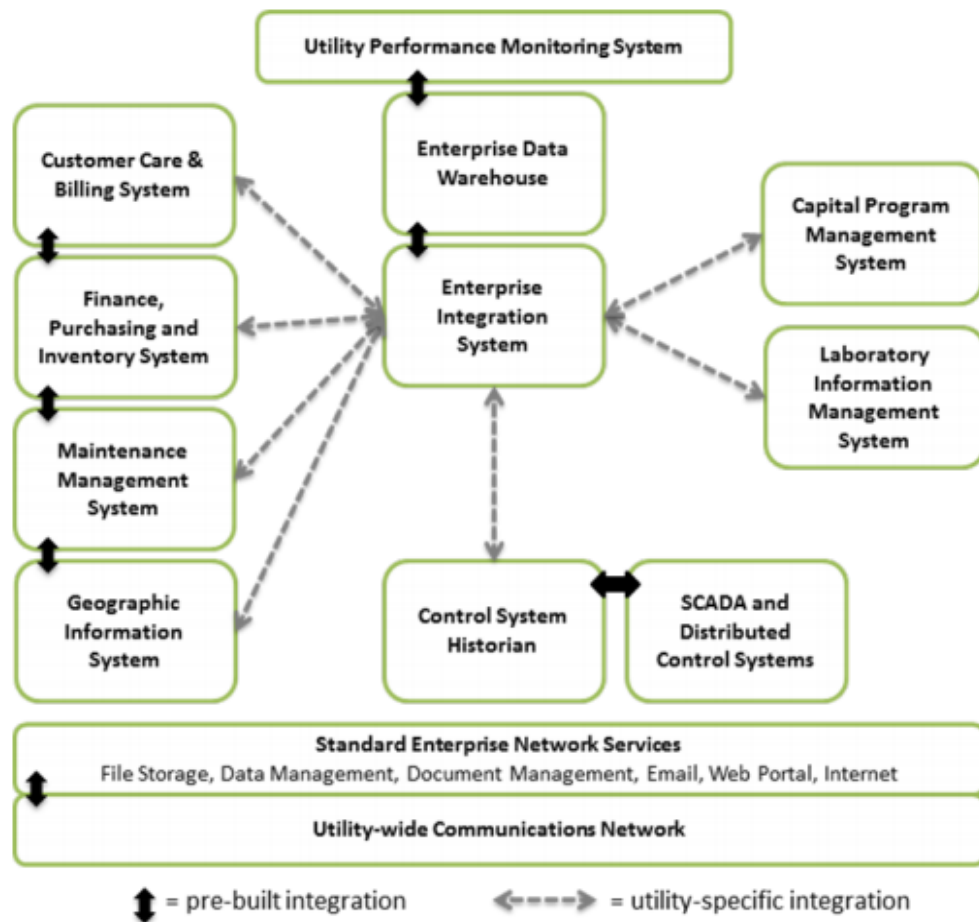


Figure 5.3: Core utility information systems.

Source: (David et al., 2013, NALAS, 2014, Prodanovic, 2014)

Physical assets

Physical assets refer to Plant, equipment, buildings, property, pipelines, infrastructure and other items that have potential or actual value to the organization. Physical assets in utilities are the items that contribute to the production and delivery of the utilities' service to the community or group of customers.

Key challenges, key stakeholders and enabling factors have already been considered previously described in sections 5.2, 5.3 and 5.4 and are not detailed in this section. However, in line with understanding the processes for managing all asset types and challenges and enabling factors, the four (4) case utilities will be asked to identify management practices they have in place for

delivering services. This processes will cut across all asset types and challenges and enabling factors. Any of the adapted assets in figures 5.1 and 5.2 which are lacking following the responses from the utilities will be replaced with the actual assets that are currently existing in the Nigerian water utilities.

5.8 Performance evaluation

The next element for the conceptual framework is performance evaluation. This element was selected because the literature reviewed for good management practices and best practices showed recorded successes occurred because of the presence of assurance systems (AAMCoG, 2001, BSI, 2008a, BSI, 2008b, BSI, 2014, GFMAM, 2014, Institute of Asset Management, 2015a, Institute of Public Works Engineering et al., 2015, Laue et al., 2011, Laue et al., 2014). The rationale for including this element is to establish a way to evaluate the system to determine whether it is effective and efficient in supporting asset management for the water utilities.

The performance assessment tools are common to the developing countries and developed countries in section 2.3.3 and section 3.3.2. The asset maturity tools and IBNET indicators are proposed as the major tools for this element as shown in table 5.1 and figure 5.3. Countries like the UK, US and Australia in section 2.4.1, 2.4.3 and 2.4.4 respectively had adapted benchmarking tools and asset management maturity models to their context (GFMAM, 2014, Institute of Asset Management, 2015a, GFMAM, 2015, Institute of Asset Management, 2015b, Godau and McGeoch, 2016).

The IBNET indicators are tools have also been used by (Macheve et al., 2015) for assessing the performance of state water agencies. The asset management maturity, however, has been adapted to assess management processes for contextual factors and all asset types identified in section 5.7. This adaptation is based on the flexibility of the scales for the maturity models to consider policies as well as processes related to managing assets, challenges and enabling factors which cannot be measured by technical KPIS details shown in figures 3 and 4 of appendix 2. The proposed evaluation element of the conceptual framework will be tested by asking respondents to identify the performance of their assets, management processes for all asset types, challenges and enabling factors. This will allow the research to also establish where the Nigerian water context is in terms of maturity for asset management.

Table 5.1 IBNET indicators.

Source: (World Bank, 2017a)

| | | |
|----------------------------|--|--|
| IBNET Indicators | Water Gaps | Assets |
| Service Coverage | Population growth & urbanisation | Infrastructure |
| Financial Efficiency | Unwillingness to pay/funding | Internally generated revenue, capital investments and operational expenditures |
| Operational Efficiency | Illegal connections, pipe vandalism, personnel management issues | Physical infrastructure and human assets (staff and personnel) |
| Production and Consumption | Population growth, infrastructure inadequacy | Infrastructure |
| Poverty and Affordability | Unwillingness to pay | Financial assets |



Figure 5.4: Asset Management Maturity.

Source: (Institute of Asset Management, 2015b)

5.9 Improvement

Following the review of asset management frameworks developed by (AAMCoG, 2001, BSI, 2008a, BSI, 2008b) a final element that emerged was continual improvement. Section 2.3.4 of the literature showed the importance of continually improving asset management practices. Countries like US, Australia and South Africa were stated by (Godin et al., 2012, Sneesby et al., 2012, Aikman, 2014, Harding et al., 2010, Kay and Roxburgh, 2011) to have established ways such as training, workshops and bodies of knowledge for continually improving and changing their existing asset management practices. This element is key for allowing the asset management system to continually evolve to continually evolving to match its context, organizational objectives. The proposed improvement element of the conceptual framework will be tested by asking respondents to identify key areas and processes they will need to improve and to also state any existing intentions they have for that. This will allow the research to also establish how the Nigerian urban water can be improved thus addressing the “how factor” that was not evident in other asset management frameworks in chapter 2.

5.9 Summary

This chapter outlined the first step towards developing an asset management framework that is relevant to the context of Nigerian water utilities. It established specific concepts in the conceptual framework that are considered to be important and critical to developing the final asset management framework for Nigerian water utilities. The conceptual framework was premised on the propositions of developing a framework that considers all asset types, that also considers contextual factors within the scope of the asset management system. Furthermore, the conceptual framework developed had 7 elements and ways in which these elements will be tested were discussed in great detail. After careful consideration of key concepts which inform the development of the conceptual framework, the next step will be to assess the methodological approach used to acquire relevant data for testing and validating the conceptual framework.

Chapter 6

Research Methodology

6.1 Introduction

The literature on asset management and good management practices in previous chapters have established the importance of having enabling institutional systems for implementing asset management successfully. However, the literature in Chapter 4 suggests that the current institutional environment in the Nigerian urban water context lacks the capacity for enabling asset management improvements. In an attempt to explore how asset management improvements can be delivered in the Nigerian urban water sector, the research will be conducted using the qualitative research method.

This chapter, therefore, aims to establish how qualitative research method is deemed suitable for conducting the research. The chapter is organized and written in ten (10) sections. The first sections three sections will examine the research question, research design and research philosophy. The next three sections will focus on establishing the rationale for adopting the selected research method, sampling technique, case study strategy and data collection methods. Finally, the last three sections will focus on the data analysis process, data management issues and ethical considerations of the study.

6.2 Research Problem

The success of research depends on how well it meets its purpose and a key factor that contributes to the success of research is evident in how well the research problem in question is articulated and resolved. A research problem is described by (Creswell 2013, Walliman, 2006) as an existing issue which needs to be critically evaluated and addressed. A research problem offers an occasion for focusing on an issue that merits research. Thus certain criteria will need to be met before a problem is considered suitable for research; such criteria include being able to contribute to existing knowledge, should be manageable, it has potential and achievable solutions and finally, it should be specific.

It is important to note however that, the nature of a research problem also determines the appropriate methods, procedures and measuring instruments that will be adopted for undertaking the research. In addition, potential solutions only occur when the research method fits the research problem it is chosen for (Holden and Lynch, 2004). Thus a thorough evaluation and definition of the research problem which the research seeks to address will be considered first in this section before proceeding with the selection process for the research methods.

The literature in Chapter 2 has previously established how asset management has become a prominent management practice in the global water sector. However, a review of literature had shown best practices in asset management occurred majorly in developed countries characterised by effective institutional systems, high competency levels and improved information systems and technologies. Additionally, discussions in literature stated that best practices in asset management were seen to have emerged more from developed countries while few studies were seen in developing countries most especially developing countries characterised by failing institutions and policies. Hence the specific research problem will be to explore **“how modern asset management practices can be adapted to suit a developing African urban water context”**.

The research questions which have been developed specifically to address the research problem are outlined below:

1. What are the essential features of asset management best practices in the water sector?
2. What are the critical factors and maturity levels required for successful asset management implementation?
3. What are the benefits of implementing asset management best practices?
4. How have countries in Africa developed good urban water management practices?
5. What are the existing management practices in Nigerian and what has been their impact on water utilities?
6. How can lessons learnt from African utilities with good urban water management practices be transferred to the Nigerian urban water sector?

6.3 Research design

Yin (2018) defines research design as “a logical plan for getting from one point to another point. The first point refers to the initial set of questions to be answered and the final point

there is some set of conclusions about these questions. The research design also functions as a blueprint for addressing issues relating to what questions need to be studied, what data are relevant, what data to collect and how to analyse the results (Yin, 2018, Robson and McCartan, 2016). Hence it focuses on looking at the different methods and tactics carefully and selecting the best options that can answer the research questions that need to be addressed. The research design also ensures the evidence provided is able to answer the research questions logically and clearly (Blumberg et al., 2008, De Vaus and de Vaus, 2001, Sarantakos, 2012, Burns, 2000).

There are different propositions for a research design framework. (Yin, 2018) proposes five (5) key components for a research design as defining the Case study questions, proposition of cases and units of analysis, the logic linking the data to the propositions and the criteria for interpreting the findings. However, (Robson and McCartan, 2016, Rudestam and Newton, 2007, Maxwell, 2012, Baxter and Jack, 2008) have opposing views and outline components such as purpose or goals, research questions, conceptual framework, methods, sampling techniques or cases and validity.

For the purpose of this study, the research design specified by (Robson and McCartan, 2016) will be adopted because it is a more flexible design which allows for repeating and revisiting various components of the design as the study emerges. The components for the research design as stated by (Robson and McCartan, 2016) include the purpose of the research, the conceptual framework the research questions, the methods and the sampling strategy as shown in Fig 6.1.

The research purpose the conceptual framework and the research questions are components of the research design which have already been discussed in detail in sections 1.3, 1.4 and Chapter 6. This section will only focus on discussing the details of the research methods and the sampling strategy. However from Fig 6.2

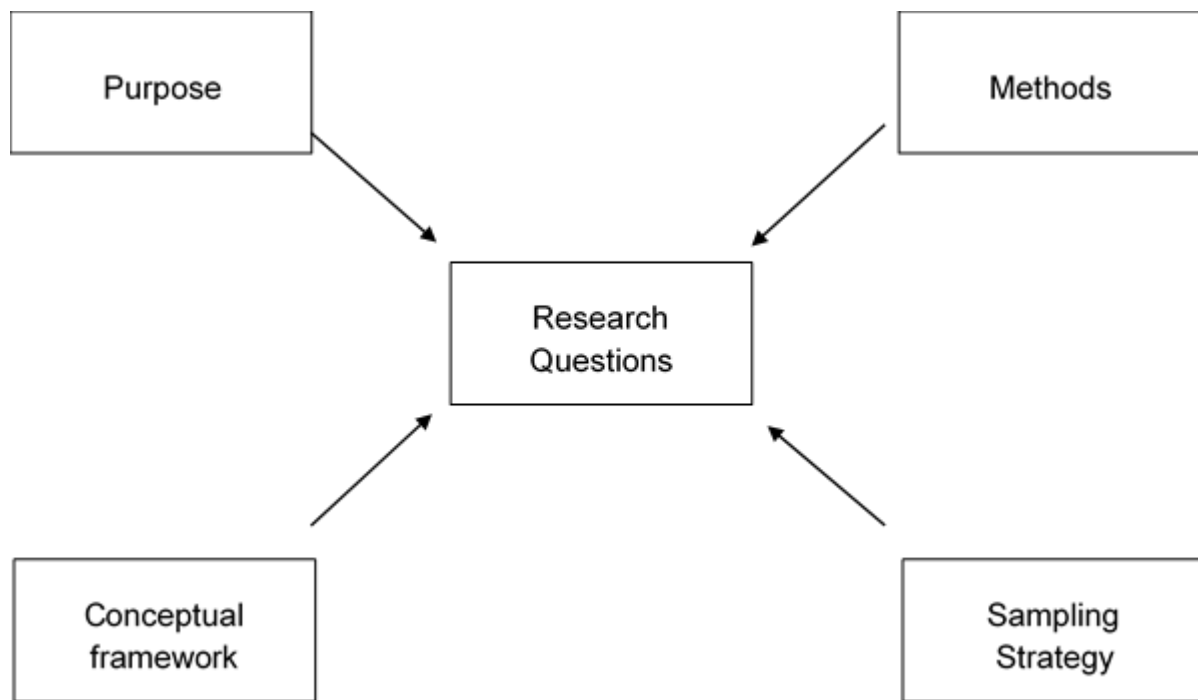


Figure 6.1: Research Design Components.

Source: (Robson and McCartan, 2016)

6.3.1 Research Purpose

This component deals specifically with why the study is being conducted. It also highlights the importance of the results of the study and identifies what issues need to be clarified. The research purpose as shown in Fig 6.1 should feed into the research questions and help specify the research questions that will be addressed in the study. As previously described in Section 1.3 of the research, the purpose of the study is to develop an asset management system that improves the performance of water utilities in Nigeria. The research purpose and conceptual framework are normally integrated while conducting research being the first elements likely to be developed (Maxwell, 2012, Robson and McCartan, 2016). The conceptual framework will, therefore, be the next component discussed below.

6.3.2 Conceptual Framework

The second component of the research design is the conceptual framework. It focuses on the theory guiding the research (Maxwell, 2012, Robson and McCartan, 2016, Yin, 2018). The conceptual framework helps a researcher reflect on important theoretical issues and it also directs the researcher in knowing where to search for relevant evidence. The conceptual framework, therefore, has a role to play in determining the research questions. Through preliminary studies and prior research findings, the various aspects of the issues being studied

can be articulated clearly. The generic theory guiding the study is modern-day asset management practices. The conceptual framework is an asset management framework that is adapted to suit a developing African urban water sector like Nigeria. A detailed conceptual framework has been described previously in Chapter 5.

6.3.3 Research questions

Defining the research questions is stated by (Baxter and Jack, 2008, Blumberg et al., 2008, Burns, 2000, De Vaus and de Vaus, 2001, Maxwell, 2012, Robson and McCartan, 2016, Rudestam and Newton, 2007, Sarantakos, 2012, Yin, 2018, Saunders et al., 2015) as the most important step when conducting research. Research questions are either classified as who, what where how and why questions. The research questions allow the researcher to gain insights into what needs to be understood to achieve the purpose of the study (Robson and McCartan, 2016). The research questions should be questions that capture details of the settings or participants that are being studied.

The research questions which have been developed specifically for adapting modern-day asset management practices have already been discussed previously in section 1.4 and section 6.2. As shown in Fig 6.2 the combination of how what, and why questions were used for conducting the research. In addition, the research questions are aligned to the research purpose and the theory guiding the research see fig 6.1 and 6.2 for details. Understanding the type of question that is relevant to the research, guides the researcher on deciding on the most relevant method to be used as shown in Fig 6.1 and 6.2 (Baxter and Jack, 2008, Yin, 2015, Yin, 2018).

6.3.4 Methods

This component of the research design is related to the specific techniques and approaches used for collecting and analysing the data. This component anticipates the selection process for data collection and analytical techniques. It also focuses on knowing how well suited these techniques are for the research. According to (Maxwell, 2012, Robson and McCartan, 2016, Yin, 2018) the following elements are usually considered for methods.

- Methods for collecting the research data
- The data analysis strategies and techniques
- Establishing that the data collected is valid

These elements are discussed below in great detail in the next three sections.

6.3.4.1 Data collection methods

There are two major categories of data types which can be collected for research purposes and they are secondary and primary data. Written sources that interpret or record primary data are called secondary data. All research studies require secondary data for the background of the study (Walliman, 2006). Secondary data usually takes the form of various types of documents and official statistics, media and artefacts (McNeill and Chapman, 2005, Miles et al., 2020).

Primary data, on the other hand, are data that have been observed, experienced or recorded close to the event and are the nearest one can get to the truth are (Walliman, 2006, Walliman, 2010). Information is collected first hand by the research mainly through surveys, interviews or participant observation (Brennen, 2012, McNeill and Chapman, 2005, Walliman, 2006, Miles et al., 2020, Baxter and Jack, 2008). The data collection methods used for collecting secondary and primary data during this research is analysed below:

6.3.4.1.1 Literature review

According to (Bryman, 2012, Saunders et al., 2012, Kumar, 2010), a critical review of existing literature in research is a very critical factor for establishing the relevance of a study/ research as no research is relevant unless it fits and contributes to a wider context of knowledge. There are two main reasons for carrying out a literature review stated by (Saunders et al., 2012). The review of literature aids the process of formulating and refining a research problem by making it clearer and more concise (Burns, 2000). The search terms for the review were selected based on the research objectives, and the searching process was carried out using search terms such as asset management, water asset management, infrastructure asset management, urban water management, African urban water utilities, African urban water sector. The limit for the research was from 2001 to 2019.

An electronic database search was carried out to establish existing literature on asset management in the African urban water sector compared to developed countries. The inclusion criteria for studies on asset management that were focused on the water sector, asset management frameworks, good urban water management practices urban water management in African countries and studies conducted for urban water supply and sanitation in Nigeria. Studies for rural water and asset management in other sectors like transport and housing were excluded. ICE Virtual Library, Web of Science, Science direct and IWA publishing open access were database used for the research.

Base on inclusion and exclusion criteria used in the review 935 articles were presented from the searched database. 605 were screened out and 330 of the articles were referenced and used for the literature review. Out of the 330 articles reviewed very few of the asset management literature was related to African countries. However, there were a lot of studies from the World Bank, African Development Bank, OECD, UN and WHO which were focused on assessing the performance of African urban water sectors.

6.3.4.1.2 Pilot Study

Pilot studies are preliminary studies carried out before the main studies to prepare a researcher before he conducts his main study. It is necessary for research as it offers the following benefits

- Prevents possible errors that might occur during the main research (Sarantakos, 2012)
- It is a learning platform and gives confidence to the researcher during the main research study as the researcher gains more knowledge about the study (Burns, 2000)
- It shows how Research participants may perceive and understand the questions being asked (Matthews and Ross, 2010)
- Test data collection procedures/ research methods on a few of your sample cases and make proper adjustments before proper research takes place

Preliminary interviews were conducted with 8 water professionals for 30 minutes to 45 minutes with the first draft of the interview questionnaires. The pilot study aimed to understand how research participants were going to be engaged. To understand if the questions asked will be able to address the research problem, provide an opportunity to generate as much information required as possible. In addition, the participants of the pilot study gave feedback in terms of what could have been improved in the interviews and any missing relevant information and issue that could have been added to the questionnaire, the participants also gave feedback in terms of their understanding of the research and wording of the interview questionnaires prepare the researcher for the interview process and thus it provides a means for getting written elicit information from respondents.

Feedbacks were given by participants about concerns they had about some questions in the interview questionnaires and also other concerns that could have affected the validity of the research instruments. The pilot study data collected was not used to generate any findings as it was only meant to prepare the researcher for the main implementation phase which is now analysed below in great detail.

6.3.4.1.3 Interviews

An interview is a conversation between a researcher who is the interviewer and the research participant who is the respondent or interviewee (Berger, 2010). It is employed for getting elicited information about beliefs or opinions from the participant being interviewed (Berg and Lune, 2012, Berger, 2010, Burns, 2000). It is a predominant primary data collection technique for gathering qualitative data. Interviewing skills required include making participants comfortable, probing for details, remaining neutral while encouraging them to talk openly, listening carefully, following a participant's train of thoughts and extracting insights from hours of detailed descriptive dialogue (Cooper and Schindler, 2008). Interviews are categorised by (Cooper and Schindler, 2008, Robson and McCartan, 2016, Saunders et al., 2015, Brennen, 2012) as semi-structured, structured and unstructured interviews.

Structured interview uses a detailed interviewer guide similar to a questionnaire to guide the question order and the specific way the questions are asked (Robson and McCartan, 2016, Saunders et al., 2015). Questions remain open-ended. Structured interviews are majorly used for surveys while semi-structured and unstructured interview methods are commonly used for conducting qualitative research. Structured interviews focus on collecting quantifiable facts that can be used to generalize about human behaviours. However, with face-to-face interviews using semi-structured or unstructured interviews, an in-depth understanding of the opinions, interests, values, and emotions of participants is possible (Brennen, 2012).

King and Horrocks (2010) identify flexibility as a key requirement for qualitative interviews. Unstructured and semi-structured interviews are more flexible tools for conducting qualitative research (Robson and McCartan, 2016). With unstructured interviews, there are no specific questions or order of topics to be discussed, with each interview customised to each participant. On the other hand, Semi-structured starts with a few specific questions and then follows the individual's tangents of thoughts with interviewer probes (Cooper and Schindler, 2008).

A chance of rapport is achieved better with semi-structured interviews and participants can provide answers in ways that resonate with them. (Holstein and Gubrium, 2011). Thus the perspective of the participant is gotten more than that of the researcher. The process of probing and prompting is inherent in semi-structured interviews which resolve issues such as participants giving incomplete answers, ambiguous answers or no answers at all (Zikmund, 2003). Thus in-depth information is gained and new topics arise from interviews which the researcher might not have considered (Kumar, 2010).

Semi-structured interviews were employed for the research as they provide an element of flexibility that is not inherent in structured interviews which strictly follows an interview schedule and pre-determined questions. For the purpose of the research as shown in Fig 5.2, semi-structured interviews were used to collect data from 60 management professionals in 4 case water utilities. Semi-structured follow a common set of topics or questions for each interview, introduce topics and question in different ways or orders as appropriate to each interview (Matthews and Ross, 2010).

To prevent elements of bias while maintaining rapport and preventing participants going off-topic, an interview guide will be employed for conducting the interview and the researcher will also acquire necessary interview skills and any forms of prompting are avoided. The interview guide will be a comprehensive guide outlining the topics and interest areas the researcher intends to cover. Interviews were conducted with 23 participants in case utility one between the 19th of January and 29th of January 2016. Interviews were also conducted with 23 participants in Utility two between the 2nd to the 12th of February 2016. In Utility 3 interviews were conducted with 9 participants between the 15th to the 18th of February 2016 while interviews were conducted with 6 participants in utility 4 between the 3rd and 9th of March 2016.

The interviews were between 45 to 60 minutes and not more than that to prevent participants from getting weary and tired of the whole process. Probing questions were used to ensure participants were actively involved in the research. They were also used to for understanding any areas the researcher was not clear and needed more information to ensure the researcher was evidently capturing what the participants were saying and not what the researcher was thinking to eliminate any form of bias. Permission was sought from each interviewee before the interviews are recorded and participants will be guaranteed anonymity.

Group interviews were conducted in cases where certain employees in similar departments were only available at the same time. The major advantage of this approach is stated by (Mansell et al., 2004) to allow for debates and interactions that can produce richer data. It is also a quicker means for getting data from a lot of participants at the same time. However, the limitation of this research is that quiet participants and participants in lower hierarchical positions may feel uncomfortable in voicing their opinions. Also, one participant may be vocal compared to others and only one person's voice may be heard compared to the required interaction and debate that makes group interviews successful.

The following actions prescribed by (Beyea and Nicoll, 2000, Acocella, 2012) were taken to elicit information from all participants and eliminate bias during the group interview.

- Probing questions to ensure people were actively involved
- Ensured did not start the questions with the same person and moved around
- Kept assuring people they were entitled to their opinions and there was no wrong or right answer
- Where there was only one vocal participant, the researcher probed other participants to state the level to which they agreed with the other participants and were obliged to state their contradictory views.
- Watched the emotions of people to see if they were confident about what was said.
- Asked contradictory or critical questions based on real evidence when not sure the answer provided was true.

Interview Design

The interview guide was designed with reference to the conceptual framework and the research question. The semi-structure interview guide was designed to accommodate flexibility and enable in-depth exploration of the asset management phenomenon being studied within the Nigerian context. The interview was guide was developed into three main sections as shown in Appendix 4. A total of 10 interview questions were asked within 45 to 60 minutes. Details of each section and interview questions are discussed below

Section A focused on the profile of research participants:

In this section, the information needed by the interviewer was participants' gender, their currently occupied position and department which participants worked. Information of participants' years of experience and level within the firm was also required for the study

Section B focused on questions required for understanding the organisational context:

In line with the conceptual framework, questions related to understanding the context in which the Nigerian urban water sector was developed in this section. Information was sought about participants' opinion on who key stakeholders were and how they influenced their organisation. Questions regarding key challenges and enabling factors influencing service delivery were also asked. These questions were aimed at answering the following research question - How does the context of countries with failing institution impact the performance of their water utilities and water sector?

Section C focused on elements of an asset management system:

This section was developed in line with the next component of the conceptual framework which is the asset management system. Information was sought on existing policies within the organisation and their level of implementation. In addition, the opinion of participants was sought on existing management processes utilised in their respective organisations for managing all asset types - people, finances, physical infrastructure and information.

This section was developed to answer the research question of how AM can be contextualised to suit the urban water sector in Nigeria characterised by failing institutions. Since the existence of AM processes were questionable, following no detailed literature showing asset management was existent in Nigerian water utilities; this section sought to gain information about existing organisational management processes associated with people, finances, physical infrastructure and information which could be incorporated to form an asset management system adaptable to the Nigeria context.

Section D focused on performance evaluation and key performance indicators:

The next element of the conceptual framework was associated with the evaluation of an asset management system. Participants' perception was sought on key performance indicators, the best way to measure performance associated with people, finances, physical infrastructure and information.

Section E areas for improvement:

Finally, information regarding areas where improvement was required for service delivery was gotten from participants in this section.

6.3.4.2 Data Analysis

Data Analysis is the search for patterns in data and for ideas that explain why those patterns are there in the first place (Bernard and Ryan 2012). There various data techniques for analysing qualitative data however thematic analysis was used for carrying out data analysis in this research. According to (Braun and Clarke, 2006), one of the benefits of thematic analysis is its flexibility. Thematic analysis provides a flexible and useful research tool, which can potentially provide a rich and detailed, yet complex, account of data. Thematic analysis adopts both inductive and theoretical maps and is not restricted to one of these processes.

Thematic analysis was adopted because it takes a flexible approach for conducting data analysis inductively or theoretically (Braun and Clarke, 2006). Since it was important for the research

questions to be answered, the developed themes were premised on the conceptual framework. Before the thematic analysis occurred, the recorded interviews from 23 participants in case utility one were first of all transcribed based on the following 8 key headings key stakeholder, key challenges, key enabling factors, existing policies and actual practices, key management processes, key performance indicators, the maturity of management processes and key areas for improvement which were elements of the conceptual framework. After all 23 interviews were transcribed in utility one, the research went over the data collected and re-read the transcripts and made notes of any initial interesting ideas.

The next phase was to sort the data systematically which was where the process of sorting the data into initial codes became useful. Any interesting idea under each of the 8 headings was labelled with a code that best describes the idea. For example, for the key stakeholders, descriptive codes like staff, customers were codes under the key stakeholders and any data set relating to these codes were gathered together. This process was repeated until codes had been developed under the 8 headings. The researcher kept an open mind when coding at this stage so as not to miss out on any relevant information.

Additionally, the initial coding process occurred as data was being collated to allow so changes could be made to the interview questions so more relevant information could occur. For the research purpose, In vivo coding, process coding and value coding and theming the data. These coding strategies are stated by (Saldaña, 2015) to be appropriate for answering how and what research questions. In Vivo coding, process coding and value coding also helps the research stay attuned to participant perspectives and actions (Saldaña, 2015).

After the initial codes had been developed the next step was to merge similar codes into potential themes. This was done by collating codes that had the same characteristics or were talking about ideas that were related still under the 8 headings. This process was necessary for synthesising the data and reducing it into smaller chunks. All relevant data under the potential themes were gathered together. The potential themes that emerged under each of the 8 headings were then reviewed to see if they worked in relation to the codes extracted. This same analysis process from the transcription to reviewing potential themes was repeated for the 23 participants in case utility 2, the 9 participants in utility 3 and the 6 participants in utility 4.

After the thematic analysis for all the 4 utilities had occurred. The next step was to do a cross-case analysis. Cross case analysis are either case-oriented strategies or variable-oriented strategies (Liamputtong, 2013). For the purpose of the research, a case-oriented strategy was

adopted. This involves studying one in great detail, then successive cases are examined to see whether the pattern found matches that in previous cases (Miles et al., 2020). Prevalent themes that were found in all the four utilities were compared for each of the 8 headings (elements of the framework). Any themes that emerged from up to 50% of the respondents from all utilities. Results from this phase led to the development of key theme and concepts which were used for developing the management framework that was meant to suit the Nigerian water sector.

6.3.5 Sampling Procedures

Sampling is defined by Given (2008) as a process for selecting actual data sources from a larger set of possibilities.

The question of who data will be gotten from is normally addressed in sampling. According to (Maxwell, 2012) two major issues are usually addressed in this component which are:

- The relationship that should be established with the participants in the study
- The selection of the research settings, participants, times and places of data collection

(Bryman, 2015, Bryman and Bell, 2015, Burns, 2000, Sarantakos, 2012, Saunders et al., 2015, Creswell and Clark, 2011) categorise sampling techniques under probability and non-probability sampling. Probability techniques include simple, stratified systematic, multistage and cluster sampling methods. Probability sampling is usually used for quantitative research while non-probability sampling or purposive sampling is commonly adopted in qualitative research where researchers select a sample based on their judgement (Bryman, 2015, Given, 2008, Robson and McCartan, 2016, Creswell and Clark, 2011). Unlike probability sampling, where each participant has an equal chance of being selected, participants selected using the nonprobability sampling technique are chosen because they meet certain criteria.

Qualitative methods are, for the most part, intended to achieve a depth of understanding while quantitative methods are intended to achieve a breadth of understanding (Cooper and Schindler, 2008, Creswell and Clark, 2011, Patton, 2002, Palinkas et al., 2015). Qualitative studies offer a “mirror-like” view on the specific situation or phenomenon being studied (Mays and Pope, 1995). Because minimizing bias and maximizing generalizability are not the primary goals of qualitative research, proponents have asserted, quantitative sampling techniques cannot be transferred directly to qualitative research (Higginbottom, 2004, Koerber and McMichael, 2008).

6.3.5.1 Selected Sampling methods

For the purpose of this study, purposive sampling was used in selecting the participants of the study. Purposeful sampling means that the researcher is looking for participants or cases that possess certain traits or qualities. The researcher considers the research purpose and research questions and selects samples accordingly (Coyne, 1997, Teddlie and Yu, 2007, Luborsky and Rubinstein, 1995).

There is no general consensus regarding the types of sampling techniques for carrying out qualitative methods. According to (Liamputtong, 2013, Patton, 2002, Sandelowski, 2000) all sampling methods for qualitative studies are purposeful. Patton (2002) identifies 15 types of sampling methods for qualitative research. (Bryman, 2015, Bryman and Bell, 2015, Burns, 2000, Sarantakos, 2012, Saunders et al., 2015, Miles and Huberman, 1994, Luborsky and Rubinstein, 1995) states qualitative sampling techniques include purposive, quota, convenience and snowballing sampling. (Marshall, 1996) categorises purposive sampling as convenience, judgemental and theoretical sampling. However, categories outlined by (Liamputtong, 2013, Teddlie and Yu, 2007, Patton, 2002) which are comparative, special, sequential and multipurpose cases are central to the research.

For the purpose of the study, a combination of maximum variation sampling and criterion sampling was adopted for recruiting the research participants and selecting the case utilities. Maximum variation is comparative sampling method. (Liamputtong, 2013, Teddlie and Yu, 2007) argues for its adoption when the research is focused on selecting a sample that will characterise a broader group of cases or compare different categories of cases. Maximum variation sampling involves finding heterogeneous samples across wider sample groups. It aims at capturing and describing the central themes that cut across a great deal of variation. Maximum variation sampling framework was developed to include variables such as gender, qualification level, work designation and years of experience and organisation level (strategic, operational and tactical level).

Efforts were made to ensure that participants came from a range of technical, managerial, commercial, financial and social backgrounds. Participants from different work fields within each case utility were sampled to get rich information regarding how people with various designation types managed the different asset types they worked with.

Maximum variation sampling was also used for selecting the 4 case utilities this was required to ensure all the four factors impacting performance in the Nigerian utilities were looked into

as not all cases were impacted by all issues analysed in the literature. In selecting the case study utilities, variables such as geographical location, level of performance and maturity, years of existence, population served, size of the organisation, institutional framework, and nature of the organisation (water and sanitation utility versus water utility) were taken into consideration for the sampling framework.

Criterion sampling is part of the unique cases group and (Liamputtong, 2013, Teddlie and Yu, 2007) states it should be used when a specific group of cases are the major focus of investigation instead of the issues. On the other hand, criterion sampling is the selection of cases that meet a predetermined specific criterion that is crucial for the research. This technique will allow researchers to select those who can provide rich information relevant to the research project. Criterion sampling was also required when selecting research participants. The criterion sampling framework was based on selecting participants who were the senior-level staff that had a wealth of experience in the water industry. Staff with over 10 years of experience was participants selected for research because the researcher believed these participants could offer rich information regarding the organisation's management processes and ways in which the organisation was run and their people, infrastructure, finances and information was managed.

Theoretical sampling is a sequential sampling technique that should be selected when cases are selected based on their relevance to the research questions (Liamputtong, 2013, Patton, 2002, Teddlie and Yu, 2007). The 4 case utilities were also selected based on their ability to test theory propositions put together in the conceptual framework. Theories on asset management, good urban water management for African countries and the urban water sector were proposed in the conceptual framework and the four utilities selected based on the proposition that asset management could be adapted to different utilities in the Nigerian context.

6.3.5.2 Sample size

The general aim of sampling in qualitative research is to acquire information that is useful for understanding the complexity, depth, variation, or context surrounding a phenomenon, rather than to represent populations as in quantitative research (Gentles et al., 2015, Coyne, 1997, Teddlie and Yu, 2007, Luborsky and Rubinstein, 1995).

The major focus when deciding an appropriate sample size in qualitative research is whether the sample provides enough data to answer the research questions thoroughly (Marshall, 1996, Liamputtong, 2013, Patton, 2002, Koerber and McMichael, 2008). There is no set formula to

apply when determining the sample size for qualitative research (Liamputtong, 2013, Patton, 2002). The number of samples is adequate when the quality of data is optimal and there is sufficient data to account for all aspects of the phenomenon being investigated.

The commonly proposed criterion for determining when sufficient sample size has been reached in qualitative research is saturation (Gentles et al., 2015, Luborsky and Rubinstein, 1995, Marshall, 1996, Liamputtong, 2013, Patton, 2002, Onwuegbuzie and Leech, 2007). Saturation has also become widely recognized as a guide or indicator that sufficient data collection has been achieved (Gentles et al., 2015). Saturation refers to obtaining detailed knowledge by continuing to sample until no new substantive information is acquired (Miles and Huberman, 1994, Bernard, 2006, Bernard et al., 2016, Palinkas et al., 2015, Gentles et al., 2015).

Data saturation is used by qualitative researchers as a way of justifying the number of research participants during the data collection process (Luborsky and Rubinstein, 1995). Saturation occurs when new data no longer emerges during the data collection process. Other factors include the scope of the research questions, the nature of the research questions and the amount of useful information gained from each participant or research resource. The focus of the sample size in qualitative research is on flexibility and depth.

In general, sample sizes in qualitative research should not be too large that it is difficult to extract thick, rich data. Also, the sample should not be too small that it is difficult to achieve data saturation, theoretical saturation, or informational redundancy (Onwuegbuzie and Leech, 2007). Whereas quantitative research requires sufficiently large sample sizes to produce statistically precise quantitative estimates, smaller samples are used in qualitative research.

Purposive sampling is flexible and at the start of the project, the number of participants to be recruited is not known in contrast to quantitative sampling where sample sizes are predetermined (Marshall, 1996, Liamputtong, 2013, Patton, 2002, Gentles et al., 2015). In the research, informational redundancy occurred after a total of 4 cases studies were conducted. New themes stopped emerging while interviews were conducted in the 4th case utility and an acceptable interpretative framework was constructed after 61 interviews the stage of thematic and theoretical saturation. In addition, it was necessary to conduct multiple case studies for addressing any element of bias which occurs in qualitative research and also to ensure that the data was driven by participants and not by the notion of the researcher.

6.3.5.3 Research setting and participants

Qualitative studies cannot avoid the difficulties of selecting research sites and participants (Charney, 1996, Koerber and McMichael, 2008). In purposeful sampling, an important guiding principle is maximum variation; where cases recruited to represent the widest variety of perspectives possible within the range specified (Higginbottom, 2004).

Purposeful sampling can only be successful when cases selected are diverse enough to represent the variation known to exist in the population being studied. Hence the researcher ensured that the four utilities selected were diverse enough to represent the variation known to exist for the Nigerian urban water context.

The ultimate aim of the research was to develop asset management adaptable to a developing African urban water context. The study covered four (4) utilities to ensure that the attained results were reliable, valid and transferable to other Nigerian utilities. Consent was sought at an organizational level for the utilities. Since the research settings needed to be characterised by the context of the Nigerian urban water sector established in section 4.3 of the literature, the researcher ensured that case utilities selected varied in terms of their varying capacity in governance, infrastructure, manpower, available financial resources, customer orientation, electricity generation and data management. As shown in Table 2 of appendix 5 Utility one and two have larger infrastructure compared to utilities 3 and 4. Utility 2 and 3, on the other hand, have existing laws and regulatory commission while only Utility 3 has a policy document established. Utility 4 had only just reformed the law as at the time the study was conducted and Utility one was not established by the law and thus dependent on the National bill to be passed. Utility 4 performed better in terms of service coverage and collection compared to other utilities. Utility one performed better in terms of non-revenue water and cost recovery.

After selecting a research site, the researcher can also use purposeful sampling to select participants from that site (Koerber and McMichael, 2008). When recruiting participants it is important to select information-rich informants that cover the range of variation required for creating a representative sample. In addition, an iterative approach of sampling and re-sampling to draw an appropriate sample is usually recommended for achieving theoretical saturation (Miles and Huberman, 1994, Palinkas et al., 2015)

Research participants across the four utilities were recruited between November 30th 2015 to January 31st 2016. Around November, introductory letters were sent out specifying details of the research and participant requirements in terms of the level of experience from ten years and

above, at least one participant from one department and variety of participants from different staff levels ranging from managerial to tactical and operational levels. Seventy-five (75) senior-level water professionals in the different utilities were invited to take part in the study through personal invitations.

Only sixty-one (61) respondents took part in the study while the remaining fourteen (14) respondents were unable to attend the interviews even after much follow up due to busy schedules and unforeseen circumstances. The profile of interviewed participants is shown in Table 7.1 in appendix one. The organisational structure of the 4 case utilities shows various designations and fields of the selected respondents as shown in Figures 1-4 of appendix 5.

Amongst the participants who took part in the study, 13 out of 61 participants were in commercial, financial and customer care departments, 4 out of 61 participants were human resources department and were responsible for staff management and administration, 34 out of 61 participants were in technical departments like Production, Distribution and Quality/Operations. 5 out of 61 participants were in project management departments responsible for projects, 3 out of 61 participants were responsible for management information while 2 participants were in rural water and sanitation departments. Also, 23 participants were interviewed in utility one, 23 respondents were interviewed in utility 2. There were also 9 respondents interviewed in utility 3 while the remaining 6 respondents were interviewed in utility 4. In addition, a majority of respondents were male (73%).

A crucial point in qualitative research is to select the research participants meaningfully and strategically instead of attempting to make statistical comparisons or to create a representative sample (Liamputtong, 2013, Patton, 2002). Purposeful sampling involves identifying and selecting individuals or groups of individuals that are especially knowledgeable about or experienced with a phenomenon of interest (Patton, 2002, Gentles et al., 2015).

The years of experience of participants and levels were considered for ensuring participants provided the required information needs for the operational activities of the 4 utilities. Amongst the interviewed personnel in the four utilities, 34% were heads of departments, 40% were senior-level staff responsible for decision making at the tactical level of the organisation while 26% were junior staff at the operational level of the organisation responsible for the day to day activities. In terms of years of experience, 74% of respondents stated they had over 20 years of experience while 26% stated they had 10 to 20 years of experience.

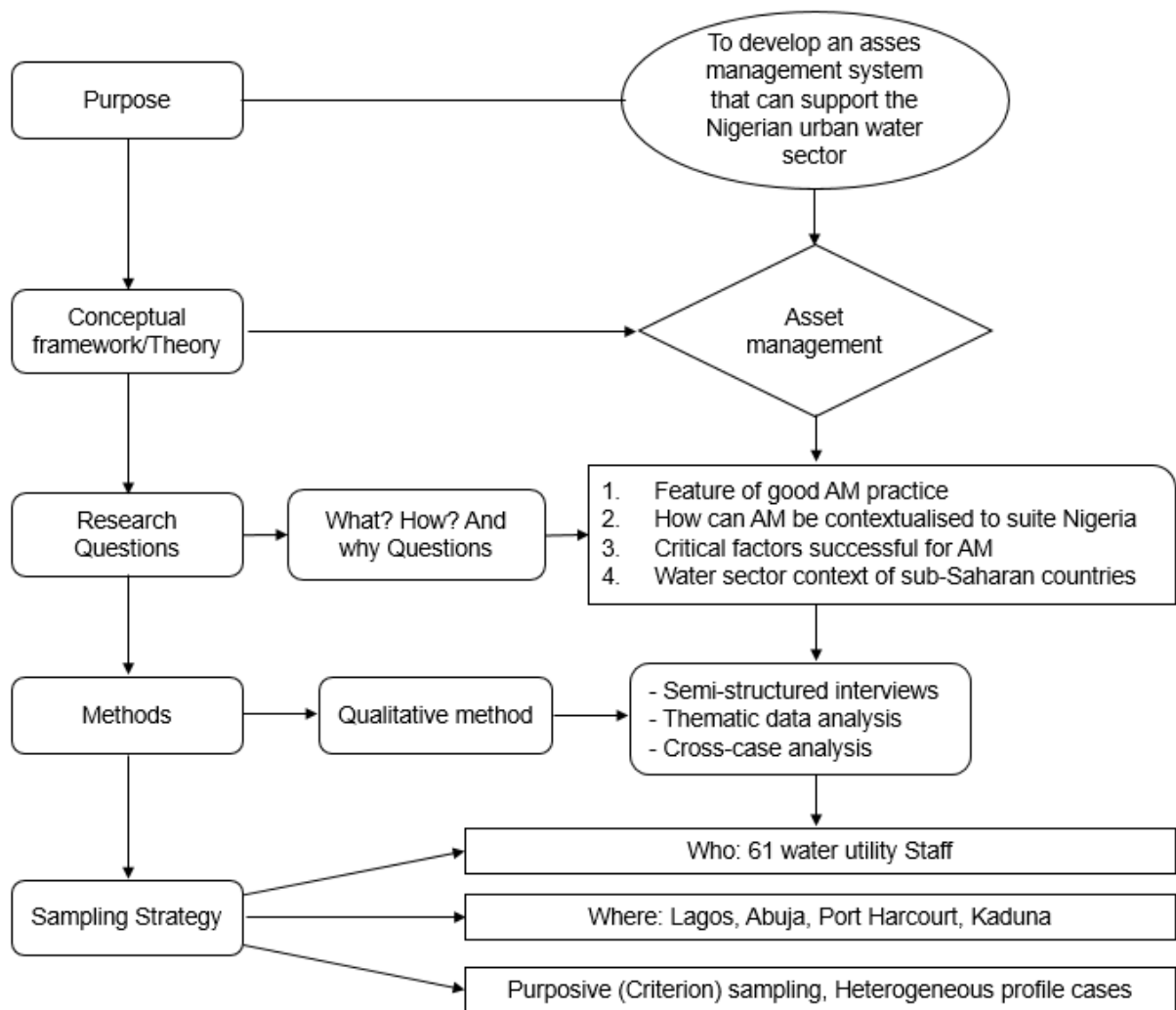


Figure 6.2: The Framework for the research based on the study context

6.4 Rationale for adopting Qualitative Research

Selecting a suitable research approach is not just based solely on quantification, or use of words but is about reflecting on the required knowledge stance and the research questions that need to be answered. These perspectives need to be carefully considered and analysed to justify the logic behind choosing specific methods (Mkansi and Acheampong, 2012, Onwuegbuzie and Johnson, 2006, Onwuegbuzie and Leech, 2004, Nyame-Asiamah and Patel, 2009, Morgan, 2007). Qualitative research is gaining momentum because of its ability to add a new dimension to interventional studies that cannot be obtained through the measurement of variables alone (Pathak et al., 2013). The qualitative research approach was adopted for this research based on the preoccupation characteristics emphasised by (Bell et al., 2018, Bryman and Bell, 2015) which are analysed below.

6.4.1 In-depth exploration of a phenomenon

Qualitative research is used to get deeper insights and meanings of events (Burns, 2000). It goes deeper than giving facts and it reveals the story behind numbers. It looks at X in terms of how X varies in different circumstances rather than how big is X or how many Xs are there (Anderson, 2010). Qualitative research offers deep insights and explores nuances related to the problem being investigated (Malterud, 2001). Quantitative research provides a narrow understanding for a phenomenon at hand while qualitative research helps to produce a more robust, well-grounded and rich description of the issue being investigated (Petty et al., 2012, Miles and Huberman, 1994, Boeije, 2009, Anderson, 2010, Miles et al., 2020, Ghauri and Grønhaug, 2005, Byrne, 2001).

Quantitative studies are better at testing hypotheses to demonstrate abstract principles and law-like relationships, while the qualitative studies are better at producing situated knowledge about how to understand and act in contextualized settings, based on deliberation about specific circumstances being investigated (Gunder, 2013, Flyvbjerg et al., 2012, Flyvbjerg, 2004, Flyvbjerg, 2001, Flyvbjerg, 2012, Flyvbjerg, 2006, Erickson, 2018)

To the knowledge of the researcher and based on a literature review search, previous studies on implementing asset management for the Nigerian water context are very few. Also, the extent to which asset management occurred in Nigerian water utilities was questionable as there was little or no literature on asset management in the Nigerian water sector. The research will, therefore, require an exploratory method that can provide an in-depth analysis in discovering hidden issues and complexities in the Nigerian context which will need to be incorporated into existing asset management theories so these theories can be modified to fit the Nigerian context. Based on the arguments developed by (Flyvbjerg, 2001, Flyvbjerg et al., 2012, Gunder, 2013, Flyvbjerg, 2012, Flyvbjerg, 2006) for focusing on issues of context, values, and power, for research on contextual factors, this research will, therefore, adopt the qualitative research method.

6.4.2 Holistic approach for considering a phenomenon

Richness and holism are core attributes of qualitative research. Qualitative data provides rich descriptions that are vivid, nested in the real context and have a strong potential of revealing complexity (Miles et al., 2020). Subtleties and complexities about the research subjects are discovered that are often missed by more positivistic enquiries (Pathak et al., 2013, Anderson,

2010, Silverman, 2017). This is because qualitative approach helps view the data more extensively because all series of events and variables that lead to actions are investigated completely (Pathak et al., 2013, Ghauri and Grønhaug, 2005, Harding, 2019).

The research is aimed at testing existing asset management theory for a developing African urban water sector using the Nigerian water context. The complexities involve adapting asset management to interdependent factors such as limited financial resources, ineffective governance, conditions, lack of infrastructure, lack of competencies, lack of data and different stakeholder interests. In section 3.1 these factors affect the Nigerian Urban water sector in different ways and the influence of each factor for adapting asset management to the Nigerian context will need to be studied in totality. (Anderson, 2010, Austin and Sutton, 2014, Sutton and Austin, 2015, Ticehurst and Veal, 2000, Thorpe and Holt, 2008, Daher et al., 2017, Zikmund et al., 2012, Zikmund, 2003) assert that qualitative research provides the opportunity for carrying out in-depth investigations that can look at an issue holistically which is why it was adopted for the research.

In addition, the research is focused on linking the management of all asset types impacting the Nigerian urban water. The research will incorporate a study looking at developing a process for managing people, infrastructure, information and financial resources. The influence of different assets cannot be easily be reduced to number or calculations. There are intricacies that and underlying factors that will need to be analysed which close-ended questions will be unable to provide a full picture of. The possibility of understanding latent, underlying and nonobvious issues is strong when using qualitative research (Miles et al., 2020, Bell et al., 2018, Bryman, 2015, Bryman and Bell, 2015, Creswell, 2013, Girod-Séville and Perret, 2001, Saunders et al., 2015, Ticehurst and Veal, 2000, Zikmund et al., 2012).

6.4.3 Seeing through the eyes of people being studied

The purpose of qualitative research is to describe and understand social phenomena in terms of the meaning people bring to them (Boeije, 2009). Qualitative research can help researchers to access the thoughts and feelings of research participants, which can enable the development of an understanding of the meaning that people ascribe to their experiences (Sutton and Austin, 2015). It strengthens field studies by enhancing user involvement in it. (Pathak et al., 2013)

Qualitative methods are concerned with how human behaviour can be explained, within the framework of the social structures in which that behaviour takes place (Austin and Sutton,

2014). In qualitative research, the researcher is trying to hear the voice of the participants which is missing in quantitative research. (Austin and Sutton, 2014, Sutton and Austin, 2015)

(Flyvbjerg, 2001) argues that conducting contextual studies is premised on studying human interactions that involve human consciousness, volition, power and reflexivity. Therefore, attempts to build generalizable, predictive models randomise controlled trials such as those for the natural sciences are misplaced and even futile (Flyvbjerg, 2001, Flyvbjerg, 2004, Gunder, 2013, Flyvbjerg et al., 2012, Erickson, 2018)

The Units of analysis in quantitative research are unable to attribute meanings to events and their environments but people do (Bell et al., 2018, Bryman and Bell, 2015). According to (Austin and Sutton, 2014, Sutton and Austin, 2015) qualitative research allows the voice of the participants to be heard. In addition, qualitative research enables the researcher to probe beneath the surface. With qualitative data, one can preserve chronological flow, see precisely which events lead to which consequences, and derive fruitful explanations. (Austin and Sutton, 2014).

While quantitative research methods can establish how many people undertake particular behaviours, qualitative methods can help researchers to understand how and why such behaviours take place. (Austin and Sutton, 2014, Sutton and Austin, 2015).

In addition, Anderson (2010) states that data gotten from human experience are usually powerful and sometimes more compelling than quantitative data. Focus on understanding from informants point of view while focusing on facts (Ghauri and Grønhaug, 2005, Burns, 2000) also states that since humans are conscious of their behaviours, their thoughts, perceptions and feelings are vital.

The research contextual factors are influenced by the actions of participants or organisations studied. The research tends towards a subjective approach which is found in qualitative research. Bearing in mind that the success of asset management interventions and processes is impacted greatly by the competence of people and key stakeholders who have a major influence in the urban water sector, interacting with personnel in the Nigerian urban utilities, having them share their experiences, their perspectives about what defines performance will go a long way in developing an asset management phenomenon that will fit the context of the Nigerian urban water sector. Qualitative research is therefore appropriate for carrying out the research.

6.4.4 Description and emphasis on Context

According to (Bell et al., 2018, Bryman and Bell, 2015) qualitative research lays emphasis on understanding the settings being investigated. It deals with understanding the social, political and economic factors that impact an organisations decision-making process. To understand a situation, Cohen et al. (2017) state that a researcher must understand the context both specifically and holistically because situations affect behaviour and perspectives and vice versa. In qualitative research, the influences of the context are not taken away but are taken into account (Orb et al., 2001, Miles et al., 2020, Malterud, 2001, Miles and Huberman, 1994).

Quantitative research excels at conducting decontextualized experiments to understand abstract and generalizable law-like relationships, while the social sciences can conduct contextualized studies involving field research that produces intimate knowledge of localized understandings of subjective human relationships, and especially in relation to the values and interests that drive human relationships (Flyvbjerg, 2012, Flyvbjerg, 2006, Anderson, 2010, Miles and Huberman, 1994, Ghauri and Grønhaug, 2005, Harding, 2019, Orb et al., 2001)

Critics for the use of qualitative approaches and social research argue that qualitative approaches have not provided the cumulative and robust evidence base for the development of relevant policy interventions (Clark, 2008, Flay et al., 2005, Goldacre, 2013, Nutley et al., 2007, Slavin, 2002, Torrance, 2008)

The role of evidence in aiding policy and practice is the result of several factors such as the growth of an increasingly and well-informed public, the explosion in the availability of all types, developments in information technology, the growth and size and capabilities of a research community, emphasis on productivity and international competitiveness and an increasing emphasis on scrutiny and accountability in government. (Davies and Nutley, 2000)

Randomised control trials in the view of many have become the basis for producing evidence-based research for testing policy interventions. (Davies and Nutley, 2000, Erickson and Gutierrez, 2002, Torrance, 2008, Labuschagne, 2003)

However for designing policies, randomised controlled trials and large scale surveys may be typically strong on general quantitative relationships but are relatively weak on the more finely grained understanding of specific context and meanings which individuals give to that context (Davies and Nutley, 2000, Erickson and Gutierrez, 2002)

Given that asset management improvement interventions are context-sensitive, one of the research questions the study aimed to answer was how to successfully implement asset management in a context characterised by failing institutions. Observing the context in which the utilities operate, and understanding how contextual factors (social, political and economic factors) impact actions like decision making is an important issue to be studied. Analysing the subject matter with quantitative research will not be possible because quantitative research methods employ natural science approaches which do not consider social, political, cultural and economic factors that affect participants, social actors or organisations which are meant to be studied.

The Nigerian urban water sector is unique when comparing it with countries with best practices in asset management. There are specific and unique characteristics which are evident in the Nigerian water sector different from major utilities with asset management best practices. It will, therefore, be interesting to understand the characteristics of the Nigerian water sector, understand how it differs from other countries and also understand how it impacts the performance of water utilities. Qualitative research as previously described allows for studying the context of the study being conducted and thus its use in this research is justified. The research will be better off through an in-depth investigation of the Nigerian urban water context rather than making assumptions that performance systems designed for water sectors with best practices can function perfectly in the Nigerian context. This is because there is a high risk of such systems being unadaptable to the Nigerian context and if this occurs it will inevitably affect the outcome of the research.

6.4.5 Flexibility

According (Asselin, 2003) the research design of qualitative studies is flexible and iterative, and the process is creative and intuitive. Qualitative research has an emerging nature. Interviews are not restricted to specific questions and can be guided by the researcher in real-time. The research framework and direction can be quickly revised as new information emerges. (Anderson, 2010)

The element of flexibility is required to creatively adapt asset management theory to suit the Nigerian context which differs from developed countries where asset management has been developed previously. Also, flexibility was required for the sampling process to achieve data saturation. The interviews were semi-structured and flexible so elements of probing could occur to elucidate accurate and detailed information from participants.

6.5 Research Method

According to (Saunders et al., 2015), there are 7 key strategies which can be employed in research. They include experiments, survey, case study, action research, grounded theory, ethnography and archival research. Experiments and survey are widely used for quantitative research (Leavy, 2017) while the remaining strategies are associated with qualitative research.

The experimental or scientific method seeks to investigate the impact of an independent variable on a dependent variable as measured by observable outcomes (Hammond and Wellington, 2012). The essential feature of experimental research is that the research controls and manipulates the context which determines the events being studied introduce an intervention and measures the difference that it makes (Cohen et al., 2017). It involves studying casual links and changes between the value of one variable and observing the effect of the change on another variable.

Experiments are usually associated with natural sciences and quantitative method and will not apply to the research. Normally experiments are used for testing hypothesis derived from literature as stated by (Hammond and Wellington, 2012). The experimental method will therefore not be feasible for this study which seeks to develop the theory on how best to implement asset management in a context characterised by failing institutions which will require a good level of flexibility.

A survey is predominantly used for quantitative research and most times answers who, what, where, how much and how many questions (Saunders et al., 2015, Robson and McCartan, 2016). Survey research refers to the systematic collection of data from a survey population (Hammond and Wellington, 2012). It relies on asking people standardized questions which can be analysed using descriptive and inferential statistics (Leavy, 2017, Saunders et al., 2015). Surveys are commonly used for market research, polling on political issues and a census (Hammond and Wellington, 2012, Leavy, 2017). However, a survey will not be used for the purpose of this research because it is usually associated with the deductive reasoning of testing theories. The research as previously specified made use of the qualitative method and while testing existing asset management theory. Ethnography, action research, archival research and grounded theory are strategies related to qualitative research methods (Saunders et al., 2015).

Ethnography connotes long term residence with an individual, group or specific community (Cohen et al., 2017, Saunders et al., 2015). The main purpose of ethnography is to produce a very rich description and interpretation of the culture and social structure of a social group

(Robson and McCartan, 2016). The researcher is immersed completely in the world of the research subjects being studied (Hammond and Wellington, 2012, Robson and McCartan, 2016, Saunders et al., 2015) Ethnography was not adopted for the purpose of the research because it is very time-consuming (Hammond and Wellington, 2012, Saunders et al., 2015), and the feasibility of becoming a full member of a social group is difficult and requires full access and trust. Secondly, ethnography is not adopted for this research because personal biases can occur since the researcher is immensely involved in the world of the research subjects.

Action research is defined by (Berg and Lune, 2012) as a kind of collective self-reflective enquiry undertaken by participants in a social relationship with one another to improve some condition or situation in which they are involved in. Action research seeks to address social and professional problems through an iterative cycle of action and reflection (Hammond and Wellington, 2012). Action research starts from a vision of social transformation and aspirations for greater social justice for all (Somekh, 2005, Carr, 2006). Crucial elements for action research include a collaborative process between the researcher and research participants, a high level of reflexivity and sensitivity to the role of self during the research process (Checkland and Holwell, 1998). Action research is uniquely suited for researching the processes of change and innovation (Somekh, 2005, Carr, 2006, Hammond and Wellington, 2012). The self-reflective nature and collaborative elements of action research are the major reason why it was not be adopted for the research.

The grounded theory according to (Saunders et al., 2015, Cohen et al., 2017) places a lot of emphasis on developing and building theory grounded in data which has been systematically collected and analysed. It is an inductive approach that attempts to generate theory from the constant comparing of unfolding observations (Babbie, 2013, Silverman, 2017, Babbie, 2017).

Grounded theory is criticised by (Cohen et al., 2017) for oversimplifying complex meanings in data by focusing on the immediate, apparent and observable issue at hand. It is also criticised by (Cho and Lee, 2014) because a predefined research sampling process is lacking and there are also issues with anticipating the length of the research period. Hence grounded theory was not adopted for the research. The case study method, however, was adopted for this research and details of the rationale for adopting case study as the preferred method is analysed in the section below.

6.5.1 Adopted Research Method - Case Study

Simons (2009) defines the case study approach as “an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used.” It is an exploratory study which deals with addressing particularities, uniqueness and complexities of cases and gaining a major insight about the importance of these features within an important context.

The case study thus offers an example from which the experience and phronesis of people provide an avenue where deep insights about a problem are gained. (Thomas, 2010)

Thus the case or cases based on their unique attributes are the main subjects of the inquiry (Stake, 1995). It also privileges an explicit and detailed inquiry rather than coverage thus the investigator understands the case rather than generalizing findings to the population at large (Stark and Torrance, 2005).

Firstly, it privileges an in-depth understanding and detailed exploration of a case rather than coverage/generalisation to the population at large. (Bernard et al., 2016, Burns, 2000). The context of Nigeria is unique based on the analysis of previous countries which have successfully implemented asset management as literature established that proper institutional, legal and regulatory platforms existed unlike in Nigeria. The research will be better off through an in-depth analysis of the Nigerian urban water context rather than generalising and assuming that what works in developed countries can work in the Nigerian context. Researching 36 utilities within the time frame given for the research will be labour intensive and almost impossible. Thus through the selection and detailed analysis of unique cases which vividly exhibit the important features apparent to the Nigerian scenario, it is expected that the research problem will be addressed.

Secondly, various data collection methods can be employed in a case study method. It also relies on multiple sources of evidence with data needing to converge in a triangulating fashion (Stake, 1995, Stark and Torrance, 2005, Thomas, 2011, Yin, 2013, Burns, 2000)

The luxury of carrying out interviews, observations and document analysis simultaneously is feasible with fewer cases which typify the research problem than in 36 Nigerian utilities.

Also, the case study methodology provides a rich perspective of a phenomenon as it is being looked at from different angles. It also offers an opportunity for studying particularity and complexity (Stake, 1995, Stark and Torrance, 2005, Thomas, 2011, Yin, 2013, Burns, 2000)

The complexities in the Nigerian urban water sector which could hinder the successful application of the asset management framework can be assessed critically with the case study method which offers an opportunity for studying particularity and complexity.

Real-life situation and context can be taken into consideration especially where boundaries between phenomenon and context are not evident. It copes with the technically distinctive situation in which there are more variables of interest than data points (Stake, 1995, Stark and Torrance, 2005, Thomas, 2011, Yin, 2013, Burns, 2000)

Other methods like the survey method and experiments do not consider the external context as they see it as noise and assumptions are made that tests are made under a controlled environment (Stake, 1995, Stark and Torrance, 2005, Thomas, 2011, Yin, 2013, Burns, 2000).

Thus identifying how asset management can be implemented in the Nigerian context will require an approach which will critically assess the external social, cultural and political factors without boundaries.

Even though there are strengths attributed to using the case study method, there are weaknesses which have been established by some school of thoughts. Hitherto many strengths in qualitative research and the case study approach have been identified it is also important to note that there are inherent weaknesses which critics have established analysed below.

Case study research has been undermined by many for lacking the opportunity for generalisations and thus cannot contribute to scientific development. (Saunders et al., 2012, Simons, 2009, Stake, 1995, Stark and Torrance, 2005, Thomas, 2011, Yin, 2013) as a method which not good for scientific/ statistical generalisation.

Secondly, the use of case studies has been stated by (Burns, 2000, Bryman and Bell, 2015) to lack transparency because researchers most times find it difficult to show how they arrived at their findings and study conclusion. They have also been criticised to lack rigour, and contain a bias towards verifying the researcher's preconceived notions (Flyvbjerg, 2011).

Additionally, they have also been criticised for being only suitable for pilot studies and not main studies as they are stated to only be useful for generating theories and not testing theories which are only considered to be the first half of the research.

However, these weaknesses can be addressed and eliminated in the following ways. The research questions were detailed to show how the research problem will be resolved. Secondly, the conceptual framework which was used to test all the case studies was developed in line

with the research questions. The case studies also answered the same research questions which were major “how” questions. In addition, the procedures for collecting and analysing data sources the interviews and thematic analysis were used consistently for all the case studies.

To eliminate bias, an interview guide shown in section 6.8.1 was employed for testing respondents in all the four utilities. Additionally In vivo coding which was one of the 1st cycle coding elements employed was used for retaining the voice and perceptions of participants. Furthermore, a verification exercise and validation exercise was conducted to ensure the findings were credible, easily replicated and transferable.

With regards to statistical generalization, (Yin, 2013) states that case studies are generalized to theoretical propositions i.e. analytical generalizations and not statistical generalisations. Thus the unit of analysis defines the case that is to be studied. Therefore, the cases selected should vividly represent the scenario that is being investigated. The selected 4 utilities which give a good representation of the uniqueness of the Nigerian water sector are considered below in great detail.

The research made use of a multiple case study where several cases precisely 4 cases were used for replicating the asset management theory in the selected case utilities. The cases selected were different so they could be contrasted for achieving a good level of theoretical saturation. Different cases were also selected so that a good level of maximum variation could be achieved to adequately represent all characteristics defining the Nigerian urban water sector.

The 4 cases were studied to understand the similarities and differences between each case while testing the asset management theory on the Nigerian urban water context. Each of the four cases is tested using the conceptual framework that was developed based on asset management literature, the good practices literature and the Nigerian water sector literature. The theory propositions tested were as follows

- Asset management can be adapted to the Nigerian urban water sector when all asset types are actively managed,
- Asset management can be adapted to the Nigerian urban water context when existing risk management processes can tackle contextual issues, stakeholders interest and risks related to managing all asset types simultaneously.
- Asset management can be adapted to the Nigerian urban water context when performance measures are in place to evaluate the management process outlined 1 and 2.

- Asset management can be adapted to the Nigerian urban water sector where contextual factors are integrated into the asset management system.

The conceptual framework was used as a guide for carrying out the fieldwork and data collection in each of the case utilities. The profile of the four cases showing their differences in terms of institutional capacity, infrastructural capacity, financial viability, service coverage are detailed in the next section.

6.5.2 Case study profiles

There are currently 36 states in Nigeria. Out of the 36 states, four states were selected based on their ability to truly representing what characterises the Nigerian urban water sector. These states provide the best available example for implementing asset management in developing African context, due to evident challenges such as Rapid Urbanisation, population growth, policy, governance, human and institutional challenges, economic scarcity were previously highlighted as major challenges applicable to African countries and Nigeria. The 4 cases selected for the research are discussed below and key features which make them suitable cases are discussed below.

6.6.2.2 Case-study profile one – Abuja

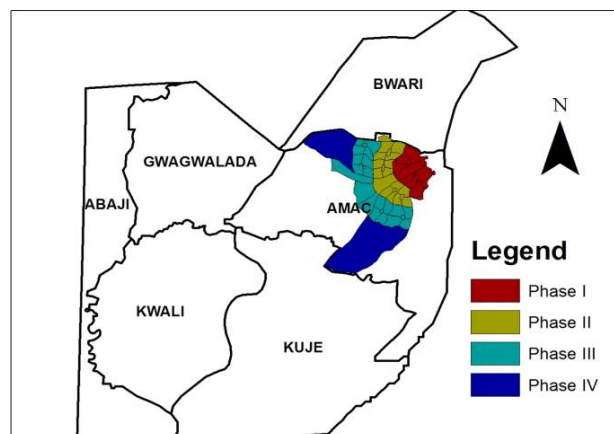


Figure 6.3: Map of Federal Capital Territory.

Source: (Abubakar, 2014)

Abuja the capital of Nigeria is situated in the north-central region of Nigeria and is the country's 3rd most populated city after Lagos Kano and Ibadan. Its rapid urbanisation rate of 8.32% makes it the fastest growing city in Africa and is projected to be regarded as a megacity by 2018 with a population of over ten million. The capital city is a strategic city as it is home for most of the

headquarters for government bodies and public agencies governing the affairs and various sectors of the country (Ojo, 2011).

The initial plan for Abuja was for it to be a city that was well planned with state of the art infrastructure making it one of the purpose-built and wealthiest cities in the country, however, the government had not anticipated the rapid influx of migrants from Lagos and other states. This has increased informal settlement and slums in satellite towns like Karu, Kubwa, Kuje and Gwagwalada with poor social amenities like water supply and sanitation.

FCT water board which is a self-regulating body provides water supply services through an administration of a headquarter and 10 service areas(Ojo, 2011). This city's water master plan was initially designed to meet a population of 3.2 million at a production capacity of 1400 MLD. A water scheme that consists of 4 phases of treatment plants with 10 reservoir tanks. Currently, 2 phases of the water treatment plant have been completed along with 5 out of the reservoir tanks. The city's water supply is also supported by two major dams with a combined reservoir capacity of 950 million cubic meters. Rapid population growth and rapid urbanization have however caused a water demand deficit as the utility currently operates at a production capacity of 720MLD (Enang et al., 2016).

FCT water board has been selected because it has an existing Master plan, its performance in non-revenue water and cost recovery compared to other utilities. Its large infrastructure and production capacity has also been reasons why it has been selected. (Mansour et al., 2015)

In line with the main functions and mandate of utility one, the organisation is structured into 7 major departments namely Reservoir and productions; Distribution, rural and water supply and sanitation; Finance and Accounts, Commerce, Administration and Supplies and Quality Control (Fig 7.1 in Appendix). The organisation also has 7 stand-alone units which are shown in Fig 7.1 of appendix 7. They include Planning Research and Statistics, Public relations, Procurement, Servicom, Internal Audit, Legal and Management Information system unit. The profile of interviewed participants is shown in Table 7.1 in the appendix.

6.6.2.1 Case study Profile Two: Lagos state

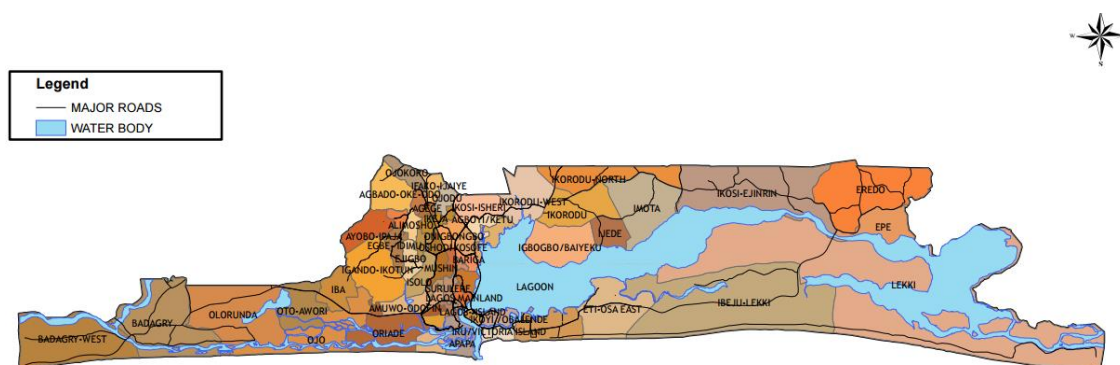


Figure 6.4: Map of Lagos State.

Source: (Ojuri and Bankole, 2013)

The city of Lagos which is a coastal region situated in the western part of Nigeria is surrounded by abundant water bodies such as lagoons, creeks rivers and the Atlantic Ocean which is more than enough to meet the demands of its current population of 20 million. Many parts of the city are even flooded during the peak period of the wet season due to heavy rainfall, very high tides, poor drainage systems and a lack of urban planning.

Lagos is a good case for a state which shows an area where water security is greatly impacted by the rapid rate of urbanisation and increasing population growth (Jideonwo, 2014, Oyegoke S. O., 2012). It is classed as a megacity with a population of twenty million which is over ten million and is projected to be 29 million making it the world's 3rd mega city after Beijing and Mumbai by the year 2020. It is Nigeria's industrial and commercial hub which Okusipe (2003) identifies as being attractive to migrants from other states that are increasingly settling into the city for a better means of livelihood. Lagos state water corporation which is regarded as the largest water corporation in Nigeria is tasked with a mandate of providing potable water services to a population of about 20 million.

It is the largest water corporation in Africa with total assets worth 40.43 billion Naira and it has 11 service operation areas (Jideonwo, 2014, Balogun et al., 2017). Currently serves the system with 3 major water schemes and 48 micro/ mini-water schemes with a total production capacity of 240MGD which is less than half of the total population demand. The utility has therefore been selected because of large infrastructure assets it has compared to other utilities.

Provision of potable water services by the case utility has been in existence since 1910 and has been selected because it has been the oldest utility in existence compared to the other case utilities. Utility two has also been selected because it has a few institutions in place a water law and an existing state water regulatory commission. Also, the water corporation has been corporatized by law to be autonomous. Lagos state has also been selected because it has an existing master plan which could serve as a potential means of systematically implementing the management processes slated in the conceptual framework. The few strengths highlighted in terms of large infrastructure base, existing institutions and years of existences and being corporatized are reasons why utility two has been selected.

In line with the main functions and mandate of utility one, the organisation is structured into 7 major departments namely Reservoir and productions; Distribution, rural and water supply and sanitation; Finance and Accounts, Commerce, Administration and Supplies and Quality Control (Fig 7.1 in Appendix). The organisation also has 7 stand-alone units which are shown in Fig 3 of appendix 5. They include Planning Research and Statistics, Public relations, Procurement, Servicom, Internal Audit, Legal and Management Information system unit.

6.6.2.3 Case-study profile 3 Rivers State

Rivers state is a coastal city located the south-south Geo-political zone of Nigeria surrounded by the Atlantic Ocean in the north and bounded by other Niger-delta states in the country. The state capital city is Port-Harcourt and it is a hub for major oil refineries for the country (Obinna et al., 2010, Ekiye and Zejiao, 2010). As the name of the city implies it is surrounded by major rivers and the Atlantic Ocean however the city is plagued by water supply shortage especially in its major urban centres which are Port Harcourt and Obio/Akpor.

Previously responsibility of urban water services and rural services was vested on rivers state water board which performed inefficiently. Only 15% of Port-Harcourt's population have access to schemes run by their water utility.

Ownership of water schemes is also unclear as so many bodies have developed borehole schemes due to the inefficiency of the water corporation (MWRRD, 2012). Port-Harcourt has been selected is the only utility that has attempted to combine sanitation with the existing water service and currently has a sewage treatment plant where tankers bring sewage for treatment. Port-Harcourt has also been selected there are existing institutional elements such as state law, state policy and a regulatory commission.

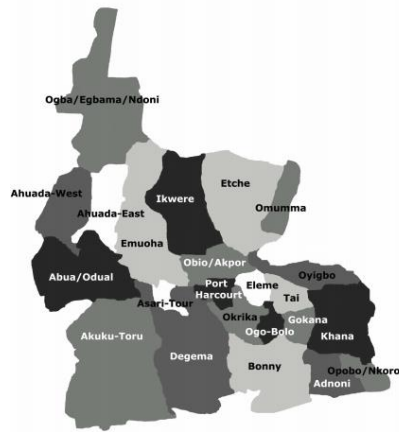


Figure 6.5: Map of Rivers State.

Source: (Nwauzoma & Dappa, 2013)

Recently an urban water sector reform has been established to address the inefficiencies in the urban water sector in Port Harcourt. The Rivers state water board responsibilities were reviewed and a newly created corporation which is Port-Harcourt Water Corporation for urban water supply came into existence (MWRRD, 2012, World Bank, 2014b). Port-Harcourt has been selected because it is a relatively new corporation that is currently looking to expand its service and get more customers connected (MWRRD, 2012, World Bank, 2014b).

Examining how asset management can be implemented following the establishment of new regulatory, institutional structures are timely as some level of organisational change as occurred. Port-Harcourt is, therefore, a good case to be studied based on the strengths of existing institutions and sanitation facilities. The organisation is structured into 8 major departments namely Administration and HR, Finance and Accounting, Projects and Planning, Commercial and Business Development, Water Operations, Waste Water Operations, Legal and public relations as shown in Figure 1 of Appendix 5.

6.6.2.4 Case Study Profile 4 – Kaduna State

A major city located in the northwestern part of Nigeria with a population of about 1.8 million, and a major hub for trade, transportation and textile. It is strategically situated and serves as a link between other northern states and the capital city of the country. The state has 12 waterworks which only serves 95% of its urban population based on 2012 performance targets specified by (Chiori, 2018, Macheve et al., 2015, World Bank, 2014b). The legal instrument governing the state is the Kaduna State Water Supply and Sanitation Law 2004, and it was recently reformed and approved in 2016. There is no developed policy instrument however the

law states its State policy is outlined in the previously identified mission and vision statement. Kaduna state was selected as a case based on its good performance in financial viability and service coverage from performance measures of (Chiori, 2018, Macheve et al., 2015, World Bank, 2014b)

The Kaduna State Water Board (KSWB) was first created through an edict in 1971, Edict No.2 of 1971 (Kaduna State Government, 2016). The KSWB is made up of Nine (9) key departments, namely; Administration, Finance, Operations, Commercial, Projects, Corporate Planning, Audit, Quality Control, and Special Duties as shown in Figure 2 of Appendix 5.

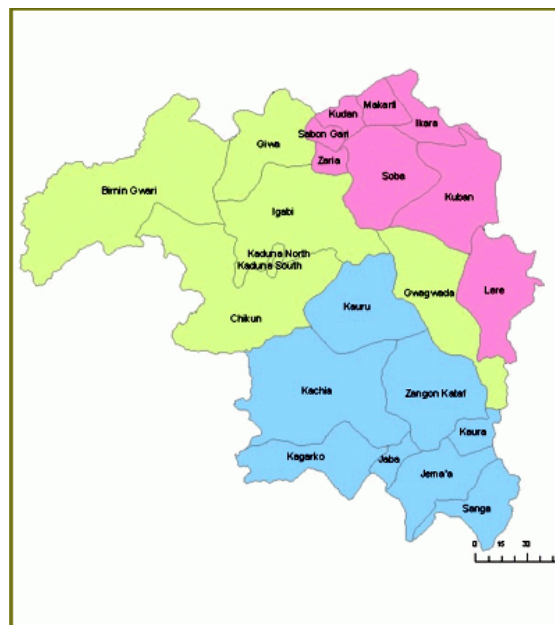


Figure 6.6: Map of Kaduna State.

Source: (Yunusa et. Al, 2013)

6.6 Measuring Research Rigour - credibility, transferability and confirmability

Without rigour, research is worthless, becomes fiction, and loses its utility (Morse et al., 2002). The most predominant criteria for evaluating the rigour and trustworthiness of qualitative research are credibility, transferability, dependability and confirmability (Byrne, 2001, Morse et al., 2002, Korstjens and Moser, 2018).

Credibility is defined as the confidence that can be placed in the truth of the research findings (Korstjens and Moser, 2018, Lincoln, 1985). It establishes if the research findings represent plausible information drawn from the original data of the research participants. It also determines if the research findings represent the correct interpretation of the original views of

participants. Credibility is equivalent to internal validity and is concerned with the aspect of truth-value. (Zikmund, 2003, Neuman, 2013, Lincoln, 1985, Seale, 1999).

Transferability is the degree to which the results of the research can be transferred to other contexts or setting with other respondents. Dependability deals with the stability of findings over time. Confirmability deals with the degree to the findings of the research could be confirmed by other researchers (Lincoln, 1985). Confirmability involves establishing that the data and interpretation of findings is not a figment of the imagination of the researcher but evidently derived from data.

A verification exercise was conducted to establish the credibility and confirmability requirements for rigour. The research was presented to 8 participants who had been part of the first case study conducted. It is important to state the difficulty in accessing more participants for the verification exercise as most of the participants in utility one had left the organisation when the verification exercise was conducted by presenting initial findings to participants. This is necessary to show that findings truly represented the views and perspectives of respondents and to show forms of bias were eliminated.

To achieve the transferability and dependability criteria for rigour, the research was conducted with multiple case studies (four in number) for 4 months. In addition, the interviews were and thematic analysis used for the study was the same for all four utilities. Furthermore, a validation exercise was also conducted with 14 personnel in the Federal Ministry of Water Resources and directors in other state water agencies. The participants of the validation exercise were asked to confirm if they agreed with the findings and if any additional issues needed to be addressed in the research. The validation exercise and multi-case study adopted was used to show the study could be replicated and transferred beyond the confines of the context of one case utility.

6.7 Limitations and potential problems

(Cooper and Schindler, 2008) states that limitations and flaws in a research strategy should be documented with total transparency as the value of research is questionable if this is not done.

The researcher encountered the following limitations under-listed while carrying the study:

- The research is limited to Nigerian urban water utilities, however, lessons learnt are transferrable to African countries with similar institutional context as it adds to asset management studies conducted in developing countries. Focus on Nigerian Utilities only is because of how improvements in the Nigerian urban water sector could potentially impact the achievement of SDG goals of west African and Sub-Saharan

African region; the most significant contributor to Sub-Saharan Africa ranking as the lowest in the world for access to improved drinking water and sanitation (Oluseyi Abdulmalik et al., 2016, WHO and UNICEF, 2014, WHO and UNICEF, 2015, WHO and UNICEF, 2017)

- The research acknowledges the existence of informal service provision in the Nigerian Urban water sector however the research is only limited to formalised systems in Nigeria. The research will identify the major gaps in the formal systems provided by state water agencies and aim to proffer recommendations for improving the formalised systems where most of the national capital investment and grants from International agencies go to in comparison with informal service provision.
- The research makes use of a case-study of 4 urban utilities in Nigeria out of 36 utilities and the issue of replication of findings to the context of other utilities might pose a challenge however a case-study protocol will be developed to address the issues of replication of findings
- During the first fieldwork, it was difficult to access secondary data from the utilities and primary data through questionnaires in case utilities, even though questionnaires had been distributed before scheduled interviews only a few questionnaires were returned and data from interviews were used since interview questions covered major aspects of the research objectives.
- Initially plans to organise a validation workshop with key stakeholder in the Nigerian Water Sector through the Federal Ministry of Water Resources during their World Water Day and annual meetings with 36 utilities in Nigeria, however, due to the high-cost implications, bureaucratic and long process of approval, a validation exercise was conducted with various experts in the Federal Ministry of Water Resources that are knowledgeable about the urban water sector in Nigeria.
- Focus is majorly on analytical generalizations and not statistical generalizations

6.8 Ethical considerations

Research ethics are critical measures that need to occur and considered during the research process. Liamputtong (2013) defines ethical considerations as a set of moral principles that aim to prevent research participants from being harmed by the researcher and the research process. Asselin (2003) also asserts the need for putting definite measures in place that will

prevent participants from having unnecessary expectations or misconceptions about the research process.

The first step in fulfilling ethical requirements was getting ethical approval from the Faculty of Engineering and Physical Sciences Research Ethics Committee (EPS FRC). The process involved completing a risk assessment form to determine and identify all risks that could occur during the research and also various mitigation strategies that were in place to manage the identified risk. Also, data management issues such as encrypting documents containing the interview transcripts and ensuring computer systems used were protected with passwords. Transcribed data and raw data was also treated with strict confidence and was inaccessible by third parties and was used strictly and solely for the purpose of the research.

Once approval and guidance were received from the EPS FRC, the next step was to getting approval and informed consent from the Directors of the four case utilities. Written introduction letters asking for permission to conduct the study with employees of each utility were addressed to the company directors. The correspondence clearly spelt out the purpose of the research, type of data that will be collected, and the fact that it was PhD research which would be publishable. These letters were sent at least 4 months in advance to accommodate any delays. In return, correspondence from the organisations was received by the researcher.

Key ethical issues such as informed consent, privacy, anonymity and confidentiality were addressed during the research (Miles et al., 2020). The use of a written consent form and an information sheet were central towards getting informed consent from the research participants. These documents were sent to the organisations 2 months in advance to give research participants enough time to go through the documents and decide if they wish to participate or not. Informed consent is the provision of information to participants about the purpose of the research, its procedures, potential risks, benefits and alternatives so that the individual understands this information and can make voluntary decisions whether to participate or not. (Liamputtong, 2013).

The information sheet used was able to provide detailed information regarding the research aim, the interviews which would be conducted and the duration of the interviews. In addition, details about the profile of participants required for the research was also included in the information sheet. The detailed information collected was necessary for eliminating any form of coercion or deception from research with participants.

The consent form was a way of ensuring confidentiality was achieved. Confidentiality aims to conceal the true identity of the participants (Miles et al., 2020). It also encompasses a signed agreement with a person or organisation about what will be done with their data. In the consent form used for the research, participants were told that their data would be stored until the end of the research which was a duration of 3 years.

In addition, participants were informed that their data was going to be treated with strict confidence and used strictly for the purpose of the research. Participants were also advised that the data was going to be viewed by the researcher and supervisor only. The research participants were also promised anonymity so that information that would indicate which individuals or organisations provided data was concealed and unavailable.

Anonymity was an important factor for giving the research participants confidence that partaking in the research process will in no way have a negative implication on their jobs. Participants were also assured that it was voluntary and they were free to decide if they wanted to take part in the research or not. Copies of the Information Sheet, Consent Form and ethical approval letter for the research are in Appendix 6.

6.9 Summary

This chapter presents the methodological considerations and research methods used in conducting the research. It reiterated the research problem which determined the selection of the research methods and data collection techniques. These methods were justified based on their strengths, inherent properties and suitable application. A critical analysis of the weaknesses of the selected research method which may impact the results of the study was done with much frankness. Mitigation measures used to rebuff the weaknesses of the research methods to prevent any compromises in the value of the research. Next, the various phases of the research design were discussed to give the reader details about the various steps that were taken in achieving the research. Having established the research methods and data collection techniques, the data analysis process and results from the data analysed can be assessed.

Chapter 7

Results and Major Findings

7.1 Introduction

This chapter presents the results of the analysis of the interviews and focus groups carried out during this research. This chapter addresses the fifth research question which is focused on integrating asset management best practices and good urban water management practices for adapting asset management to the Nigerian urban water sector. Firstly the results from the analysis of key stakeholders in all utilities are discussed. An analysis of the key challenges and enabling factors in the four case utilities is presented and questions regarding policy implementation are addressed after. A subsequent section shows the key management processes applicable to the case utilities studied. Also, the findings for performance evaluation and improvement areas for all case utilities will be analysed. Finally, the results from the verification exercise conducted for the key findings and revised framework will conclude the chapter.

7.2 Key stakeholder influencing the performance of water utilities

As previously discussed in section 5.2 contextual factors such as environmental, social, technical and economic factors impact the performance of water management systems, hence understanding the organisational context is an important step for implementing asset management effectively. To gain a better understanding of contextual factors associated with the water context of the 4 case utilities, the focus was on three key areas which are influential stakeholders, key challenges and enabling factors impacting the performance of all four utilities. The set of questions asked in the interviews related to this section was about identifying the major stakeholders influencing the performance of state water agencies, their impact, interests and interactions of water companies. Table 7.1 shows the summary of the results of the analysis from the data set of respondents in the four case utilities.

Table 7.1: Comparative Analysis of Key Stakeholders in all Utilities

| Dependent nodes for Key stakeholders | Percentage of respondents in all Utilities (N = 61) | Dependent nodes |
|--|--|--|
| Customers | 97% | Domestic customers, industrial and commercial customers, customers paying regularly, customers not paying, peri-urban and urban customers |
| Informal service providers, illegal connector and vandals | 88% | Informal service providers (mairuwas), sachet water providers, construction companies destroying pipes, borehole providers, customers connecting illegally |
| Funding institutions | 82 % | International donor agencies, (infrastructure investment, subsidies, funding) international donors/NGOs World Bank, JICA, AFDB, ADB, Islamic Bank State Government and FCTA, FCDA, MFCT (infrastructure investment, subsidies, funding) |
| utility management and staff | 61% | Area managers, staff, Heads of department, The Director, technical, commercial, customer service and IT department. |
| consultants, contractor and manufacturers | 40% | Chemical suppliers, maintenance |
| policymakers, lawmakers and regulators | 40% (dominant in utility one) | Federal ministry of water resources, Ministry of Environment, Ministry of Health, The National Assembly, Lagos regulatory commission, Abuja environmental board, Kaduna state ministry of water resources, Rivers state Water Services regulatory commission |
| CSOs | 31% (dominant in utility two) | Community groups |
| other supporting sectors | 19% | Banks, institutions, media, power and planning, trade and justice ministries |

The results showed that about 97% of the respondents in all utilities identified customers as the most influential stakeholders that impact their performance. While 100% of respondents identified customers as key stakeholders in utilities one, two and four, 89% of respondents were observed to have identified customers as key stakeholders in utility three. In addition, customers emerged as the most prevalent theme for key stakeholders from all 4 case utilities.

This trend is similar to works cited by (IDEV and AFDB, 2015, Jacobsen et al., 2012, Owolabi, 2014, Oyegoke S. O., 2012, World Bank, 2000) where customers play a role in the sustaining the urban water sector. Table 1 in Appendix 6 shows details of the percentage of respondents in each utility. The commentaries below summarise the views from all respondents regarding customers influence as key stakeholders

“The urban customers are important stakeholders. They are interested to see that our services are the best. Because they are enlightened, when there are issues they call, they inform us. (Respondent A2)”

“Critical stakeholders are customers. They are very critical in the sustaining the sector because their activity can cause a serious problem in providing the needed services”. (Respondent L18)

“Our number one stakeholders are the people we are serving. They are our customers” (Respondent K2).

“Our key stakeholders are the residents of the Island they are residential houses, schools, clinics, maybe huge shops, large supermarkets. They are our basic key stakeholders”. (Respondents P1-P3)

From the results, customers influence was based on payments made. Respondents stated that customers did not pay their water bills because they felt water should be free and the services from the utilities were poor. This stems from the comments put forward by respondents A1, A4-A8, A10-A16, A18-A21, in case utility one, respondents L2-L15, L17-L23 in case utility two, respondent P1-P3, P5 and P8 in case utility three and all respondent in utility four. These respondents all expressed affirmation to the fact that there were customers unwilling to pay for services. This view is supported by the work of (Ajai, 2012a, Water Aid, 2007, Agbor and Akpan, Odigie and Fajemirokun, 2005) stating similar trends experienced by water utilities. The following commentaries substantiate the influence of customers relating to not paying for services.

“Some customers could be of negative influence. They believe it is a God-given product which they do not need to pay for”. (Respondent A1)

“We also have a lot of people that do not want to pay because they believe water is free.” (Respondent L20)

“Customers are key stakeholders. Some believe water is free and they feel they should not pay for water”. (Respondent P5)

In terms of influence from customers, respondents also stated some customers supported their service by making timely payments and notifying utilities about issues on time. This stems from comments put forward by respondents A2, A4-A8, A10-A13, A15 and A18-A21 in utility one, respondents L2, L18-L23 in utility two, respondents P1-P5 and P7 in utility three and respondents K2 and K5 in utility four as opposed to works by (Ajai, 2012a, Water Aid, 2007, Agbor and Akpan, Odigie and Fajemirokun, 2005) that state most customers do not want to pay for services because of political campaigns about water being free. The few commentaries below provide a detailed summary regarding categorizations based customers that were supportive and willing to pay.

“There are also individuals that are interested in what we are doing and have shown a certain level of concern and eagerness to see what will happen vis-à-vis payment plans”. (Respondent P5)

“We have people that are interested in our services and they are willing to pay bills.” (Respondent L20)

“because they are enlightened when there are issues they call, they inform us, even when we are unable to on our own detect these issues”. (Respondent A2)

Another theme that was observed to be prevalent in all the four utilities was informal service providers. Out of all the participants of the interviews and group interviews, 88% identified informal service providers, as influential stakeholders. While all participants in utilities 2 and 4 were observed to identify informal service provision as a dominant theme for key stakeholders, 83% of respondents in utility one and 67% of respondents in utility three were found to identify informal service providers as an influential stakeholders. The prevalence of informal service providers is a similar trend found in studies by (Dos Santos et al., 2017, Collignon and Vézina, 2000) who have stated that urban water sectors in Africa depend on informal service providers. See details in Table 1 in Appendix 6. The few quotations below are said to represent the views on informal service vendors as influential stakeholders.

“In places like Asokoro and Maitama, we have booster pumps that pump water. In a situation where these booster pumps are not efficient enough that is where these

informal people come in. So sometimes, we even engage them to help us reach areas we cannot reach. That is why the informal service providers are important stakeholders". Respondent A2

"Informal service providers are influential stakeholders. They could be a hindrance because they are not organised. We should be able to control their activities but if they carry on providing water supply from sources that we do not approve of course it could endanger people and then it will still boomerang on the organisation". (Respondent A9).

"Mairuwas (meaning water vendors that sell water in containers loaded in movable carts) go to the extent of breaking our pipe, they do all kind of things to make us experience pipe burst. You know for those people once there is a disruption in the supply of water definitely, they will have access to sell their water" (Respondent A15)

"I think the negative stakeholders are these bottled water people because they give false information to customers. They tell people water board water is not clean and cannot be consumed directly. We have illegal connections too we have people who connect our water illegally." (Respondent A18-A21)

"The major stakeholders that affect us negatively are the water vendors, they use our water and they are not willing to pay. They connect illegally sometimes in connivance with our staff. The effort to control them has not been yielding good result". (Respondent L22)

"Stakeholders with major influence are those who are involved in water theft. If we invest so much to ensure that water is produced and our pipes are vandalised. We will not get value for money for which these infrastructures have been put in place". (Respondent L16)

"Some people think because it is a government agency we are ripping them off. So when we cut them off they still reconnect back to our pipe connections" (Respondents P1-P3)

"Stakeholders like the flower operators, the garden operators, the car wash operators and the block industry operators influence us negatively. They vandalise our pipes, connect illegally and waste our water". (Respondent K5)

Reflecting on the influence on informal service vendors as influential stakeholders the following inferences can be made. Informal vendors impacted the utilities negatively by connecting illegally to the utility services and vandalising pipes. This emanates from the comments put forward by respondents A4-A13, A15 and A18-21 in utility one, L1-L19, L21-L23 in utility two, Respondents P1-P5 and P7 in utility 3 and all respondents in utility 4. These respondents all expressed affirmation to the fact that informal service providers impacted their services negatively and they lacked the capacity to enforce laws for arresting informal service vendors. This view contradicts works by (Collignon, 2002, Banerjee and Morella, 2011) who cited that African utilities with good practices had the capacity to employ and partner with licensed local water vendors to support their services for slums and illegal settlements. However only respondent A2 had stated similar trends with works (Collignon, 2002, Banerjee and Morella, 2011) regarding employing services of informal service providers to provide water in areas that the utility services which is a smaller ratio compared to respondents that viewed informal service providers from a competitive angle.

Next set of stakeholder that were classed as important identified by 82 % of the respondents in all four utilities, were financiers. As shown in Table 1 in Appendix 7, all respondents in utilities one (1) and four (4) were found to described funding institutions as key stakeholders while 96% of respondents in utility two (2) and only 33% of respondents in utility three (3) classified funding institutions as key stakeholders. Quotations from the following respondents best summarise the views on funding institutions as key stakeholders:

“The Federal Capital administration (FCTA) is the co-stakeholder that is assisting us with funds to finance some of our maintenance activities here. FCTA provides infrastructure while we maintain what they provide”. (Respondent A16)

“There is the FCDA (Federal Capital Development Authority) which is a parastatal under the Federal capital territory administration who are very important stakeholders. They are important because they are the body that is charged with the provision of water infrastructure in the FCT. We operate as an arm of the Federal capital territory administration and then we take charge of the operations alone”. (Respondent A1)

“JICA has also helped us maximise our revenue generation by installing bulk meters in all the zones, tanks and in the loops and districts”. (Respondents A22-A23)

“International donors support us in forms that ensure the sustainability of our water supply to our consumers. We reach out to International donors and organisations like the World Bank and French bank that could provide loans. These funds are put together to execute projects. There are also guaranteed loans by the State government and the Federal government which are put to adequate use to ensure that the customers get water”. (Respondent L16)

“Lagos Water Corporation is one of the agencies of Lagos state government so we have to relate with our mother ministry which is the ministry of environment because it is part of Lagos state government”. (Respondent L19)

“We have an ongoing project sponsored Japanese International Cooperation Agency (JICA) project. The project is not a loan it is a grant. They are providing solar energy as an alternative power generation system for the lower Usman Dam”. (Respondent A14)

“Though external, the government are key Stakeholders, because they give us subventions based on what we sell and the revenue we generate.” (Respondents L3-L15)

“UNICEF provide counterpart funding for water projects we provide 50% of the funding and UNICEF supports with the remaining 50%. In other areas, UNICEF could provide 100% like training community artisans so that they could maintain those small scale water schemes”. (Respondent A3)

“I will consider NGOs as a stakeholder. We invite them to help us project our plans to the public. They act as intermediaries between us and the public during stakeholder palets. They are sponsors too. For example the World Bank, SUWASA the Sustainable group from America USAID, an ADB partner with us. The government too is a stakeholder” (Respondent P4)

“We have development partners who partner with us in providing infrastructure. The federal government is also a stakeholder because of an ongoing

arrangement with the Federal Government to supply water infrastructure to some parts of the state” (Respondent K2)

Reflecting on the influence on funding institution as influential stakeholders the following inferences can be made. International donor agencies and various state government were major funding bodies stemming from comments put forward by all respondents in utility one, respondents L1-L16 and L18-L23 in utility two, Respondents P4, P6 and P7 in utility 3 and all respondents in utility 4. These respondents all expressed affirmation to the fact the water infrastructure projects and operations of the utilities were funded by the state government or international donor agencies. This trend is similar to cited works by (World Bank, 2011b, Fall et al., 2009, Newborne et al., 2015) about successful African utilities being dependent on state government subsidies and capital projects and grants from international donor agencies.

Also, utility management and staff were identified as key influential stakeholders. In total 53 % of the respondents from the interviews and group interviews stated the utility management and staff were considered as major stakeholders. However, this theme was pertinent to utilities one, two and three and non-existent in utility 4. This theme emerged from 96% of respondents in utility one, 83% of respondents in utility two and 33% respondents in utility three. Some commentaries from the interviews and group interviews substantiate these findings:

“Number one stakeholder that I will mention is the staff because the input of the staff has a long way to give us the result that we desire. So it positively impacts on our activities i.e. staff” (Respondents A11-A13)

“You need staff to operate the plant equipment. I manage this plant he manages this plant we are all key stakeholders. Staff have a major role to play when it comes to managing the water treatment plants”. (Respondents A22-23)

“Staff are key stakeholders because they are the ones who do the job in-house”. (Respondent A9)

“Our head of department is a key stakeholder because they are the main people that ensure the necessary resources required for producing quality water is made available. We also have other head of departments that ensure are operations are run successfully.” (Respondents A18 –A21)

“The staff are very important stakeholder because they ensure a smooth flow of activities from production to transmission to distribution and revenue collection”. (Respondent A17)

“We have what we call area managers like in the whole federal capital territory (FCT). In FCT, we have districts and in these districts we now have areas. This is where we have managers controlling areas officers where customers can go to respective area offices that take care of different districts instead of coming here”.

Respondents A2

The workers here we are stakeholders. (Respondent L2)

Internally, the staff are the key stakeholders of the organisation. (Respondent L21)

“Every staff that I interface with are our key stakeholders. The staff in water operations, procurement, finance and administration are all stakeholders as far as the project is concerned” (Respondent P6)

In summary, the following conclusion can be deduced with respect to how the staff impacted all utilities based on the responses from 61% of participants in all utilities. Staff, heads of department and utility managers were responsible for running different types of assets and the operations occurring within the utility. Stemming from comments put forward by A1-A15 and A17-A23 in utility one, respondent L1-L15, 17 and L20-L22 in utility two, Respondents P5-P7 in utility three and respondents K3 and K6 in utility four. These respondents all expressed affirmation to the fact that staff and utility management impacted the operations of the utility. This trend is similar to cited works by (Baietti et al., 2006, World Bank, 2012a, Budds and McGranahan, 2003, Chiplunkar et al., 2012, Dominguez Torres, 2018 , Kayaga et al., 2018, Tropp, 2007, Water Aid, 2007, Uchegbu, 2009) stating the importance of investing in the capacity and management of staff for improving efficiencies of utilities.

Another theme that emerged from utilities one and two only for key stakeholders were contractors. 78% of the respondents in utility one (1) identified contractors as key stakeholders while 83% of respondents in utility two (2) identified as key stakeholders. The following commentaries summarise the perception of participants that were interviewed during the research.

“The specialists responsible for supplying chemicals like chlorine and other treatment chemicals are very important to us. Because of the kind of understanding we have with them, they keep supplying products to us believing that they will get their money. They get the money but not at the right time” (Respondent A1)

“On the distribution network, some of our contractors have shown willingness to go and borrow money on our behalf alright to come and provide distribution network in form of a loan we have not been able to provide the distribution network to those places”. (Respondent A17)

The contractors are important stakeholders we need chemicals and plant equipment for production and this is why we engage contractors to do that. We have a large chain of contractors that are stakeholders. (Respondent A22 – A23)

Then our contractors and consultants are very influential Stakeholders. Contractors who for example are on-site at our major waterworks ensure that the standards are put in place during construction. Consultants also do their best to ensure that they carry out necessary supervisory function over those contractors on site. (Respondent L16)

Other stakeholders should be contractors. We outsource some of our jobs maintenance jobs we outsource them because we cannot cope with it in-house. (Respondent L19)

“APN are key stakeholders. Before 2010 we are solely relying on NEPA, PHCN, but now we have our own IPP Independent power plant being operated by APN that is a subsidiary OANDO and since then we have had a war constant power supply”. (Respondent L20)

Contractors were stated by respondents A1, A4-A9, A11-A13, A15, A17 and A18-A23 in utility one, respondents L1-L19 to be influential because of the outsourced services and water projects they were involved in. These respondents stated contractors provided support compared to the contrary views about contractors based in works by (Hall, 2006, Idris and Salisu, 2016, Aduda, 2007) where contractors were described to be involved in corrupt practices and were responsible for abandoned infrastructure projects.

Civil society organisations and community groups for keys stakeholders that emerged in all utilities however it was more dominant in utility two where 74% of respondents in utility identified civil society organisations as a key stakeholder. However, 9% of respondents in utility one and 22% of respondents in utility three and 17% of respondents in utility four stated the operations of the organisation were impacted by civil society organisations and community groups. The commentaries below is a summary of the overall view of respondents.

“We have had this stakeholder engagement sometimes we involve people who know them especially the CDAs that is the community Development Association because they know about these projects and what they can benefit from the projects”. (Respondent L1)

“Civil society organisation are key stakeholders. We engage civil society organisations that speak to the landlord association and the transitional rulers. We have a contract with them for about 5 years”. (Respondent L18)

“The Civil Society Organizations you engage because they have positive thinking all the time. They talk to those with negative interests so you can have your way”. (Respondent L4)

“We make use of Community development association and the Community development committee which is on a higher level before we commence our projects”. (Respondent L3-L15)

“The members of the CDC that is the community development committee but the larger individuals, the committee itself different people your regular Joe we want to invite all of them over for a meet where we would discuss with them on different issues concerning water production and water services”. (Respondent P5)

The Commentaries made by Respondents A3, A17 in utility one, Respondents L1, L3-L15, L18-L19 and L23 in utility two, and respondent P5 and P9 in utility three, and respondent K6 in utility four showed CSOs acted as intermediaries between the utilities and communities during community engagement for projects. This trend is similar to works by (Bouman-Dentener and AM Devos, 2015, Eneh, 2016) stating CSOs play a vital role in the water supply. Policymakers as key stakeholders were observed as a dominant theme in utility one compared to the other case utilities. 57% of respondents in Utility one stated policymakers and legislative bodies were key stakeholders. 35% of respondents in utility two and 33% of respondents in utility 3 and 4. The few quotations below present an overall perception of respondents on the influence of policymakers and legislative bodies.

“The ministry of environment, the ministry of health, and the ministry of water resources are main stakeholders. (Respondents A4 –A8)

“Then the federal ministry of water resources is one of our key stakeholders. They release water from Gurara dam to augment what we have”. (Respondent A16)

“The National Assembly is very important to us because they need to pass the law as quickly as possible to make the utility board independent. The issues of staffing, operating as an arm under another organisation, infrastructure development will be solely vested on the board once the bill is passed”. (Respondent A1)

“In order of priority, the Ministry of water resources should come first because that is where the national policy on Water is domiciled. Whatever decisions they make about their policies on the provision of water supply affects us”. (Respondent A9)

“The Ministry of health checks and test the quality of water we give out. The ministry of environment also impacts us indirectly”. Respondent A2

“The Federal Ministry of Water resources acts as facilitators. When we have interventions from development partners outside the country they go through the federal ministry of water resources.” (Respondent A3)

The impact from lawmakers enacting laws and policies and regulating the operations of utilities can be construed with respect to quotations stemming from Respondents A1-A13, A15-A21 in utility one, Respondents L1, L2, L16, L17-L19, L21 and L23 in utility two, Respondents P4, P8 and P9 in utility three and respondents K1 and K2 in utility three. This trend is similar to works by (Nwankwoala, 2014, Owolabi, 2014, Omole, 2013, Iliyas, 2000, WaterAid, 2006, Water Aid, 2007, Akpor and Muchie, 2011, Akpabio, 2007) who state that the progress of State water agencies in Nigeria has been impacted by lawmakers.

7.3 Key challenges affecting performance

The set of questions asked in the interview which this section actively considers are the major challenges impacting the performance of the selected case water utilities evaluated in the study.

Table 7.2 shows the summary of the results of the analysis from the data set of respondents in all utilities.

Table 7.2: Comparative Analysis of Key Challenges in all Case Utilities

| Key themes for Major Challenges | Percentage of respondents (Total number = 61) | Dependent nodes |
|--|--|--|
| Funding | 100% | low-cost recovery, low revenue generation, high production and operational costs, delayed subsidies and running costs, low water tariffs, no charges for water |
| Infrastructure challenges | 92% | Decaying and ageing infrastructure and lack of infrastructure and poor maintenance, vandalised infrastructure, infrastructure functioning below design capacity |
| Governance | 73% | Political interference and bureaucracy, poor governance and lack of autonomy, long budgetary approval processes, slow policy implementation, Lack of an enabling legal framework |
| informal service provision and illegal connection and non-revenue water | 88% | People with illegal connection, providers of sachet water activities, activities of flower vendors, car wash operator activities. pipe vandals |
| poor staff management issues – | 70% | Lack training, lack of staff, low competency and staff capacity, delay in paying staff salaries, low morale and incentives, staff discipline, staff placement |
| Water is a social good | 67% | Water is free, unwillingness to pay, political campaigning, water is a human right |
| power failure and lack of power | 60% | Lack of power, low voltage, irregular power supply, expensive electrical costs on diesel. |
| population growth and rapid urbanization | 53% | Populations growth, rapid urbanisation and migration Prevalence of slums |
| Project-oriented issues | 31% | project delays, unsustainable projects and abandoned projects |

The findings show that funding was the most dominant theme representing challenges experienced by all utilities. All respondents interviewed were observed to mention funding as a major challenge see Table 2 of Appendix 6 and Table 7.2 for details. The following

commentaries represent a summary of the views of respondents in the interviews and group interviews in utility one.

“Funding has been a major challenge for us, I hope you have the opportunity of visiting one or two of our areas offices they are not in good shape. When you are in business a kind of PR the way people see you is how they will take you. Now when you get to an office, the place is in a mess the respect is low. So funding is a major challenge”. (Respondent A1)

“Funding is still that same issue like the FCTA they have their reasons why they are starving the board of funds”. (Respondent A2)

“We also have problems with the state government releasing funds for our subvention. we are not charging an economic rate government is subventing the tariff by giving us money for some of our business activities for example for the salary they subvent us, for purchase of chemicals they subvent us but the release of the money for buying chemicals is not as frequent as it should be we are not getting enough IGR to pay salaries. Salaries are delayed” (Respondent L2)

“The major challenge is finance, in 1996 Water Corporation as a whole was generating 100 million naira. But today we cannot even go near 50 million. And we still have to pay a salary of over 100 million”. (Respondent L20)

“Now with the issue of funding, there is some money they normally release to us they call it running cost, throughout last year towards the end of the year, it was last September running cost that we picked which is since last year”. (Respondent A15)

“The government is not helping because when the water board generates revenue all monies goes to the treasury single account (TSA). I strongly believe that the water board needs to be exempted from it. A revenue-generating organisation will generate millions but at the end of the day get stipends to work to realise that goal in a month”. (Respondent A12)

“The revenue is just below 40% because we plan to realise at least a hundred thousand naira daily but right now it has not been achieved. In January we only

realised about 161,000 and for these two weeks in February we have realised about 66,000 and it is not adequate.” (Respondent P8)

“Previously we get over 200 million naira. But currently, as I am speaking to you this month it is slightly above 70 million, so the revenue is reducing because they were not ejecting anything into the system again. The only allocation we had was 22 million naira which was in September and we have piles of liability. They are starving us with funds”. (Respondent A13)

“Our revenue generation in comparison with our production cost it will take some time. our production cost it is far up here while we have nothing to talk about in terms of what we are getting to in fact it is no measure most of them have not started even responding to the fact that they receive a bill and then they want to pay”. (Respondent P3)

“Our tariff structure is not appropriate. I mean it does not cover the cost of production. Yes, it might not cover the cost of production because some people are unable to pay. But it should be defined if we are producing water at 50 naira let us sell it at 50 naira, if the government is saying sell it at 25 naira let it be that they will be able to mark up the 25 naira”. (Respondent K6)

“We have not been able to break even for a while. As an organisation, we are always operating on a deficit. Secondly, we have the challenge of revenue generation or payment of bills like I told you earlier some people feel that it is their right”. (Respondent K2)

“We used to have about 10 textile companies paying about 11 billion naira in a month but all of a sudden all of them they folded up. Now we are relying only on commercial and domestic customers with low tariff rates”. (Respondent K1)

Reflecting on the impact of funding as a major challenge, the following inferences can be made. The utilities were found to generate low revenues that could not cover cost and had to depend on subventions from the government. This emanates from the comments put forward by all respondents in the four utilities. The views of respondents about funding as a challenge are similar to works by (Owolabi, 2014, World Bank, 2000, Nwankwoala, 2014, Oyebode, 2014) that state utilities in Nigeria have low revenues that are unable to recover costs.

Challenges with infrastructure was also another prevalent factor that was observed across all the case utilities. 94% of the respondents in all the utilities identified challenges related to infrastructure as a major challenge impacting service delivery. From the analysis, all respondents in utility one (1) and four (4) identified infrastructure challenges impacted their activities. 96% of respondents in utility 2 were found to identify issues with infrastructure while the remaining 78% of respondents were in utility 3.

Infrastructure challenges such as pipe vandalism, ageing infrastructure, inadequate infrastructure and infrastructure operating below design capacity can be deduced from the commentaries of all the respondents in utility one and four, respondents L1-L15, L17 and L19-L23 in utility two and Respondents P1-P6 and P9 in utility 3. This trend is similar to works cited by (Ajibade et al., 2015, NTWG, 2009, Ohwo, 2016, Olajuyigbe, 2010, WorldBank, 2011a) that stated State water agencies were challenged by ageing infrastructure, lack of infrastructure and infrastructure operating below design capacity.

The following citation is an overall summary of some of the views of respondents regarding challenges related to infrastructure.

“For the physical infrastructure, we do not have enough, like the area offices they are not in good condition. The staff are supposed to have a conducive environment for work to help with their psychology”. (Respondent A14)

“Our water infrastructure is not enough and population growth is putting pressure on water supply” (Respondent A10)

“Our physical infrastructure is obsolete. In terms of our waterlines, they are more than 30 years but we are still using them. There should be some kind of phased replacement of all these things but it has never happened but what we do is wait for something to happen before we replace them”. (Respondent A2)

“We have about 12 or 13 treatment plants or so but I do not think they are operating at full capacity because why the equipment is old they are ageing. Like the rehabilitation now the pipeline rehabilitation in Zaria now. The pipes were laid as far back as 1939 so they are obsolete” (Respondent K3)

“Yes we have a lot of infrastructure in the state we have about 9 plants and we give water across the state even though it is not adequate because of the rate of growth

of population among the state and our future plans are to add more”. (Respondent K4)

“Most areas do not have water not that we are lacking water, production is not a burden but the distribution channel is not there, re-reticulation is a problem and we do not have enough booster stations. Some are very high areas that water cannot get to that place, so presently I think we are having issues with funding anyway in terms of budgeting”. (Respondent A11-A13)

“If you go to those offices there are no chairs, no furniture for now and it is because of limited cash so funding is a challenge”. (Respondent P6)

“We experience a lot of pipe burst because our pipeline is old. We have also stopped using one borehole because the saline intrusion in it is too much”. (Respondent P1-P3)

“The sewage treatment plant was built with the mentality of the white man and with their central sewage system in mind. That was why I showed you the Huber unit where we ignored that side to do our own locally made filtration process. We modified the plant design because customers throw condoms, sanitary pads, used blankets and towels inside the soakaway and the tank drivers suck it down here and pump it as well. Some of these things can cause serious blockages”. (Respondent P9)

“Major challenge in the organisation just as he said we have equipment challenges. Most of our systems in the office they are outdated we need to upgrade them. Most of our area offices they do not have structures some of them they stay outside under trees”. (Respondent A12)

“Our network is over a hundred years old you can imagine trying to adapt and change a network like that to suit the Lagos of today you know from 1810 or something like that no for 1910 to 2016 in those days they had network from Iju right down to Ikoyi”. (Respondent L2)

“One we need to fix most of our waterworks they are not performing at the optimum. Because most of the equipment we have are ageing” (Respondent L17)

Furthermore, the results of the data analysis from the one to one interviews and group discussions revealed that 96% of the respondents in all the case utilities identified governance. Governance was more dominant in Case utilities 1, 2 and 4 where views of respondents on Governance were 96% in Utility 1 and 2, 67% in Utility 4 and 33% in Utility 3. The commentaries below provide an overall summary of the main points associated with governance as a key challenge.

“Utilities should not be run as a department of another organisation. The Lawmakers need to pass the law as quickly as possible to make the utility board independent and capable. It is necessary for us as an organisation so we can address issues of staffing, issues of operation and issues of infrastructure independently.” (Respondent A1)

“We also have government bureaucracy on the ground. When we require things that will enable us to carry out our analysis and water treatment we have to submit a document highlighting our needs. However, we have delays in receiving feedbacks and getting funds that will allow us to work quickly (Respondents A18-A21)

“Lastly on the challenge is on the issue of the act, establishing FCT water board that bill to be enacted by National Assembly because National Assembly happens to be like our own state assembly that bill has not been enacted it is a challenge. We cannot go to court sue in our name and people cannot sue us in our name because we do not have an act establishing us. People have to sue our minister. The act establishing our minister and the FCDA is what we are still using”. (Respondent A17)

“I will also say legislation because since we do not have an act. We are not empowered to operate in the full capacity that we should. We cannot decide on our infrastructural development. We are unable to take a loan from the bank to carry out projects like expanding services to this area. We are depending on another agency for that”. (Respondent A9)

“Like presently now we cannot prosecute any of our defaulting customers because we do not have that legal power, we do not have that act establishing the board. So our bill has been in the National Assembly for the past two to five years it is still

there. Presently there are issues with passing that bill. If that bill is passed we will have the legal powers to prosecute any of defaulting customers”. (Respondent A11)

“There is a big deviation from what we are doing right now and one of our main problems is called political interference you know it has affected us. Even though the water law has spelt out what we are supposed to be doing, political interference has affected our operations”. (Respondent L2)

“Corruption is major because you cannot readily determine what goes into all these loans that we get and what they are used for, if the bid is done properly and open in the presence of everyone and there is the transparency, of course, we will expect that the best supply bid gets the job. But with corruption, all these things will not be possible because of the self-interest of people”. (Respondent L16)

“Also political inclinations for example areas like Epe, Gbadagry, the corporation has not increased the tariff since 1999 because the government would not consider doing it because of its political inclination”. (Respondents L3-L15)

“Like I told you earlier one of the major challenges is the legal framework. Political interference. If you look at the 2004 Lagos water law it said Lagos Water Corporation will be autonomous but today, we still go through the state government to go and beg for money to do things. For me, one of the challenges which I know that we are facing is that if we have a very implementable legal framework and everybody key in line to it”. (Respondent L18)

“People we serve generally believe that water should be free. Water is one of the campaign points for politicians. Some people expect that water should be free and if you give them the water they will not pay.” (Respondent L19)

“Political influence and promises about water being free and politician seeing investment in water as a waste when compared to other competing sectors”. (Respondent P4)

“The law that set us up is meant to give us a level of autonomy. We were supposed to generate and spend that is what we do, so most times we are not able to generate enough for purchasing chemicals, paying water bills and staff salaries. We are not a profit-making organisation we have to fall back on government, subventions because our collection rate is bad”. (Respondent K2)

“The law states that we are supposed to review our rates from time to time by giving the government recommendations. But in our case, the last time we had a

tariff review has been since 2012 and the government expects us to operate as a business entity when we can hardly survive”. (Respondent K5)

The summary of trends identified by Respondents A1-A13 and A15-A23 in utility 1, Respondents L1-L16 and L18-23 in Utility two, respondents P4-P6 in utility 3 and respondents K2 and K4 to K6 in utility 4 are as follows.

- The inability of utility managers to make decisions regarding daily operations, tariff structures and investment loans.
- Dependence on running cost and government subsidies to carry out day to day activities
- Established laws not being enforced properly
- Political interference politicians campaigning to provide water for free
- Delayed and bureaucratic approval processes for budgets and policies

These trends are similar to what was found in literature from works by (Akpabio, 2007, Akpor and Muchie, 2011, Durokifa and Abdul-Wasi, 2016, Hodge, 2007, Iliyas, 2000, Nwankwoala, 2014, Omole, 2013, Owolabi, 2014, Oyebande, 2006, WaterAid, 2006, Water Aid, 2007) who assert that the Nigerian Urban water sector has poor governance structures and a lot of political inference.

Another challenge which emerged from the analysis of the interviews and group discussions were the issues related to the management of staff. About 70 % of respondents in all utilities identified challenges associated with staff management. Staff management issues were more dominant in Utility 2 at a rate of 91% and least dominant in utility 4 at 33%. While the remaining Utilities 1 and 3 were 87% and 67% respectively. The few commentaries below encapsulate the perception of respondents regarding challenges related to staff management.

“We have issues with staff placement. There is so much pressure on politicians especially from their relations to employ just anyone. Even if the man is qualified or not they just employ and send to us”. (Respondent A1)

“Incompetency is a major challenge. You cannot support someone incompetent and unwillingly to work. When people are timid and are not ready for the change, they would be unable to provide the desired result. Training and staff welfare are issues we also face.” (Respondent A2)

“For staff, I would say they are efficient but they are not enough. Because we have to augment the currently employed staff with some casual staff who do activities like meter reading and bill distribution. Then in terms of professionalism across the organisation, we have more skilled people at the top who might be on their way out compared to junior cadre officers.” (Respondent A9)

“When it comes to the manpower we have a lot of gap in here. The Lagos state government has for some time placed an embargo on employment and you know the older staff are reaching retirement age they are leaving and new staff are not recruited so we have to make do with small manpower we have and that is one of the challenges”. (Respondent L1)

“You cannot train your staff. Because you just do not have the money you are just barely managing to pay salaries sometimes we even have to borrow to pay salaries” (Respondent L2)

“Our area offices have increased to 18 (eighteen) but we have only two information technology staff. They will not be able to man those areas. We need more competent hands in terms of well-trained engineers” (Respondent A15)

“More technical staff are required”. (Respondent A16)

“Training and re-training are what is lacking. And there are some training some people will embark on training by the time they come back probably they will have changed them to another department. Then the psychic of the staff need to change, their minds need to be reformed”. (Respondent A17)

“One other thing that we will require will help us move forward is that if there is staff welfare, giving attention to the personnel that are there doing the work it makes the work attractive and appealing to the person involved”. (Respondent A21)

“Training. I have been here since 1990 and we are not carried along when it comes to training.” (Respondent A22-A23)

“Also look at the staff welfare too, you know the human capital, the human aspect is important as an organisation. Presently as a revenue-generating organisation, we are supposed to have a salary structure different from other organisations as a kind of encouragement to us but presently our salary structure is so meagre”. (Respondent A11 – A13)

“The staff are supposed to have a conducive environment for work it even adds to your psychology. The environment is not conducive”. (Respondent A14)

“We have competent hands available but compared to the work to be done yes I can say we are short-staffed which is a challenge”. (Respondent P5)

The following key points were raised from staff management issues identified by Respondents A1, A2, A4-A9, A11-A13, A15 and A18-23 in utility one, Respondents L1-L15 and L17-L22 in utility two, Respondents P1-P5 and P7 in utility three and Respondent K2 and K5.

- Training is lacking
- Low salary structure and poor staff welfare
- Lacking an adequate number of staff with certain work qualifications and skills that can carry out day to day operations in specific departments and also manage specific assets
- Incompetency
- Issues with placement and discipline of staff

The issues with staff management were similar trends to works cited by (Water Aid, 2007, Akhionbare et al., 2012) that established competency issues facing Nigerian water utilities. However, these trends were not similar to works by (Alegre and Coelho, 2012, Alegre and do Céu Almeida, 2009, Amaral et al., 2017, Institute of Public Works Engineering et al., 2015, Schulting and Alegre, 2009, van Heck, 2008) about asset management best practices where capacity building was an enabling factor for successful asset management

Another major issue identified by 53% of participants in all four utilities was the issue of population growth and rapid urbanisation. The challenge of population growth was found to be more dominant in Utility 2 at a percentage rate of 91% and least common in utility 3 with a percentage rate of 11%. While population growth was observed in the remaining utilities which are case utility 1 and 2 amongst respondents at 65% and 50% respectively: See details in Table 2 in Appendix 6.

“Because some of the facilities that were meant to serve a certain number of people have been overrun and they were based on calculations of population growth rate but they have not been accurate. Population growth which will also dovetail to urbanisation rate is a challenge”. (Respondent A9)

“Currently illegal settlements are growing around our treatment plan area which is affecting our activities because it is downstream”. (Respondent A19)

“You will agree with me that Abuja is rapidly growing and if you say want to provide water to these people that means your response has to go with the rate at which the population is growing. However, we are unable to move at a pace that allows us to meet the demand of the city due to government bureaucracy and lack of funds”. (Respondent A20)

“I want to talk about the informal settlement of slums and shanties. In places where the settlements are not planned, people can just go probably they want to build they might start digging and some pipes might get broken in the process”. (Respondent A6)

“The city is expanding so we need more staff and we need more distribution mains because what we have cannot meet the current population growth and city expansion”. (Respondent A16)

“We know that Abuja being the Federal capital territory being the capital city of Nigeria people troop in every day, as a result, it increases demand” (Respondent A10)

“Yes we have a lot of infrastructure in the state we have about 9 plants and we give water across the state even though it is not adequate because of the rate of growth of population among the state”. (Respondent K4)

“Another major challenge is that there is a fast increase in urbanisation. In the last ten years, there has been a massive movement of people into urban areas. The investment is not enough to reach those people both in terms of quantity and the distribution network”. (Respondent K6)

The following key findings can be deduced from the perceptions of respondents A1, A2, A4-A10, and A16-A21 in utility one, respondents L1-L17, L19, L21 and L22 in utility two,

respondent P5 in utility three and respondents K1, K2, K5 and K6 in utility four on population growth and rapid urbanisation

- The uncontrolled development of illegal settlements, slums and shanties impacts the ability of the utility in meeting the water demand
- Rise in population due to migration into the capital city also impacts the ability of the utility in meeting the water demand for the city
- Pipe vandalism and developing public taps to reduce pipe vandalism which results from unplanned settlements

These findings are similar to works cited by (Adams, 2018, Dos Santos et al., 2017, IDEV and AFDB, 2015, Jacobsen et al., 2012) about urban population growth impacting water utilities in African countries.

Another challenge which emerged from the analysis of the interviews and group discussions were the issues related to non-revenue water associated with activities of illegal connections and informal service providers. A total percentage of 88 % of respondents identified challenges associated with illegal connections and pipe vandalism. While all participants in utilities 2 and 4 were observed to identify informal service provision as a dominant theme for key challenges, 83% and 67% of respondents were found to identify informal service providers in utility 1 and 3 respectively. See details in Table 2 in Appendix 6. The few quotations below is a representative summary of the perception of respondents on informal stakeholders as major challenges.

“The people that affect us negatively are the people that are into illegal connections and they are there all over the place”. Respondent A1

The informal providers (the borehole providers, water vendors) are our co-competitor so if anything will make the board not to work they will be happy because it will widen their customer base. They will be so glad if we have shut down for one week. You can imagine that is an explosion for them. (Respondent A2)

“Informal service providers sometimes they could be a hindrance because they are not organised it is not structured yet. We should be able to control their activities but if they carry on providing water supply from sources that we do not approve it could endanger people”. Respondent A9

“The unscrupulous people who go about doing illegal connection of water. Some properties by-pass the meter. They could recharge 4000 and if you do not go and check for the next three months they will not buy anything” (Respondent A10)

“There are some people that normally break our pipes. They also use our water or for washing cars”. (Respondent A15)

“When constructions are ongoing they break our pipelines. Also when water passes through some illegal settlement, sometimes they create access into the water and take water thereby they contaminate our water also which reduces revenue”. (Respondent A19)

“We are supposed to be in charge of the boreholes. because of our vested responsibility to be able to control them we do not have that anymore, that is why they could be negative to us because even if there is any disease in Abuja nobody is going to ask if it is informal provider or government provider. They will say it is us”. (Respondent A4)

The following key findings can be deduced from the commentaries related to issues with pipe vandalism and illegal connections.

- Pipe vandalism from unplanned settlement happened a lot and impacted water quality and revenue
- People refusing to pay for water and connecting illegally
- Inability to regulate activities of informal service providers in delivering water service to required standards

This emanates from the comments put forward by respondents A1, A4-A13, A15 and A18-21 in utility one, L1-L19, L21-L23 in utility two, Respondents P1-P5 and P7 in utility 3 and all respondents in utility 4. These respondents all expressed affirmation to the fact that informal service providers impacted their services negatively and they lacked the capacity to enforce laws for arresting informal service vendors. This view contradicts works by (Collignon, 2002, Banerjee and Morella, 2011) who cited that African utilities with good practices had the capacity to employ and partner with licensed local water vendors to support their services for slums and illegal settlements

Another challenge which emerged from the analysis of the interviews and group discussion were the issues related to power failure. A total percentage of 53 % of respondents in all utilities identified challenges associated with power failure. The power failure was found to be the most dominant in utility 2 at a percentage rate of 91% and least dominant in utility 1 at a percentage rate of 9%. While power failure was observed to be 67% amongst respondents in the remaining utilities 3 and 4. See details in Table 2 in Appendix 6. The commentaries below substantiate the findings.

“Our major problem is power, the PHCN as they are called now have been a big nuisance to us because they have refused to supply electricity to us. We have to power our treatment facilities with generators and diesel is very expensive”
(Respondent L2)

“We need to ensure that we can get sufficient supply of cow dung for you to generate the gas. Because with gas we do not need the diesel, Nepa (energy) supply, if we generate the gas, we can get a bigger gas generator we can power the plant using the biogas thereby reducing the cost of diesel and the rest of them”.
(Respondent P9)

“We lack constant electricity. What management has done is we made provision for extra diesel to run our generator so without public power (without Nepa) we are ensuring customers a minimum of 8 hours of water supply.” (Respondent P5)

“Electricity supply is our major constraint. The state government has gone ahead to even come to our rescue with what they call an independent power plant to power our major waterworks. But our 48 mini waterworks are not connected to the independent power plant and the cost of running diesel generators is expensive”. (Respondents L3-L15)

“The generator sets are very old; the second generator we were trying to start was overhauled with a lot of money. But this morning when we went the battery was down it was spilling”. (Respondent P4)

“One of our key challenge here is the electricity, it has been a big challenge you know for a long time now, and the cost of running your power in Nigeria is very high”. (Respondent P1-P3)

“The major challenge is energy. We rely on energy for production. If you are not getting energy throughout the day for your production you will have to get an alternative and the alternative is expensive”. (Respondent K1)

“Like every other organisation, in Nigeria, we have the challenge of power supply. It is the number one challenge. Apart from the metropolitan areas Kaduna and Zaria and maybe Kafanchan almost all our other water treatment plants are located in rural areas and there is hardly any power supply in those areas” (Respondent K2).

“We have power shortage that is one of the challenges”. (Respondent K3)

Reflecting on the impact of the lack of power as a major challenge, the following inferences can be made. The lack of constant electricity impacts the operations of the water utilities and activities such as water production and distribution are hindered by a lack of power supply. In addition, alternative sources of energy are expensive to operate and maintain. The impact of the lack of power as a challenge emanates from the comments put forward by respondents A22, A10 and A14 in utility one, respondents L1-L18, L20, L21 and L23 in utility two, respondents P1-P3, P5, P8 and P9 in utility three and respondents K1-K4 in utility three. The views of respondents about power failure as a challenge are similar to works by (Owolabi, 2014, Oyegoke S. O., 2012, Chukwu, 2015, Oyebode, 2014, Odaro, 2012) that asserted that the lack of constant electricity impacted utilities from carrying out operations smoothly.

Poor project management also emerged as a challenge identified by 31% of respondents. Poor project management was the most dominant theme in case utility two at a total percentage of 78% compared to other utilities as only 11% and 35% of respondents in utility 1 and 3 respectively. This emanates from the comments put forward by respondents A1, A10, A11-A13, A15 and A17 and A22-A23 in utility one, respondents L3-L15, L17, L18-L20, L23 in utility two, Respondents P4 in utility 3 and no respondents in utility 4. These respondents described their projects with attributes related to poor performance. Projects were stated to be abandoned, delayed, incomplete or unsustainable. This is similar to finding depicted by (World Bank, 2014b, World Bank, 2005, Independent Evaluation Group, 2018, World Bank, 2004, Al-Jamal, 2018b, Independent Evaluation Group, 2017, Al-Jamal, 2018a) where the progress of urban water sector reforms in selected Nigerian utilities was characterised as unsatisfactory.

The commentaries below are a representation of most of the opinions of respondents about poor project management.

“The second project is the Adiyar two project is ongoing it is about 60% completed because we have had serious delays in finishing the project”.
(Respondent L2)

“Yes we have some ongoing projects, there are some that we are unable to further or continue because of lack of funds. There are a lot of ongoing projects that we are unable to finish due to financial constraints”. (Respondent A15)

“The issues we have with implementing the project is that counterpart funding from ADB and government has been delayed because of political issues and government transition after the elections. Until that is approved we are unable to start the new master plan” (Respondent P4)

“the corporation ran a pilot metering scheme but unfortunately we have just terminated the appointment of the contractors installing the meters because the project is not giving us value money, rather than increase revenue we have gone below 30%” (Respondents L3-L15)

Another challenge which emerged newly from the analysis of the interviews and group discussions in all four utilities was that people believed water was a social good. A total percentage of 67 % of respondents identified challenges associated with unwillingness to pay. In utility 4 all respondents identified unwillingness to pay as a major issue while only 22% of respondents in utility 1 were observed to describe an unwillingness to pay as a challenge. With the remaining 78% and 67% emerging from utility 2 and 3 respectively. The commentaries below provide detailed evidence of the perception of respondents regarding unwillingness to pay.

We have a lot of people that do not want to pay when they receive the water they state they have not been supplied water. (Respondent L20)

Politically the politicians campaign that water is free. When we try to get money from customers they say water is free so why are you billing us? We have been at the verge of increasing tariff some years back but we cannot because of the political impact (Respondent L22)

“a lot of politicians have been campaigning to people that they are going to provide this service free. We live in a state or country where politicians campaign to the people that water service is going to be free” (Respondent L23)

“The second challenge is the attitude of the citizens. There is a mind-set thing about our service being another government thing which will not succeed. That is also a challenge in trying to get citizens buy-in because that is half the battle if you get their buy-in then sales will pick up”. (Respondent P5)

“Most of our stakeholders especially the schools say our charges are very high so they are very reluctant to pay”. (Respondent P8)

“Before now water is given to them free so some people have not come around to appreciate what we are doing they feel we are ripping them off”. (Respondents P1-P3)

“A lot of consumers consider water supply as a social good so that is causing a lot of problems” (Respondent K1)

“Consumers see everything that government does as their right and they believe it should be free” (Respondent K5)

In summary, the following conclusion can be made with respect to how water being seen as a social good impacts service delivery. The views about water being considered as a human right stems from comments put forward by A1, A16, A18-A21 in utility one, respondent L3-L15, L18-L23 in utility two, Respondents P1-P5, P7 and P8 in utility 3 and all respondents in utility four. These respondents all expressed affirmation to the fact that there were citizens that felt water should be free and political campaigns from politicians further exacerbated the issue of non-payment from the public. This trend is similar to cited works by (Ajai, 2012a, Water Aid, 2007) stating citizens were unwilling to pay for water due to political campaigns from politicians making people have the mentality that water is free.

7.4 Key enabling factors affecting the performance of water utilities

The literature on good management practices and asset management had previously stated that factors such as governance and assurance, pro-poor solutions, capacity building, infrastructure and financing were required for implementing management practices successfully. To decipher the enabling factors pertinent to all case utilities, respondents were asked to identify critical factors which had impacted the activities of the interviewed water companies positively.

This subsection presents the results of the analysis of the interviews and focus group discussions conducted in case utility one on critical factors that enable successful asset management. Table 7.3 gives a brief summary of the different factors pertaining to all Case Utilities.

Table 7.3: Key Enabling Factors for the studied Case utilities

| Dependent nodes for Enabling factors | Percentage of respondents by case utilities | |
|---|--|---|
| | Abuja N = 61 | Dependent nodes |
| staff competency and dedication | 42% | Competent staff, well-trained staff, staff commitment, staff dedication |
| support from development partners and government | 57% | Funding from NGOs, and infrastructure projects from NGOs and government, training by NGOs |
| Customer paying regularly | 20% | Customers making payments |
| governance reforms and leadership | 19% | Making favorable policies, ministries regulating water quality |
| stakeholder engagement | 38% | Feedback from customers, stakeholder palets and workshops |

The findings show that about 42% of the respondents in 3 utilities out of 4 utilities identified staff commitment and competency as an enabling factor. Staff commitment and dedication as an enabling factor were only observed in utility 1, 2 and 4 with a percentage rate for respondents measured at 65%, 83% and 80% in utility 1, 2 and 4 respectively. This stems from the comments put forward by respondents A4-A13, A15-A21 in case utility one, respondents L1, L16-L18, L20-L21 and L23 in case utility two, respondent P1-P3, and P7 in case utility three and respondent K1 and K5 in utility four. These respondents all expressed affirmation to the fact that the staff commitment and competency was an element that impacted the organisation positively. They the utility staff were committed and dedicated even with the challenges they experienced. This view contradicts works by (Akhionbare et al., 2012, Water Aid, 2007) asserting that staff have low morale due to competency issues and poor training. The commentaries below provide a representation of respondents' views on staff commitment as an enabling factor.

“From what I have seen I see the enablers as one competency of staff the staff are well equipped they are educated we can do our job then customer satisfaction.”
(Respondent A8)

“The competency of workers is also an enabler because we have a wide variety of staff, a lot of them are well trained so competency of workers.” (Respondent A7)

“The factor that has helped us to achieve our goal I think the most important one is the staff dedication to work. Most of us you see here are ready to work and we are putting all our best”. (Respondent A18)

“It is because of the strength of the staff that we have come a long way. Even though to get the fund is difficult we have never compromised quality in terms of production of water so I believe the commitment of staff is one thing that has helped us”. (Respondent A11)

“Because the business is inherited, we have some experienced staff which is a main enabling factor for us”. (Respondent P7)

“the enablers are the dedicated people in the service that want the sustainability of the system”. (Respondent L23)

“Well the only thing that enables us is just the encouragement of knowing that what you are doing is aside from being a good deed is something that needs to be done.”
(Respondent P5)

Support from international donors emerged as the most prevalent theme for enabling factor with a percentage of 57% within 3 utilities only. 65% of respondents in case utility one identified the support from international donors while 83% and 80% of respondents were observed from utility 2 and 3 respectively. See table 7.3 and table 3 of Appendix 7 for details. The commentaries of respondents associated with the support from international donors are highlighted below:

“Well thanks to the support from all these international agencies they come with equipment and then we make use of them. It helps to a certain level because when they come they buy hardware. Also, they come in and train staff. I have benefited from one recently done by JICA they trained us in our area.” (Respondent A2)

“JICA has been of assistance to us for example they trained close to 40 of our staff members. World Bank was of assistance they brought in money physical money to work on Gwarinpa, Karu and Gwagwalada. I was told almost about 500 million naira which is a lot of money”. (Respondent A1)

“We have the Japan International corporation agency who are currently helping us reduce non- revenue water. (Respondent A16)

“Then you have the NGOs the CSOs then you can now look at these financial institutions that do support us like the World Bank, JFIG, and water aid”. (Respondent A17)

“JICA has done very well for us here in donating equipment they have been taking our staff for training and I believe they have done so much.”(Respondent A20)

“even though we say we do not have any funding at least we have had some funding from the World Bank and from the AFD which we have been using to do some expansion projects, rehabilitation of the treatment plants, capacity building for the staff that were on ground and these have helped to improve the system although we still need more”. (Respondent L1)

“Then the world bank also has helped us a great deal by extending loans to us the same thing with the African development bank (AFD) and well some commercial banks have also helped us in our time of need you know when you have shortfalls and cash flow these are our stakeholders who have helped us”. (Respondent L2)

“The World Bank and other Financial Organisations support us to get funds to achieve our objectives”. (Respondent L16)

“We have had this cooperation with the international development partners, World Bank, African development bank, the Islamic development bank they have been supportive mostly in our projects”. (Respondent K2)

“The World Bank, The African development bank, the Islamic development bank they help fund and finance this water supply water projects”. (Respondent K3)

In summary major point associated with the support from international donor agencies includes

- Training of staff
- Funding infrastructure projects and giving grants to improve the organisation
- Providing equipment, instruments and facilities that enable the staff to work better

This emanates from the comments put forward by respondents A1-A3, A9, A11-A13, and A16-23 in utility one, respondents L1-L16, L19, L22 and L23 in utility two, none in utility 3 and respondents K2, K3, K5, K6 in utility 4. These views are similar to works by (World Bank, 2011b, Fall et al., 2009, Newborne et al., 2015) that identified how funding and infrastructure and capacity building projects provided by international donor agencies impacted the performance of water utilities in Nigeria.

Another enabling factor which emerged from the analysis of the interviews and group discussions were customers paying regularly. However, compared to the challenge of customers not making payments regularly only a total of 20% of respondents in only two utilities identified timely payments from customers as an enabling factor which is lower than 67% of responses related to customers not paying regularly. 61% of respondents in utility one identified customers paying regularly as an enabling factor while 17% of respondents in utility two identified it as an enabling factor. The commentaries below provide a piece of detailed evidence regarding willingness to pay:

“There are customers interested to see that our services are the best because they are enlightened when there are issues they call, they inform us, even when we are unable to on our own detect these issues”. (Respondent A2)

This emanates from commentaries put forward by respondents A1, A4-A8, A10-A13, A18-A21 in utility one and respondents L18-L20 and L22 in utility two. However, the findings of the willingness of customers to pay for services contradict works of (Macheve et al., 2015, Odigie and Fajemirokun, 2005, Ohwo, 2016, Ohwo and Agusomu, 2018, Water Aid, 2007) that show an unwillingness to pay from customers due to intermittent water supply and the perception about water being a social good.

Another factor promoting service delivery identified by participants in the interviews and group discussion was governance reforms and leadership. However, only 19% of participants interviewed in all utilities laid major emphasis on governance. This is lower than 73% of respondents that described governance as a challenge rather than an enabling factor. Also, governance being an enabling factor was only evident in two utilities. 60% of respondents were

found in Utility one while only 13% of respondents in utility 3 described governance as an enabling factor. Facts about governance and leadership are clearly detailed in the following respondents' commentary:

“Positively I would say governance and in terms of governance, I mean government policies. The FCT probably will be a leading state because in terms of having firm policies in place this is one state that already had development plans for each sector from the inception and FCT has a water supply master plan which you know of course is a plus. It means you have a direction you know where you are going, you know what you want to do and when you should achieve it”
(Respondent A9)

“The regulators are enablers; we mention legislators that is legislation as a rule also enablers it forces people to pay” (Respondent A15)

The ministry of environment, NESRA, the ministry of health and ministry of water resources regulate our activities and since it is a water-based organisation they want to see that the populace get water so they enhance our activities as well and they control the dams (Respondent A4-A8)

Then governance, the government making policies to favour the production of water (respondent A5)

The following key findings can be deduced from the commentaries of respondents A4-A8, A9, A15, A18-A21, P4 and P7 in case utility one and three.

- Government making favourable policies
- Government regulating and checking the activities of the organisation – water quality and effluents back to the environment

This contradicts the views of (Akpabio, 2007, Akpor and Muchie, 2011, Durokifa and Abdul-Wasi, 2016, Hodge, 2007, Iliyas, 2000, Nwankwoala, 2014, Omole, 2013, Owolabi, 2014, Oyebande, 2006, WaterAid, 2006, Water Aid, 2007) who assert that the Nigerian Urban water sector has poor governance structures. However, the degree in which responses vary for good governance structures were only two utilities out of the 4 utilities studied identify governance as an enabling factors could suggest a varying degree in which utilities implement governance structures which is similar to works by (Akpabio, 2007, Akpor and Muchie, 2011, Iliyas, 2000,

Nwankwoala, 2014, Omole, 2013, Owolabi, 2014, WaterAid, 2006, Water Aid, 2007) that state that a major variance exists across utilities in Nigeria when developing and implementing governance structures.

In addition, stakeholder engagement emerged as an enabling factor for interviews conducted in case utility four. 38% of respondents reported that the stakeholder engagement was an enabling factor for the performance of water utility four see table 7.3 and Table 3 in appendix 7. However, it was observed that stakeholder engagement as an enabling factor was relatively low in Utilities 1 and 2 as only about 9% and 4% of respondents from the respective utilities identified stakeholder engagement. While 78% and 60% of respondents were observed from utility 3 and 4 respectively making stakeholder engagement a more dominant theme in utility 3 compared to other utilities. The commentaries from a few participants focus on stakeholder engagement as an enabling factor are analysed below.

“Yes, we have an engagement practice. We are having jingles on the radio, we engage with our stakeholders when projects occur. We also have a customer care unit that liaises with the customers for resolving their complaints”. Respondent K2

“We send cards to our customers if you see anything you call us and we always have zonal offices in every ward. We always say it through media that go to the nearest water board office. We give out bills every month and this engagement has made our offices to so popular. So almost all our customers know our offices”.

(Respondent K1)

“Before the project was embarked on, customers were invited to a stakeholder meeting to tell them about our intention. SWASA championed that stakeholder's meeting and after the meeting one of the customers wanted us to install meters in her place” (Respondent P1-P3)

The findings of enabling stakeholder engagement systems contradict works by (Balogun et al., 2017, Ugbah et al., 2017, Water Aid, 2007) who assert that stakeholder engagement and community participation is more of a concept in Nigeria than an actual practice. However, the degree to which responses vary across the case water utilities in regards to stakeholder engagement could also suggest a variance in implementing stakeholder engagement across the different utilities which corroborate findings by (Ugbah et al., 2017) believes that majority of the communities in Nigeria still do not practice stakeholder engagement.

7.5 Management policies and strategic plans

Sections 4.3.1 and 4.5.1 of the literature on the Nigerian water sector have shown that nationally the bill which supports the development of state water laws, policies and state water master plans has not yet been passed. But the important questions that need to be answered are what states utilities have gone ahead to develop these components and how well have they developed these components? If not, what alternatives do other states utilities without these components use to deliver value to their organisation and finally what is the level of implementation of asset management components? To understand what is going in each utility, respondents were asked to identify the existence of policies, plans, laws, objectives, strategies, for managing various asset types. Asset types in this context refer to physical infrastructure, people, information systems and financial assets. Respondents were also asked to speak on their level of implementation.

When asked about the current policies in place for water management and their level of implementation the following four key findings emerged across all the utilities studied.

Firstly, the results show that 72% of respondents studied identified policy targets that were similar to the National Water Policy. See table 7.4 for details. Policies were classified with phrases such as water quality, affordability and adequate quantity. 91% of respondents in utility one (1) were observed to classify policies similar to the National Water Policy Quotations from respondents, 80% of respondents in Utility four made similar classifications and 74% were observed in Utility two (2). The remaining 44% was observed in Utility three (3) See table 4 in appendix 7 for details. The trend of policies being similar with the national water policy is supported by works of (Ajai, 2012b, Akpabio, 2012a, Federal Ministry of Agriculture and Water Resources, 2016, FRN, 2007, Goldface–Irokalibe, 2006, Macheve et al., 2015, Water Aid, 2007, World Bank, 2011a) who have stated that state water agencies should develop policies. The following quotation substantiates the finding.

“Even with an ageing treatment plant, we are producing quality water to WHO standard or Nigerian Drinking quality water standard.” (Respondent A17)

“The board has successfully within the limit they find themselves provide potable water to the residents of FCT. The quality of our water is still the best we have not compromised.” (Respondent A2)

“Our mission statement is to produce water to the populace at an affordable rate and in a consistent manner” (Respondent L3-L15)

“Yes, we want to be known as number one in regards to the supply of water and waste treatment services and we intend to do that. We want to be a reference point when they talk about potable water” (Respondent P6)

“Our aim and objective are to produce and give out water that is world standard and that has been done”. (Respondent A10)

“So our mission statement is to provide water adequately and affordably to people 24 hours a day to entire areas of the state with good quality as well as our system to be sustainable that is our mission statement” (Respondent L23)

“Our policy is we produce standard quality water that meets World Health Standard. And we want to do it at a minimal cost”. (Respondent A18-A21)

“Yes, one of our vision is to be the best in potable water distribution. To be the best means you meet quality standards and you have very high productivity”. (Respondent P7)

Table 7.4: Results on policy development and implementation

| Dependent nodes for policy development vs implementation process | Percentage of Respondents | Dependent nodes |
|---|---------------------------|---|
| similar to NWP targets | 72% | quality, affordable rate, quantity, reduction in the incidence of diseases, |
| no discrepancies | 25% | No discrepancy in implementation, doing what the mission statement states, |
| Ineffective policy implementation | 57% | Draft policy, no law to implement policy, draft laws and laws under review, the policy is under review. Political interference impacting policy implementation. |
| existing mandate and state water master plan | 58% | Mission statement, vision, mandate, state water master plan, charter, |

| | | | |
|--------------------------------------|----------------------|----|---|
| following principles approval | common before | 4% | following common principles before approval |
|--------------------------------------|----------------------|----|---|

The results also showed that 58% of respondents were observed to refer to mandates and master plans in place of non-existent policies. See table 7.4 for details. 61% of respondents in utility one (1) were observed to identify existing mandates and master plans. Similar trends were also observed from 78% of respondents in Utility two (2) and 80% were observed in Utility four (4). The remaining 11% was observed in Utility three (3) See table 4 in appendix 7 for details. The existence of master plans corroborates the requirements stated by for the development of a state master plan (Ajai, 2012b, Akpabio, 2012a, Federal Ministry of Agriculture and Water Resources, 2016, Federal Republic of Nigeria, 2004, FRN, 2007, Goldface–Irokalibe, 2006, Macheve et al., 2015, World Bank, 2011a). The following quotation provides an overall summary regarding the commentaries from respondents that highlighted the existence of mandates and mission statement.

“FCT has a water supply master plan. Our target is to follow the master plan to every detail.” (Respondent A17)

Yes, our mandate is to produce potable water of very high standards. For now, we are ranked high amongst the states in Nigeria. In terms of water quality, we do not compromise. (Respondents A11-A13).

“We intend to provide services that cannot be compared to other services abroad”. (Respondent P4)

“This document states all our vision, mission and goals. We are working towards meeting that objective now of being a modernised water board that is why we are reforming” (Respondent K3)

“The mandate of the organisation is the provision of potable water to the residents of the FCT and they say at an equitable economic rate (Respondent A1)

“Our mission statement is just to produce water to the populace at an affordable rate and in a consistent manner”. (Respondents L3-L15)

“Our mandate is to supply potable water to the populace of FCT. We try as much as possible to go in accordance with our mandate”. (Respondent A17)

“In the master plan there is supposed to be 12 treatment plants and right now we have 4. The first two treatment plants there has been a gap in the rate at which they were being implemented.” Respondent A9

In addition, results showed that 57% of respondents indicated the implementation level was ineffective. See table 7.4 for details. 61% of respondents were observed from utility one (1) and similar trends were also observed from all respondents in Utility four (4). However, there were fewer respondents in Utility two (2) and 3 with a respondent percentage of 22% and 44% respectively. See table 4 in appendix 7 for details. This view of ineffective policy implementation is supported by the works of (Akpabio, 2007, Akpor and Muchie, 2011, Iliyas, 2000, Nwankwoala, 2014, Omole, 2013, Owolabi, 2014, WaterAid, 2006, Water Aid, 2007) who also state that the utilities in the 36 state of the country are implementing policies at a slow pace. A summary of commentaries related to slow policy implementation is detailed as follows.

“I would not say discrepancies but I will say the implementation of the policies is not as rigorous or as effective as I would have loved them to be implemented. It is just like everything in Nigeria you make policies but the implementation is always haze” (Respondent K2)

“You cannot start implementing a policy until a law comes into being since we do not have the law we cannot start implementation so we still have to wait for the law which is in the house of assembly”. Respondent K6

“We have itemised everything that needs to be done for us to hit a 100% target and we are taking it in phases. We are through with the early phase, however, we have not started the second phase because we are still testing the sludge packaging and revenue we can gain from it”. (Respondent P9)

“ In customer service, we have a policy and we have a charter more or less. Now that charter is still like on the draft stage but we still live by it in terms of service delivery”. (Respondent P5)

“Waterwork is supposed to be a corporation and the ownership and mode of operation for an organisation like this matters. However, we are not fully a corporation. I think there are slight discrepancies because we sometimes design

our policy based on certain principles but the government may see it as not proper and they can interfere at any time” (Respondent K5)

“Oh definitely. Yes. There is a big deviation from what we are doing right now and one of our main problems is called political interference. The water law has spelt out what we are supposed to be doing but political interference has affected our operations especially now that we have a new government”. (Respondent L2)

“Yes because we were supposed to be the major provider of water supply in the state. But now we can only cover maybe about I think 12 and 13% of the state. That shows that we are far away from where we should be. There is nothing wrong with our policy. The policy is there but there is no infrastructure in place” (Respondent L17)

We do not have the strength to be able to enforce the laws. Yes, the policy is there but we are incapacitated we are not able to follow the policy in practice. There are so many goals that we are supposed to have achieved. We have ideas but being able to actualise it is difficult.” (Respondent A1)

“There is a draft policy to ensure safe sanitation practice by the year I think it is a plan that spans like 10 years. There is a 5-year plan and then 10-year plan for eradication of open defecation. So we want to ensure that in the next 5 years there is no incidence of open defecation anywhere within the FCT like that and for you to achieve that you will have to do it gradually, all the local government areas”, (Respondent A2)

“We have not been able to come up with every article of the policies because of the other challenge with finance. The only thing that is affecting our policy is that finance is not making us move the way we thought we could have moved”. (Respondents P1-P3)

“Well, I know the basic function we do perform here is to distribute water to the entire FCT to the populace of FCT but the major setback sometimes is funding. The mandate of the organisation we do not have any problem with it other than implementation”. (Respondent A16)

“Of course there are major differences in terms of our targets and our policies, the targets and achievements at the end of the year, we have lots of challenges and we

are not being able to meet up our targets, I will say on an estimate not even up to 50% of our targets right now because of funding challenges”. (Respondent A3)

“From the policy statement and from the achievement I would not say that we have achieved up to 50% of our goal. The cost at which we produce water is far higher than the cost at which we sell. The reason behind the difference in cost is the political issue”. (Respondent L22)

The results also showed that 25% of respondents indicated there were no discrepancies with developed policies and the implementation process. See table 7.4 for details. This finding was only applicable to utility one and two. 43% of respondents were observed from utility one (1) and similar trends were also observed from 57% of respondents in Utility four (4). See table 4 in appendix 7 for details. A summary of commentaries related to no discrepancies with implementation is detailed as follows.

“our mission statement is just to produce water to the populace at an affordable rate and in a consistent manner which is what our target has been and we are pursuing so there is no disparity no contradiction to that policy statement”. (Respondents L3-L15)

“Well I would not say there is much difference but like you know there are always improvements. People could keep improving on these things. the Lagos state water policy is being reviewed and of course, in line with this preview the entire organisation too will go with this review so that is the stage we are now”. (Respondent L1)

“The board has successfully within the limit they find themselves have been doing what they are supposed to do. The quality of our water is still the best we have not compromised in that. The only challenge we have in terms of infrastructure management managing these infrastructures most of our lines are old”. (Respondent A2).

“One of our mandates is to ensure that the FCT residents get adequate potable water supply. What this means is providing good quality 24-7. But definitely, we are not giving 24-7 supply to every area and this is still based on some of the

challenges that we already had gone over before. Infrastructure not being enough and then, of course, population growth putting pressure on the supply”. (Respondent A9)

“When you are talking of vision and goals and whatever Waterboard is I will not say 100% I will say about 96%. Our aim and objectives are to produce and distribute water that can be compared to the world standard and that has been done. The only problem is that the lack of regular electricity affects production sometimes”. (Respondent A10)

It is not different. We have a mandate to carry out and we pursue it. The only thing is we lack funds. When the government is not funding the organisation, it has a negative effect on the mandate. That is all I will say about it. (Respondent A14)

“We practice what the policies say. We have our mandate we have our vision, we are to produce water enough and with good quality that is our mandate at a low cost which we are doing we have a standard which we are keeping to we do not compromise the standard.

(Respondents A4-A8)

“We have a mandate I think we are pursuing it; everybody is focusing on it except these few shortcomings that we have mentioned that is hampering the achievement of the mandate. Those issues that we have mentioned, lack of funds, low staff morale”. (Respondent A11-A13)

This view of no differences found in policy implementation contradicts works by (Akpabio, 2007, Akpor and Muchie, 2011, Iliyas, 2000, Nwankwoala, 2014, Omole, 2013, Owolabi, 2014, WaterAid, 2006, Water Aid, 2007) which states that Nigerian water sector are unable to enact laws and policies.

In summary, the following key findings can be inferred from this section

- More respondents identified the ineffective implementation of policies compared to respondents that firmly believed that no discrepancies existed in terms of developed policies and actual practices. This could also suggest
- Respondents that believed there were no discrepancies with policies and actual practices, however, stated that implementation of policies was impacted by issues such

as funding, infrastructure management issues, and population growth and staff management issues.

- Most respondents identified the existence of mandates and master plans as against actual policies associated with quality, quantity and cost targets.

7.6 Management Processes

This section deals common management processes utilised by the state water agencies identified during the fieldwork. The questions asked in the interview related to this section included management processes and strategies which were employed by all utilities for managing the assets i.e. the people, infrastructure, information and finances. The key management processes utilised by the utility one are outlined in table 7.5

Table 7.5: Results on key management processes

| Key themes for Management processes | Percentage of respondents by case utilities | |
|--|---|--|
| | Total number of respondents | Dependent nodes |
| | N = 61 | |
| Management of water as an asset | 78% | water treatment, production, transportation, storage, quality analysis and distribution |
| maintenance and rehabilitation | 52% | Corrective maintenance, rehabilitation projects for pipes, rehabilitation projects of treatment plants, fixing pumps, fixing pipe burst and leakages |
| Management of stakeholders (human assets) | 67% | Stakeholder engagement workshops, radio jingles, customer service units, public sensitisation |
| Management processes for financial assets | 58% | revenue generation, bill distribution and revenue collection, and budgetary mechanisms |

| | | |
|---|-----|--|
| monitoring, | 71% | evaluation, surveillance and control, risk management systems, taskforce, audit, monitoring and metering |
| information management, | 66% | knowledge management and information systems and inventory systems, data management |
| Management of staff (human assets) | 51% | Training, staff diagnostic, staff performance assessment, staff discipline, staff placement, staff rewards and payment |
| developing and executing projects | 67% | Maintenance projects, extension projects |

Table 7.5 shows that 78% of interviewed professionals stated that there were existing processes related to managing water. Processes such as water treatment, production, transportation and distribution were dependent nodes classified under managing water as an asset. The analysis from the interviews and group interviews showed that the theme was more dominant in Utility compared to other utilities as 91% of respondents in Utility 2 identified processes related to managing water. While in utility 1, 3 and 4 the percentage of respondents were measured at 87%, 67% and 67% respectively. Details are shown in Table 5 of Appendix 7. The quotations below represent an overall summary of the views of respondents in all case utilities for water management processes.

“Our basic function is to distribute water to the populace of FCT.” (Respondent A16)

“We are able to evacuate the water from the treatment plant and put it in all the storage tanks alright and distribute it”. (Respondent A17)

“We have a unit that is called quality control. They have a laboratory here and we work in synergy. From their laboratory analysis, they tell us the required quantity of alum and other chemicals for treating the water we will produce from the treatment plants”. (Respondent A22-A23)

“This is the laboratory and this where we do our pathological analysis. In the pathological analysis, we identify, Total coliform faecal coliform and E. coli. Our analysis here is the photo-based method so this pH meter what we use to measure. This is our photometer it carries out so many parameters, high methods like sinking aluminium, nitrate it carries out about 15 parameters” (Respondent P8).

“The production of water is very important to us. We are interested in abstraction and how much water you put into the system” (Respondent K6)

“The organisation aims to produce water at a very affordable price that can be consumed by the consumers”. (Respondent K4)

“We have the production, we have the distribution and you have the commercial who is in charge of collecting revenues”. (Respondent L1)

“We are to produce adequate water for the people and not just water potable water that is it is wholesome water that meets the WHO standard”. (Respondent L19)

“We have the production department, we have the commercial department, which is next, and when we receive the product from the production centre we give to the consumers. For this department, we deal with distribution and we also control leakages” (respondent L3-L15)

“regarding production, the effort is on the ground now at least to go for another major waterworks, Adiyon Phase II and that Odumola I” (respondent L21)

Also, in Table 7.5, 58% of the total number of respondents interviewed identified processes related to financial assets. The highest percentage of responses occurred in utilities one and two at a rate of 74% and 87% respectively. While only 50% of respondents identified management processes related to financial assets in Utility 4 and 22% were observed in Utility 3. The Quotations from respondents interviewed which are outlined below expatiate more on processes used to manage financial assets.

“We have a finance and account department that handle finances, and under that and of course any financial procedure is subject to the normal government regulation governing finances”. (Respondent A3)

“There is some money FCTA normally releases to us which is called running cost. it was last September running cost that we picked last. This is what we have used to take care of so many things like pipe burst”. (Respondent A15)

“when water board generates revenue, all monies go to the treasury single account (TSA).” (Respondent A12)

“We aim to break even so the revenue we collect will be able to sustain our operations and it will also be enough to invest in extending our supplies to other people who are not presently served”. (Respondent K3)

“Every water rate comes into the revenue water account which nobody has the power to spend so that is good control. Even the district offices once the money enters the account the manager has no control over it so he can view it as 5 naira came in yesterday that is all he can always check. At the end of the month or so that revenue money from the revenue account is transferred to operations action to be expended on chemicals, salaries, maintenance that is our general policy of practice”. (Respondent K5)

“When you use water, you pay for what you use so we are not charging flat rates like for everybody. So, if you do not use your water it does not read. So, when it reads every month we will come and check it and bill you based on what you used”. (Respondent P1-P3)

“You have the commercial department who is in charge of collecting revenues. As it stands, the system cannot sustain itself we depend on the government for subvention”. (Respondent L1)

You know the goal of commerce department is to get revenue for the organisation and how do we do that we read meters we send the meter reading to the reading unit they produce bills we give out bills to the customers after giving out bills we do follow up on that. Those are the major jobs we do. (Respondent A3)

About 51% of the respondents who were part of the study indicated that processes associated with managing staff as a key process. The highest percentage of responses occurred in utilities one and two at a rate of 70% and 91% respectively. While only 33% of respondents identified management, processes related to staff in Utility 4 and 11% were observed in Utility 3. The Quotations from respondents interviewed which are outlined below expatiate more on processes used to manage staff.

“We have an admin department and supply department that handles the administration of the staff” (Respondent A3)

“Our training is poor not properly channelled to the right people and not targeted to their needs”. (Respondent A2)

“Yes, as far as training is concerned it is scored zero because a lot of people have not received training in the past.” (Respondent L20)

“We do a lot of training. But for you to sustain training you need a lot of funds. It is also a major challenge funding for training it is only when we have projects like this that we will get enough money to even train the staff but from the revenue, we generate it will not be enough for us to expend part of the money on training.” (Respondent K3)

The next prevalent management process stated by 71% of respondents were risk control and monitoring systems used by the organisation. 96% of respondents in utility two identified control systems, 65% and 67% of respondents were observed in Utility one (1) and (4) four while the least rate of responses on monitoring systems was observed in utility 3 at a rate of 56%. The following Quotations from the respondents provides a general idea of the overall perception of respondents on monitoring and control systems.

“Yes, we have a task force in the corporation they go around monitoring such activities and they also collaborate with the Lagos state task force to do the same thing. The Lagos water sector law from 2004 has provided for a water court where we can charge people who vandalise our properties so these measures that are in place to curb activities like that”. (Respondent L2)

“We have set up a unit called monitoring and detection to mitigate issues with illegal connections. They go out daily you know from place to place. We have a joint task force with Abuja environmental board, and they go to every nook and cranny looking at things and situations on the ground”. Respondent A10

“Speaking from the audit perspective, yes we have control we put in place for our organization because yearly we do our audit plan. The audit plan ensures that the internal control system is sound. We go on monthly monitoring to all the area offices and we check the books of account every month. We go on surprise checks too to see how well they operate. We will gather this and pass it back to the management. (Respondent A14)

“We have some task force in 18 area offices that normally move from one place to that monitor people vandalizing our pipeline and people with illegal connections”. (Respondent A15)

“In the case of illegal water connection, a times we do inspection house to house inspection. Sometimes, some people will have two connections so when you monitor them regularly you will notice that and carry out the necessary disconnections”. (Respondent A16)

“We have the Federal Ministry of Water Resources who serve as regulators. They come around to check our water samples, check for those parameters most especially in most cases they take treated water and see whether those parameters in the treated water conform to the Nigerian standard and WHO standard for both water qualities”. (Respondent A20)

“We have just existing piped networks so what we do we also have a department that is in charge of leak detection it is called a detection department, they detect these leakages and they mend them”. (Respondent K6)

“We have a monitoring and evaluation unit under the corporate planning department which is functional they keep this data that you are talking about. They monitor, they evaluate. And we have a performance management tool in place we can now monitor performance if there are inadequacies, we train to take care of those inadequacies”. (Respondent K3)

The results showed that about 67% of the respondents stated developing and executing projects were key management processes. See table 7.5 for details. Majority of the views on developing projects occurred from utility two at a rate of 87% while utility 3 was the least dominant utility for project execution at a percentage rate of 33%. The remaining responses from utility 1 and 4 were measured at 67% and 83% respectively. Details are shown in Table 5 of Appendix 7. The following commentaries from respondents corroborate the findings

“Yes, we have some ongoing projects, there are some that we are unable to further or continue because of lack of funds” (Respondent A15)

“We have a lot of projects already on the border the Adiyen phase 2, Odumola they are all in the master plan, but funding is not available, what is being done presently by the state is the waterworks. Hopefully, by 2017, it should be completed and then we can focus on the distribution pipes” (Respondent L3-L15)

“JICA has two projects they have non-revenue water and the solar energy for lower Usuma Dam to solve the electricity problem. They have started since last year. (Respondent A14)

“We are currently building Adiyen phase 2 in the same location as Adiyen Phase one, it is like an extension of phase one. We have Sodiyan and Odumola we are trying to have another waterworks around Lekki area, and we have so many other potential projects. We want to increase the distribution network to go as far as Ikorodu”. (Respondent L17)

“The FCDA federal capital development authority came up with the Gurara project which was commissioned 3 years ago. So, they took water from Gurara River straight to our water damn so that in case shortfall from rain regularly they can take water from Gurara. The project has been completed also two new treatment plants were established”. (Respondent A10)

“So, we have a project now the JICA and is currently assisting us to strengthen our capacity to reduce the non-revenue for water”. (Respondent A17)

“Japanese government called JICA, the Japanese International corporation agency called JICA, where the generation of clean energy is our solar electricity generating system, from JICA. They want to give us 1.2-megawatt solar energy aid they threw this project they gave it to the Nigerian government”. (Respondent A22-A23)

The findings show that projects are majorly initiated by international donors and FCDA and not the utility itself. The findings also show projects are majorly initiated for changes in management processes.

Also, Maintenance and rehabilitation were identified as a key management process. 52 % of the respondents from the interviews and group interviews stated the maintenance and

rehabilitation of physical infrastructure occurred. Out of the 52% of respondents, Majority of the respondents were observed to be from utility 2 with a percentage rate of 83%. While the responses from utility 1, 3 and 4 were measured at 57%, 33% and 33% respectively. Some commentaries from the participants who took part in the study substantiate these findings:

You also have facility management which handles the management of facilities of the whole water board. Even the mega structures such as the waterworks, the dam there so you have facility management that takes care of all those facilities. (Respondent A3)

“Now we come to the maintenance of equipment which is the key to the whole process. We have plants and generators we tell our unit head the servicing requirement of our generator which are monthly and annually. We make a budget from there, and articulate the requirements in detail (Respondent A22-A23)

“even the operation and maintenance we have our PPM, we have it available but we cannot implement it, so what we do most of the time is corrective maintenance which means until when those pump or equipment breakdown that we want to attend to it, and we attend to it also based on funds availability”. (Respondent L20)
So, we have the PPM in place, but we are not following it because for one reason or the other”. (Respondent L19)

Apart from that we do not have anything in place we just fix things as the need arises, we do not have a preventive maintenance programme. We used to have but some few years back the maintenance department was scrapped and since then our assets have just been going downhill and we only rehabilitate when they grind to a halt (Respondent L2)

Another management process which emerged from the analysis of the interviews and group discussions was information management. See table 7.5 for details. A total percentage of 66 % of respondents identified existing information management processes. 89% of respondents in utility three (3) were observed to indicate the existence of information management systems. 83% of respondents in Utility two (2) showed similar trends. The remaining 43% and 50% was observed in Utility one (1) and four (4) respectively See table 5 in appendix 7 for details the commentaries below provides a general idea of the opinion of respondents regarding information and inventory systems.

“I know that we do try to take stock of what we have but there could be a better way of doing it where we try to develop a kind of an information system an inventory, inventory in the sense that it is computerized, we have been discouraged having that they still prefer these things being done the manual way”. (Respondent A2)

“The last inventory we have for the water facilities, was 2012, end of 2012 so about 3 years ago but we have not done another inventory again”. (Respondent A3)

“The information system we are using here there is still some laxity in it. If they can overhaul the whole system, it will improve our revenue generation. Most of our systems in the office they are outdated we need to upgrade them”. (Respondents A11, A12)

“Currently Port Harcourt is about 1.5 million people and we intend to meter them using a modern metering system, prepaid billing system, we would also have a SCADA system that can capture information of unaccounted water, and also capture customer consumption pattern with a smart card”. (Respondent P4)

Next set of management process classed as important identified by 67% of the respondents, was stakeholder engagement and public sensitisation. Out of the 67% of respondents, most of the respondents emerged from utility 2 and 3 with a percentage rate of 87% and 89% respectively. While the responses from utility 1 and 4 were measured at 43% and 50% respectively. The following Quotations from the respondents provides a general idea of the overall perception of respondents on stakeholder management as a process:

“What we try to do is to sensitise them to make public announcements and jingles to educate them to properly inform them that yes water is a resource from the ground but for it to get to your room or your apartment there are so many things that are going through which cost money so it is a matter of trying to sensitise them”. (Respondent A1)

“We normally call a stakeholders meeting. Where we will call all the people who are stakeholders for the meeting in one room. To address them to tell them the impact of the project. We involve people who know them especially the CDAs that is the community Development Association (Respondent L1)

“I think if I may add to what I have already told you earlier. One of the major factor, why we decided to have a stakeholder meeting monthly, is because we believe that customers are kings, therefore, they have to be well treated so that is one of the major reason and then we can have feedback from them”. (Respondent A10)

There was this radio enlightenment programme (jingles) that we used to do before but you know presently everything is being reviewed but I am sure maybe when they pass budget it will happen again. (Respondent A18-A21)

“We invite our stakeholders to a meeting to discuss issues that will arise during implementation because it has to do with pipe laying, erection of reservoirs and the rest. There are people issues. Issues of air pollution are there, issues of movement restriction”. (Respondent K3)

“We are planning to send out letters to all our stakeholder and do some radio announcement and we may also use jingles to inform them about why they must test the water they use. that is what we intend to do”. (Respondent P8)

“Yes we have stakeholders’ meetings of different categories because we have not gone into full distribution our stakeholder meeting is not frequent as it should be however we do engage stakeholders, right now we are at the stage where we are communicating the change before it was a free public service utility but now we will start billing by the new engagement”. (Respondent P7)

In summary, the following findings were found with respect to management processes in case utilities.

- There were existing management processes for all asset types. Management process in place for infrastructure, staff, customers and stakeholders, information, revenue.
- Projects were also in place and were majorly done with help from FCDA the parent ministry and international donors
- There were also risk management, control systems and monitoring processes in place

7.7 Performance measuring systems for evaluation

7.7.1. Key performance indicators

This section identifies performance measurement systems adopted by the selected case water utilities. The questions asked in this section were related to the key performance indicators used by the case water utilities to determine where they were currently sitting in terms of performance. In addition, another set of questions were asked to identify the maturity levels of water utilities.

A cross-case analysis was achieved by analysing the KPIs associated with each specific utility as shown in Table 7 of appendix 7 and Table 7.6. Documentary evidence was provided from technical experts responsible for monitoring utility efficiencies in Utilities 3 and 4 while there was no documentary evidence provided by utilities 1 and 2. See Table 10 and Table 11 in appendix 7 for details.

The results show that most of the responses regarding KPIs were related to technical oriented indicators like the International Benchmarking Indicators. About 50% of respondents in all four utilities identified non-revenue water, 76% of respondents identified billing and collection efficiency, 81% of respondents identified production capacity and service coverage as key indicators. Water quality was also identified by 59% of respondents. Also, the documentary evidence provided by the technical expert in utility 4 as shown in Table 10 shows that Key performance indicators used were technical in nature. They include Water production in million m³, Number of connections, Population served from the systems under rehabilitation, collection and billing Efficiency, Total cost of production in million naira, Revenue from water sales in million naira and Cash operating ratio which was similar to KPIs identified by respondents.

Furthermore, documentary evidence provided by an expert in Utility 3 shows that KPIs were project-oriented based on the current reform project which was ongoing within the utility. These KPIs were also technical in nature as indicators such as the number of female beneficiaries, direct project beneficiaries, the number of improved connections were used for measuring performance.

Table 7.6: Results for Key performance indicators.

| Dependent nodes for Key performance indicators | Percentage of Respondent |
|---|---------------------------------|
|---|---------------------------------|

N = 61

| | |
|--|-----|
| Production capacity | 81% |
| Billing and collection efficiency | 76% |
| Non- revenue water | 50% |
| Water quality | 59% |
| Service coverage | 81% |

The commentaries below represent a summary of the views of respondents on how the different key performance indicators were described.

“We are producing quality water to WHO standard or Nigerian Drinking quality water standard from the treatment plant we can take the water, we can evacuate the water from the treatment plant and put it in all the storage tanks alright and distribute it.” (Respondent A17)

“But the water board allows you to see their product which is water for 24 hours. That is why I said for service delivery water board I rate it 100%”. (Respondent A5)

“We do not joke with the quality and I will rate us high. All our work from quality control start from the source we do not just analyse the water we check the quality of chemicals before we buy it”. (Respondent A4, A6 and A8)

“Currently FCT water board stands top in terms of ranking in water quality it is even better than bottled water so majorly our staff in quality department rank high in terms of our efficiency and effectiveness”. Respondents A11-A13

“We can produce adequate water in terms of quantity and potable water that meets the WHO standard but unfortunately some people get water that does not meet that standard because local plumbers connect illegally”. (Respondent L19)

“The quality control department measures the quality of water while the operations measure the quantity and this is compared vis-à-vis installed capacity”. (Respondent K2)

“So number one key indicator is non-revenue water so the second one is collection efficiency how much money you collect vs how much money you billed. Then tariff is also an indicator is the tariff appropriate and how much do you produce your water and how much do you charge so these are the indicators”. (Respondent K6)

“Yes, we have KPIs, each job has its own different requirements and measurements so if you are a staff and you are in water distribution or operations. First one of your KPIs will say how many tonnes of water do you produce per hour, how many do you distribute per hour, how many homes have our water? How many hours do they have it running? How many bills out are produced. How many homes are actually paying what is the regularity of paying?” (Respondent P7)

“Yes we have a number of key performance indicators. For example, we have the number of connections that measures the number of people we are able to serve. We have the average volume of water delivered as per capita per day. We have an average of hours supply per day. You have the percentage number of quality standard. You have the coverage that is the population served. You have the population cost recovered from sale”. Respondent L1

“our response time to either fault or damages. If there is a burst pipe somewhere how long does it take us to respond that is also another key KPI. Response time to distress calls”. (Respondent L19)

“The indicator we have set in customer care when treating complaints is a maximum of seven days and minimum almost immediately. (Respondent L16)

“Yes, we check our production level. It is always much less than our capacity. We check our revenue our IGR against the amount of water that we are producing you will see that there is a huge gap. 80% non-revenue water because it is a huge gap then the efficiency of bill distribution very poor, I think it is about 11%. We benchmark our water quality against the national standard for drinking water quality”. (Respondent L2)

“ we have a good staff productivity index which ranges from four to five personnel per 1000 connections” (Respondent L23).

In summary, the following conclusions can be drawn from the analysis of Key performance indicators. Reference was made to KPIs related to IBNET indicators and IWA indicator however indicators identified were only limited to technical performance and performance of

financial and human assets. Less focus was on legal issues, political issues, and information systems, competency levels and staff placement issues. It is important to state that the difficulty in using the KPIs provided by each of the utilities for comparing performance across all utilities. This is because the documentary evidence provided by Utility 4 was for performance that occurred 5 years ago. There was no documentary evidence provided by Utility 1 and 2 even though respondents had referred to existing KPIs being used while the documentary evidence provided by utility 3 was more project oriented.

In addition, the effectiveness of the level of implementation could not be ascertained because most respondents only talked about the KPIs that were available without actually providing figures and detailed estimations attributed to the stated KPIS. The respondents were also unable to detail how frequently they monitored performance because there was no documentary evidence provided in some utilities as previously stated and not all respondents were able to accurately state their current performance using the KPIs. This is why an asset maturity assessment was also carried out in the next section where respondents were asked to state the level of performance of all asset types and the existing management processes for each asset.

7.7.2. Asset Maturity / Asset Portfolio Performance

The next set of results show the Maturity levels of the studied case utilities. The maturity scale used was adapted from IAM which was measured from a scale of 0 to 4. The levels and associated meanings are under-listed below.

0. Innocent - The organisation has not recognised the need for this requirement and there is no evidence of commitment to put it in place
1. Aware - The organisation has identified the need for this requirement, and there is evidence of intent to progress it.
2. Developing - The organisation has identified the means of systematically and consistently achieving the requirements and can demonstrate that these are being progressed with credible and resourced plans in place.
3. Competent - The organisation can demonstrate that it systematically and consistently achieves relevant requirements set out in the asset management framework.
4. Beyond ISO5500 - The organisation can demonstrate that it employs the leading practices and achieves maximum value from the management of its assets, in line with the organisation's objectives and operating context.

The maturity scale was used to assess the level at which management processes for all asset types were successfully implemented in each case utility. In addition, the different levels were mapped out using a gap analysis diagram for each utility.

In terms of maintenance maturity, all utilities analysed were characterised to be at an awareness level which is measured as 1. See figures 7.1, 7.2, 7.3 and 7.4 for details. The assessment at an awareness level occurred as 61% of interviewed participants characterised maintenance as corrective or breakdown maintenance than the standard of planned or preventive maintenance. 61% of respondents were from utility 1, while responses on maintenance maturity from Utility 2, 3 and 4 were 87%, 44%, 50% respectively. See Table 7 in appendix 6 and Table 7.7 for details. In addition, respondents acknowledged the importance of the requirement for planned maintenance however issues like lack of money and spare parts to work with were issues that impacted the maintenance culture of the utilities. The commentaries below represent a summary of the views of respondents on how maintenance levels were described.

Table 7.7: Asset Maturity and Management Maturity

| Key themes for Maturity | Percentage of respondents = N = 61 | Dependent nodes |
|--------------------------------|---|---|
| Maintenance | 61% | corrective maintenance/breakdown maintenance/poor maintenance, lack of maintenance |
| Staff management | 63% | poor training and low staff morale and lack of training, staff discipline, staff placement, staff recruitment |
| Staff number | 71% | Lacking adequate staff, lack of manpower |
| Staff dedication | 71% | Dedicated and committed staff |
| Competency | 71% | Average staff competency |
| Finance | 89% | Low billing efficiency, cost recovery, financial viability, low revenue generation, low tariff rates, high production costs |
| Governance | 34% | Slow policy implementation, a policy at the development stage and lack of autonomy |
| Infrastructure | 88% | ageing facilities and failing infrastructure, infrastructure operating below design capacity and lack of infrastructure |

| | | |
|--|-----|--|
| Projects | 28% | Delayed projects and abandoned projects, no value for money |
| Information management and Automation | 19% | Low billing efficiency (transition to automation, e-billing and AMR systems) using files, manual and conventional record-keeping, poor data management |
| Stakeholder engagement | 19% | Frequency of stakeholder engagement, time in which engagement occurs, level of effectiveness, feedback not acted on, only done during projects |

The only challenge we have in terms of managing these infrastructures is that most of our lines are old they require replacement basically what we are doing is like waiting for it to happen before you replace. (Respondent A2)

“Basically, we are supposed to be having the preventive and the corrective unfortunately because of the fund issue we only do corrective maintenance”. Respondent A16

“Our maintenance is not yet computerised fully” (Respondent A9)

“But when you look at response time to the maintenance in terms of ability to do it we have competent staff in terms of ability you can rate us 100% but in terms of equipment and materials because of lack of money we do not have material again so our response time has been increased”. (Respondent A17)

We do not have a manual that tells you this is what you do in terms of managing the asset. I have not seen the rule of thumb that we use in water board, but the issue is we have been responding to the repairs as they come. (Respondent A17)

“If I am going to rate it, I will rate it very low the reason is that the maintenance culture is not there that is the main source of our problem”. (Respondent L19)

“So, the challenges we face again is that most of our planned maintenance has turned out to become break down maintenance. Because we do not have the fund to carry them out as at when required and it is reducing the life span of our equipment”. (Respondent A22-A23)

“We are trying in maintenance the only thing is that because we are not financially buoyant, we cannot go for preventive maintenance. So, you only carry out corrective maintenance.” (Respondent K1)

“We are hoping that our routine maintenances will also get better in terms because it is static there are innovations and current trends if we get them, we will be putting them into what we do”. (Respondent P1-P3)

“We do not have a maintenance programme. a few years back the maintenance department was scrapped and since then our assets have just been going downhill and we only rehabilitate when they grind to a halt” (Respondent L2)

“What we do most of the time is corrective maintenance which means until when those pump or equipment breakdown that we want to attend to it, and we attend to it also based on funds availability”. (Respondent L20)

“If I am going to rate it I will rate it very low the reason is that the maintenance culture is not there that is the main source of our problem. The maintenance culture”. (Respondent L19)

In terms of staff management, all utilities were characterised to be at an awareness level. See figures 7.1, 7.2, 7.3 and 7.4 for details. The assessment at an awareness level occurred as 63% of interviewed participants described training and recruitment as poor or lacking or not targeted at delivery the organisational goals. In addition, respondents had stated financial resources were unavailable for carrying out effective training. 43% of respondents were from utility 1, while responses on staff management maturity from Utility 2, 3 and 4 were 91%, 67%, 50% respectively. See Table 7 in appendix 6 and Table 7.7 for details.

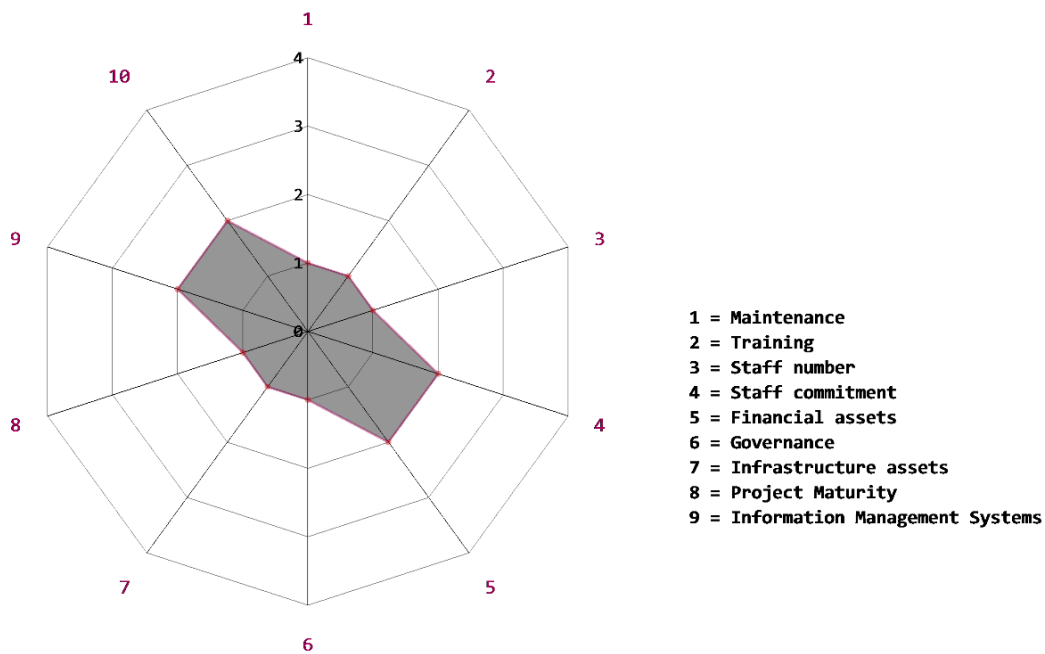


Figure 7.1; Maturity Model for Abuja

The commentaries below represent a summary of the views of respondents on the management of staff.

“We have issues with staff placement. There is so much pressure on politicians especially from their relations to employ just anyone. Even if the man is qualified or not, they just employ and send to us”. (Respondent A1)

“Training and re-training. Training and re-training alright. Simple we have been lacking that. And there are some training some people will embark on training by the time they come back probably they will have changed them to another department”. (Respondent A17)

“Our training is poor and not properly channelled to the right people and it is not targeted to their needs. Just for the sake of just doing the training you gather people and train them whether they need it or not.” Respondent A2

“Really our staff need to be trained we have the quantity of staff but the quality is the problem, the quality of staff is not really very good and that has contributed in some of the problems we having so I will rate our staff maybe 30%”. (Respondent K2)

“We do training. But you know for you to sustain training you need a lot of funds. It is also a major challenge in funding training. It is only when we have projects that we will get enough

money to train the staff. But if it is from the revenue, we generate it will not be enough for us to expend part of the money on training. So, most of the training we do is on job, where we attach experienced staff with inexperienced staff.” (Respondent K3)

“Training is inadequate because there is no money. I have lost track when last they trained us, they used to invite people from National Institute of Water Resources Kaduna, to come and organise in-house training for us or we send people there for training”. (Respondent A22-A23)

“like right now there is no training I think training has been put in the back a lot of government staff are not trained and that is affecting output in a lot of places because we need training over and over again so that is that”. Respondent A7

“Yes, as far as training is concerned, I think that is zero because a lot of people have not received training in the past 30 years”. (Respondent L20)

“Then in terms of manpower, there is still a lot of gaps and even those who are in the system they will need the training to bring them up in terms of best practices”. (Respondent L1)

“The training is not adequate; it is below average or very low. Training of staff is low in terms of rating so it would have been better, but it is when you have the fund that you can really do such” (Respondent L3-L15)

“We need to improve on training because training is on needs analysis on filling the gaps. You identify gaps, human resources gap weaknesses and you train to bridge the gaps. So training is a critical thing for us and should be used to address needs and fill in gaps. However, we are still working at that because of how the organisation is still beginning. We are still understanding the individuals so right now we just give training because we need to bring up capacity we have not been doing training to bridge the gap, training for us at the moment is to increase competencies and capacity”. (Respondent P7)

“Even though the staffing might be more than because we have 1393 staff, and by world standard, we are supposed to have one staff to ten connections. Our connections are about 97,000 while active connection are about 60,000. So, though it appears as if we have more than enough staff, the quality and placement of staff is not good”. (Respondent K6)

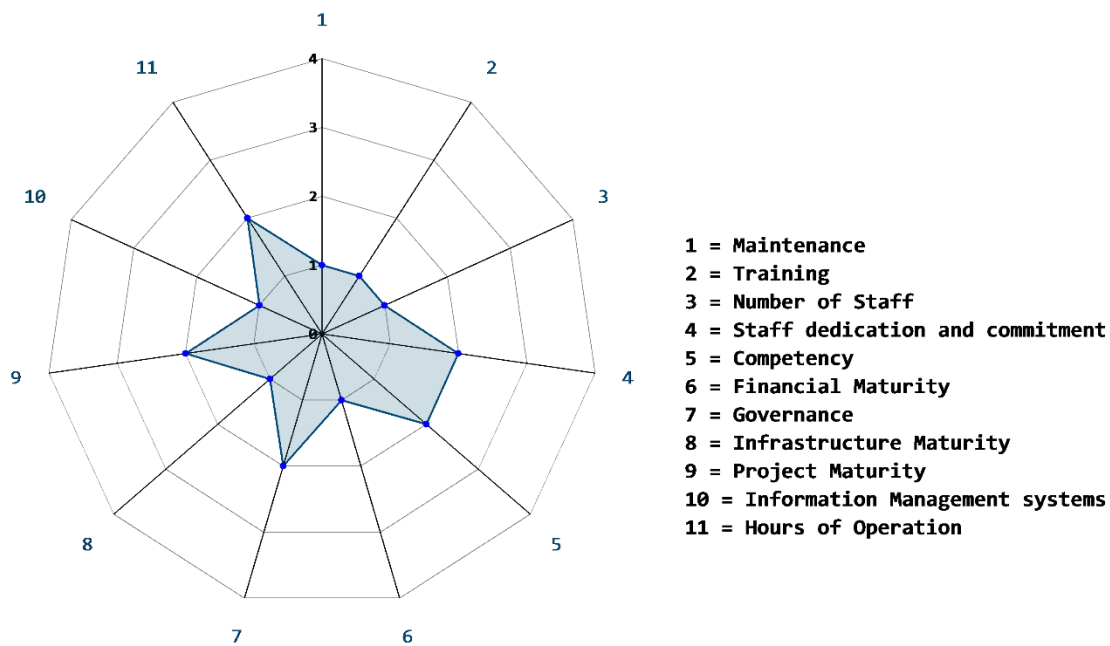


Figure 7.2: Maturity model for Utility 3

In terms of the maturity of information management, all utilities were characterised to be at an awareness level. See figures 7.1, 7.2, 7.3 and 7.4 for details. The awareness evaluation occurred as 41% of interviewed participants used words like fair, old, manual, less frequent, lack of data and documentary evidence, poor record-keeping, obsolete information system. 60% of respondents were from utility 1, while responses on information management maturity from Utility 2, 3 and 4 were 74%, 11% and 17% respectively. See Table 7 in appendix 6 and Table 7.7 for details. The commentaries below represent a summary of the views of respondents on how information management maturity was described.

“Our information system is just fair; it is just okay, but we need to improve it. Myself and my colleague we are currently trying to improve on our own because the board does not subscribe to that, they are not interested in it”. (Respondent A2)

“We do not have any funding to go round and do frequent inventories but we try to update the previous inventory when we can. There was a time UNICEF was trying to help us with the

water information management system and the sanitation information management system.” (Respondent A3)

“We still have problems with the availability of data as it is right now, we are not digital in the management of our system. The management is looking at improving systems such as telemetry, GIS. There were times that they deployed them but because of lack of funding it went obsolete” (Respondent A9)

“We want to increase the tools and even the servers they have almost become of age they need to be replaced. Most of our systems are not really obsolete I will say but IT needs upgrading per time”. (Respondent A15)

“We do not have documentary evidence for asset management. If you look at the manual of that generator it should tell you it has worked for 24 hours and you must replace the oil. So, the culture of documenting is not something we do”. (Respondent A17)

In our department, I will rate us 9 out of 10 for record-keeping. We keep records for our analysis for raw water or treated water from the treatment plant for the city and rural areas. However, for the whole organisation overall out of ten, I will like to rate us a one. I am defining one as very poor. Because there is no reason why an organisation should still be passing files from office to office. Files still get missing; a lot of things get missing. Records in a lot of offices are not being kept properly. (Respondent A7)

We can give you a record of what we are doing hourly base. Because we do analysis and it is recorded as it is done. We keep it we have a database we store. (Respondent A4)

“We are still using a very old manual system that is why in our design we are going for SCADA with SCADA, even if manpower is not many, one man can control and monitor the whole system consisting of the boreholes, pipeline and the pumps”. (Respondent P4)

“We should improve our billing facilities in other towns in Kaduna. It is only in Kaduna city and Zaria that we utilise our billing system. If we can improve our billing, we should be able to get more money.” (Respondent K5)

“The board is looking to run the AMR and the prepaid. We are phasing out the conventional metering system and we are doing it gradually”. (Respondent A2)

“We are supposed to have gone pass our staff going from house to house manually distributing bills. By now we are supposed to go electronic in such a way that people can receive it on their phones and pay on their phones but most of the things we are doing now they are still manual”.
(Respondent A1)

“now in terms of our billing system, we are upgrading to e-bills where customers can assess their bills online and then for ease of payment we will deploy an online platform for collating information about customer payment so that it reflects easily on their bills”. (Respondent A9)

“Metering system so far as not been effective most of our meters are not supporting tariff and they are also not supporting revenue. The meters are supposed to be accurate and effective for recording consumption appropriately but most of the meters are not doing that So for metering I guess it is 1”. (Respondent L16)

“Information gets lost, so they keep asking for the same information giving them the same information they have asked all the time”. (Respondent L20)

“We are trying to involve a better and much more effective GIS to ensure that we do less of physical output on the field. If we have electronic data via the internet it enables us to see the areas, we cover and also graphically see how water moves and where there are leaks and blockages. But as it is, we are just evolving on that so would measure it as 1”. (Respondent L16)

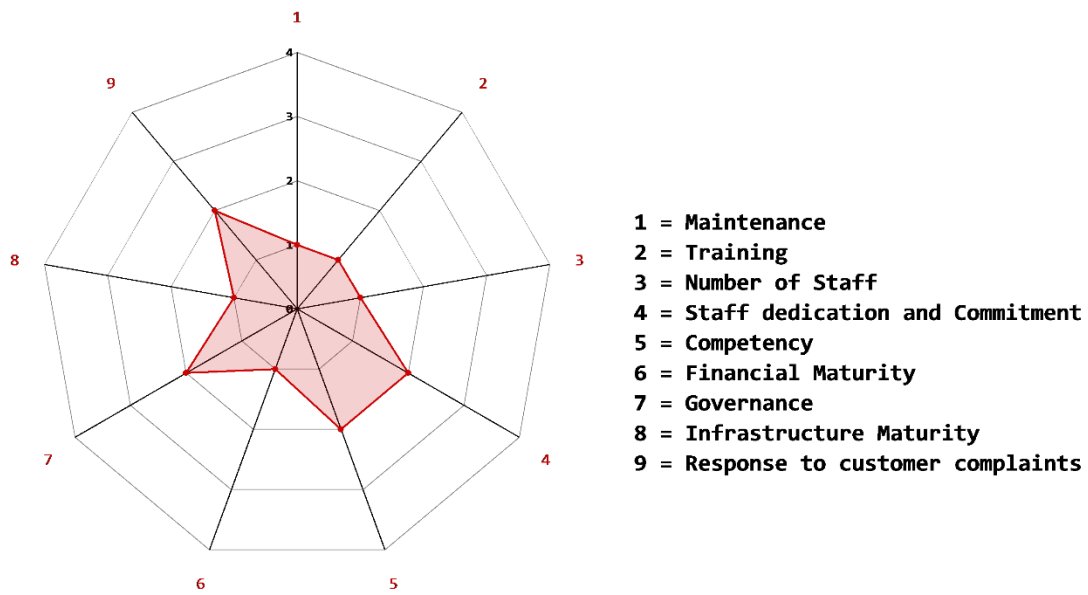


Figure 7.3: Maturity Model for Utility 4

In terms of staff competency, all utilities were characterised to be at a developing level. See figures 7.1, 7.2, 7.3 and 7.4 for details. The developing level characterisation was as a result of 71% of interviewed participants stating staff were very competent, qualified, professional, or having a wide range of experience or having very good exposure. However, in addition, the resources for sustaining competency and knowledge transfer were stated to be lacking even though staff were stated to be competent which is why competency was slated as developing. In addition, 74% of respondents were from utility 1, while responses on competency from Utility 2, 3 and 4 were 91%, 67% and 50% respectively. See Table 6 in appendix 6 and Table 7.7 for details. The commentaries below represent a summary of the views of respondents on competency.

In terms of competency, the maintenance crew are competent I will rate them 60%. They are capable but in terms of our performance, we have a lot to do. We have a lot to achieve and this is because as I said earlier, we lack some tools and equipment to do some of this work so since these are not there definitely it will affect the performance of our staff. (Respondent A3)

In terms of professional staff, you have more people at the top who might be on their way out in the distribution department. So, there is a disparity there and if they leave, we do not have younger crop of officers who are competent enough to take their positions. (Respondent A9)

And then the competency of workers is an enabler because we have a wide variety of staff, a lot of them are competent (Respondent A4-A8)

We have qualified staff from quality control to production staff to distribution staff it is second to none in the whole country, but the human resources are what we still have in the issue of treated water”. (Respondent A17)

“but for efficiency reasons, I think we have good technical staff. Highly efficient commercial staff. Rating them, technical staff 3, commercial staff 4, administrative staff 4 I should say, then financial staff 4, IT staff 3” (Respondent L16)

“Our staff I think to be fair we have experienced staff compared to other water agencies because I have gone round some number of agencies but you know we need to update as I said and we have tried to some extent. But if you want me to scale it maybe I think its above 60%”. (Respondent K5)

“But in terms of competence, most of our people are competent. Most of them have had exposures they have been exposed” (Respondent L17)

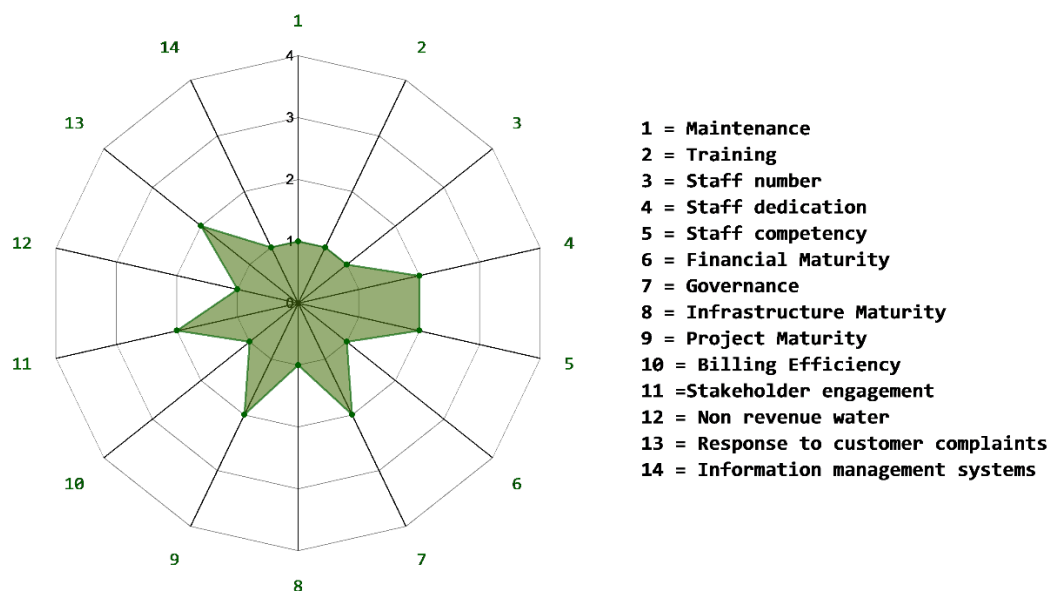


Figure 7.4: Maturity model for Lagos

In terms of project performance, utilities 1, 2 and 3 were assessed at an innocent level. See figures 7.1, 7.2, 7.3 and 7.4 for details. Project performance was evaluated by only 38% of respondents. However, responses on project maturity were majorly delayed projects, abandoned projects and no value for money and targets not being met. Responses from utility 1, 2 and 3 were at a percentage rate of 74%, 11% and 28% respectively. The commentaries below represent a summary of the views of respondents on project maturity.

Yes, we have some ongoing projects, there are some that we are unable to further or continue because of lack of funds. There are a lot of ongoing projects that we are unable to finish either due to financial constraints or it is still hanging, or it is ongoing, (Respondent A15)

The ageing treatment plant the rehabilitation is already ongoing, but it could have been finished about a year or two years ago but unfortunately, because of lack of money, it could not be completed on time. The trunk main has been awarded but unfortunately, the contractor was unable to complete it because of money. (Respondent A17)

“The second plant is under rehabilitation since 2010 and it was supposed to last for 18 months. From 2010 to date, the rehabilitation is ongoing, and it is just 23% completion about 77% undone because of lack of funds”. (Respondent A22-A23)

“Then the second project is the Adiyar two project it is ongoing, and it is about 60% completed. That one too has suffered delay because it is supposed to, the water treatment plant itself, the network and the power plant are meant to be completed by June this year but definitely, we are not going to meet up in June”. (Respondent L2)

“We had to discontinue the metering project because it was not giving us value for money. Our non-revenue water has even increased, and revenue has also gone down”. (Respondent L3-L15)

We have been unable to start the project because we are waiting for counterpart funding from the government and ADB it is delaying the project (Respondent P4)

For staff dedication, all utilities were characterised to be at a developing level. See figures 7.1, 7.2, 7.3 and 7.4 for details. The developing level characterisation was as a result of 71% of interviewed participants stating staff were very committed, commendable zeal, dedicated. However, the staff salaries and incentives were stated to be meagre which is why it was assessed at a developing level. In addition, 74% of respondents were from utility 1, while responses on competency from Utility 2, 3 and 4 were 91%, 67% and 50% respectively. See

Table 6 in appendix 6 and Table 7.7 for details. The commentaries below represent a summary of the views of respondents on the commitment from staff.

“You find out that people are committed and passionate about the job. You know many of them spent 35 years, 20 years and 13 years in this place so they hold it as their own”. (Respondent A1)

“I think the most important one is the staff dedication to work. Most of us you see here are ready to work and we are putting all our best”. (Respondent A18-A21)

“sincerely speaking the personnel even despite the condition they are okay they are working fine you discover that the normal time for working is 8-4 but you still discover that there are some people they still stay back till 6 or 7. So I can say 65 to 70%”. (Respondent A17)

“But the zeal of the staff is something you must commend. Even under such an environment, they still deliver service”. Respondent A5

For staff quantity, utility 2,3 and 4 were characterised to be at an awareness level while utility one was assessed at a developing level. The total percentage of response for staff quantity was measured at 71%. The developing level characterisation for utility one was as a result of 74% of interviewed participants stating staff were very adequate and enough. While respondents from utility 2,3 and 4 associated staff quantity with words lack major gap, inadequate, lacking and not enough. See figures 7.1, 7.2, 7.3 and 7.4 for details. Responses on staff quantity from Utility 2, 3 and 4 were 91%, 67% and 50% respectively. See Table 6 in appendix 6 and Table 7.7 for details. The commentaries below represent a summary of the views of the respondent’s staff strength.

“We do not have enough staff have to augment with some casual staff who perform activities like meter reading and bill distribution” (Respondent A9)

“when it comes to the manpower we have a lot of gap in there the Lagos state government has for some time placed an embargo on employment and you know the older staff are reaching retirement age they are leaving and new staff are not recruited” Respondent L1

“The staff are more than enough because we have a staff strength of about 824 or so staff strength. But you know in Nigeria, employment is not completely based on the job itself. It is a kind of social security”. (Respondent A1)

“But for staff, the staff is enough for work it is just the environment is not conducive and there is not enough office space” (Respondent A14)

Yes, presently I have two experts in GI working with me, I have a data manager working with me too, I have a computer analyst working and some other junior staff it is okay but we can as well get more other hands”. (Respondent A15)

“The staff we have are adequate. We have qualified staff from quality control to production staff to distribution staff it is second to none in the whole country but the staff level and qualification for the human resources department still has issues”. (Respondent A17)

“Talking of being enough we are not enough. Our manpower level is very low. Since 2011 there has been an embargo on employment. We have not been recruiting some people have been retiring so our workforce has been reducing and so we are all leaving” (Respondent L17)

“We are understaffed presently the manpower issue is also there, we are understaffed, and we all know because of dwindling revenue we cannot take as much as we want so manpower issue is also there” (Respondent L3-L15)

“when it comes to the manpower we have a lot of gap in there the Lagos state government has for some time placed an embargo on employment and you know the older staff are reaching retirement age they are leaving and new staff are not recruited so we have to make do with small manpower” Respondent L1

“Looking at the human assets we do not have enough staff as I believe no organisation would have enough because of financial constraints to handle their processes” (Respondent L16)

“Our work personnel are not sufficient we have about twenty engineers, six water chemists already you know that is an issue. We have twelve treatment plants and ideally, every treatment plant is supposed to have its own chemist. We also have a central lab which you are supposed to have chemists running them” (Respondent K6)

In Iju waterworks, for example, we only have about 3 staff that are both mechanical and electrical. They are not enough to maintain all the equipment”. (Respondent L20)

The assessment of financial maturity showed that all utilities were at an awareness level. See Figures, 7.1, 7.2, 7.3 and 7.4 for details. Table 7 in appendix 7 also shows details of the overall percentage rate of respondents regarding financial maturity. Regarding financial performance, the results show that 89% of respondents categorised by attributes under the awareness classification for asset maturity level. Responses from Utility 1 was measured at 57% while utility 2, 3 and 4 was slated at 100%. Themes such as low billing efficiency, low-cost recovery, lack of financial viability, low revenue generation, low tariff rates, high production costs were attributes used to define financial performance. Detailed evidence of the views of respondents on financial maturity is substantiated below.

“There is what is called the running cost to aid the movement of staff. The only problem concerning this is that sometimes the money does not come always”. (Respondent A10)

“We do not use the revenue here; the revenue goes directly to area 11 and they kind of give us running cost for running the whole office so the revenue is not staying here”. (Respondent A14)

“our tariff is so poor, it is very low, I believe it is the lowest in the country and we cannot do business like that. The government needs to review the tariff. The tariff is overdue for review” (Respondent K5)

“Well, revenue collection is low because people here the attitude is poor. They do not like paying for water in Nigeria”. Respondent K3

“a lot of things happening there is a need for money in some area offices to carry out some works even in the headquarters”. (Respondent A15)

“Till date, we still owe some contractor that supplies us chemical that we use to treat water, the government is still owing the contractors. It is not like we do not want to pay we have challenges with funds (Respondent A22- A23)

“The level of investment is not enough we do not have funds. Then the third one is on the issue of tariffing you know our tariff is not appropriate. I mean it does not cover the cost of production”. (Respondent K6)

“Previously we get over 200 million naira. But currently, as I am speaking to you this month it slightly above 70 million, so the revenue is dropping coming down because they were not ejecting anything into the system again since September we had only one allocation 22 million naira and we have piles of liability on the ground. The government is starving us of funds”. (Respondents A11-A13)

“What is expected is that the organisation will generate enough money it will run itself that is the cost of operation and maintenance. The level of investment is not enough we do not have funds. Also, the tariff is not appropriate. It does not cover the cost of production”. (Respondent K6)

“On the revenue, we are not where we are now because to be very frank, we are not meeting our actual cost of operation. But I think we are among the first best three water agencies. For now, our collection efficiency dropped when the TSA (Treasury Single Account), was introduced. Before the TSA I checked our performance between January and July based on the billing it was averaged 73% but after the TSA it dropped to about 39%”. (Respondent K5)

“Our non-revenue water is over 60% and there is no way you could recover cost when you have low tariff and a high percentage of non-revenue water. The system cannot sustain itself we depend on the government for subvention.” (Respondent L1)

“Our internally generated revenue is not sufficient to expand our business for us to meet up with the demand. We need investors to bring money in and partner with our state government. Our IGR against the amount of water that we are producing you will see that there is a huge gap. 80% non-revenue water because it is a huge gap” (respondent L2)

“Our OPEX is a serious problem operational and maintenance expenses have been very high for years” (respondent L18)

“Presently the cost of production to the revenue cannot be measured up. Presently the cost of our production is very high. Because electricity is our major input for the production and that cost of electricity is on the high side right away is on the high side. Then the chemicals as well they are imported goods, so the cost is on the high side” (Respondent L21)

In terms of maturity for Infrastructure assets, 88% of respondents stated infrastructure performance was within the awareness level of maturity. See figures 7.1, 7.2, 7.3 and 7.4. The reason for this classification is because respondents associated infrastructure attributes with themes such as ageing facilities, failing infrastructure, infrastructure operating below design capacity and lack of adequate infrastructure. Responses from utility one was measured at

100% making infrastructures measured at an awareness level more dominant in utility one. The remaining utilities 2 to 4 were measured at 91%, 78% and 83% respectively. The following commentaries provide an overall summary regarding descriptions associated with infrastructure assets.

“All our assets need to be rehabilitated especially the smaller water treatment plants. The groundwater plants all need to be rehabilitated because they are underperforming. Our network is over a hundred years old” (respondent L2)

“Most of the mini and micro waterworks are doing either quarter or maybe 30% or at the most 50% of their capacity. Most of them need rehabilitation”. (Respondent L1)

“Most of the equipment there are ageing. If you have a tap and you do not maintain it well at the right time water will start gushing out. In addition, our network coverage is very limited. There is nothing wrong with our policy. The policy is there but it is because there is no infrastructure in place”. (Respondent L17)

“Our physical infrastructure is obsolete I told you. I mentioned our physical infrastructure in terms of our waterlines they are more than 30 years, 35 years but we are still using them. They need to be replaced”. (Respondent A2)

“Well we did an assessment for the rural water supply, we did an inventory assessment but that was 2012, and the functional status of the water schemes was about 60% which means about 40% were not functional due to one reason or the other”. (Respondent A3)

“The infrastructural provision on the ground is not even enough to serve everyone. For our physical infrastructure, office equipment and distribution I will rate it average”. (Respondent A9)

“For the physical infrastructure we do not have enough, like the area offices they are not in good condition and you know, the staff are supposed to have a conducive environment for work it even adds to your psychology”. (Respondent A14)

“Yes, we have a distribution network, but it is not enough. The distribution network is supposed to be in phases one, two three four. It is only phase one that is fully completed now the rest of the phases have not been done. The production aspect is enough but the distribution we do not have enough”. (Respondent A16)

“Each of the treatment plant has its own separate conveyance pipeline that we call trunk line. Phase one has its own, phase two has its own. Phases 3 and 4 are still under construction it has not been laid. Phase 1 and phase 2 trunk line can only accommodate 10,000m³ per hour if you produce anything above that from Lower Usuma dam then you are in trouble. The other challenges is on the distribution mains, in all the developed phases that we have in the city, we do NOT have a distribution main it is only in phase one of the city development that is where distribution mains has been almost completed. In phase two, phase three this is where we have the highest population of people alright there is no distribution mains there. Mostly people depend on their borehole individual boreholes that they will have built their compounds”. (Respondent A17)

“For now production has more infrastructure than distribution department because the new plant 3 and 4 which I manage has a capacity of 20,000 right now we are utilising at 35 to 40% so plant 3 ten, plant 4 ten I produce 3,500, 3500 at times 4000 which means 35 to 40% capacity we cannot produce more than that because we do not have facility to evacuate it”. (Respondent A22-A23)

“Physical infrastructure I will rate it one, as in very poor. There are other offices maybe an office like this, there are some offices you enter six, seven staff sharing an office smaller than this no air conditioning and its very hot, so all sorts of things. Sometimes there is no power supply and you must be on seat. Broken tables, broken chairs, broken furniture. You need to work your computer is broken”. (Respondent A7)

“While I was area manager from 2007 till 2009, I was managing about 9 to 10 waterworks. One major water works and about two mini water works and then about 6 micro waterworks but during that time all of them are not producing at the design capacity even when they were just being built”. (Respondent L18)

“We have stopped using one borehole because the saline intrusion in it is too much and it will really disturb operation so we just stopped using it. This is the second borehole we have been using it for quite some time but one thing is that if we had two boreholes it will be faster for us to generate more water” (Respondent P1-P3)

In terms of governance, all utilities were characterised to be at an innocent level. See figures 7.1, 7.2, 7.3 and 7.4 for details. In terms of governance, the maturity level for governance was also measured at 1 which is the learning category. This was because 34% of respondents that talked about governance maturity associated it with terms like slow policy implementation, policy at development stage and lack of autonomy, no existing law, reformed policies, draft policies. Responses from Utility 1 to 4 was measured at percentage rates of 34%, 17%, 33% and 50% respectively. The under listed commentaries from respondents substantiate the findings.

“we cannot sue on our name and people cannot sue us on our name they have to sue our minister the act establishing our minister and the FCDA is what we are still using”
(Respondent A17)

“We may not be able to produce to the optimum you know sometimes we do have shortages or maybe sometimes somewhere along with the line one equipment broke down or what have you. All the others we do not compromise”. (Respondent A10)

“you do not operate well if you do not have the proper law. So, we need to amend our law so that we will have the powers to do some things”. (Respondent K5)

“The Implementation of the policies is not as rigorous or as effective as I would have loved them to be. Implementation is always haze”. (Respondent K2)

“We are not 100% autonomous we are under FCDA engineering. All Abuja infrastructure including water is being handled by our FCDA engineering services. (Respondent A22-A23)

“The law establishes a level of autonomy for generating income and spending and that is what we do, but most times we cannot generate enough to purchase chemicals, pay electricity bills, pay staff salaries. We are not a profit-making organisation, we cannot break even so most times we have to depend on the government to give us subventions which do not come on time”.
(Respondent K2)”

The scenarios presented above for maturity for all case utilities does not show the achievement of sustainable service delivery since utilities were slated to be between the innocent level and

awareness level of maturity. In terms of maturity, the implementation of processes can be characterised as being in learning phase stage.

7.8 Major areas for improvement

Bearing in mind that Nigerian utilities were at a learning and developmental stage in terms of maturity, it was important to ask questions about where the utilities were hoping to achieve good levels of improvement. The results shown in table 7.8 and Table 7 of appendix 6 shows the major areas respondents stated required improvement.

Table 7.8: Key areas for improvement

| Key themes for areas for improvement | Percentage of respondents = N = 61 | Dependent nodes |
|---|---|--|
| Automation | 43% | Automated information systems and innovation and use of modern technology |
| Governance | 29% | reformation and change management |
| Innovative funding mechanisms | 46% | Diversifying income streams, innovative subvents that can meet markup |
| Preventive Maintenance | 37% | Preventive maintenance, condition based maintenance |
| Management of staff | 54% | Training to meet needs, staff welfare, incentive-driven performance, more competent staff, staff motivation, peer review |

From the interviews, an average total of 54% of respondents from all utilities identified the need for improving staff management processes. 78% of respondents in Utility one identified improvements needed for staff management, 87% of respondents were identified in utility two while 22% and 33% occurred for respondents in utility 3 and 4 respectively. Comments from respondents A1, A2, A4-A8, A11-A13, A15-A23, in utility one, the commentaries below summarize the overall views from respondents regarding improvement areas required in staff management processes.

With proper training, I do not see any problem they can only grow better. Hopefully, proper training will happen in the next 5 to ten years. There is a new government now that is interested in the job itself, I have a feeling that the current government is interested in the job and when you have a government that is interested in the job then the civil servants they are likely to progress. (Respondent A1)

“more competent hands in terms of well-trained engineers that will be on-site” (Respondent A15)

Well, for us to improve on this we need more funding and more technical staff are required. (Respondent A16)

Training and re-training. Training and re-training alright. Simple we have been lacking that. And there are some training some people will embark on by the time they come back probably they will have changed them to another department so for them to be able to re-train those who are at home to train them on what they have gone for so we have a problem. (Respondent A17)

“One area that we also appreciate is if there will be opportunities for peer review with composite organisations that is as in checking our quality assurance for double assurance. I think he has mentioned welfare”. (Respondents A18-A14)

“Then we also look at the staff too they have the area managers at least there should be a policy in place to see that targets are given to area managers although it is there, but it is not implemented. Targets should be given to the area managers and they should be able to meet up to and when above their targets there should be a kind of incentive to them. It will be a kind of booster so that they will be able to do more”. (Respondent A11-A13)

“Training and re-training of personnel, human resources, capacity building, capacity support, and capacity anything cannot be overemphasized. When personnel lack current knowledge and information it becomes an inhibitor because they will be unable to compete with international counterparts (respondents A4-A8)

“On the human resource angle, we need massive training of our staff. Massive training, re-training. We need to introduce them to new practices. We need to train our staff at least to a certain level so that they are able to perform.” (Respondent K2)

Secondly, the results showed also show that about average of 29% of the respondents in all utilities, identified the need for governance as a major area for improvement. This trend is similar to works by (Akpabio, 2007, Akpor and Muchie, 2011, Iliyas, 2000, Nwankwoala, 2014, Omole, 2013, Owolabi, 2014, WaterAid, 2006, Water Aid, 2007) which states that governance issues exists in the Nigerian urban water sector. The following commentaries from respondents corroborate the findings

“if you have the right kind of leadership I want to say that they could be a revolution the organisation could have moved up to be more effective and productive. Yes, I believe there will be an improvement”. (RespondentA9)

“the act, establishing FCT water board needs to be enacted by National Assembly because we cannot on our own as FCT water board go to court and sue anybody because we do not have an act that establishes us”. (Respondent A17)

for us legislation I think would help go a long way because our bill has been before the National Assembly they say it has passed first reading second reading but we need to have a law backing us because before we will be able to do certain things. (Respondent A4-A8)

With good leadership and fund because majorly fund is needed in this kind of organization to grow. I think we should be levelling with other international countries (respondent A14)

You know there is one thing I want you to understand. FCT water board has not got its act therefore we are working under the government we are not independent. If we are independent, we can say this is what we want to do in the next year. (Respondent A10)

“We need to have autonomy and a fixed asset policy. We went to our parent body to give us a fixed asset policy they do not have it”. (Respondents A11-A13)

“The number one thing is to do a robust law. Once you do a robust law you institutionalise let there be complete definition, let the method of governance be defined. If this is what we are supposed to deliver it should be clear. A robust law is tenable because you can constitute a board and people will know what they need to do”. (Respondent k6)

“Give Water Corporation seed money, give the Water Regulatory Commission the approval to set an economic tariff and then hands off operations, you have given them the approval to increase their tariff, given them the free hand to manage the assets, all I would expect water

corporation to do is to remit some money to the government as rent for the infrastructure that government has invested in Lagos Water Corporation that is what we need” (Respondent L2).

The results showed that an average of 43% of the respondents in all utilities identified the need for innovative and automated technology as a major area for improvement. The following commentaries from respondents corroborate the findings.

“And in terms of my IT section so many things updating the antivirus, getting the sophisticated software then up to date IT systems or improvement in terms of the system it has to be in place. So many new software are being produced daily that can resolve the issue of people going to the site to take interim indices if we have a working GIS system we can be taking all these things here”. (Respondent A15)

“and a kind of any manual meter is being erased and we bring in prepaid and AMR meter that they don't need to go into somebody's property in the next ten years” (Respondent A14)

The results showed that about 46% of the respondents identified funding as a major area for improvement. The following commentaries from respondents corroborate the findings

“Well, for us to improve on this I think we have to have more funding and then more technical staff are required”. (Respondent A16)

“With good leadership and fund because majorly fund is needed in this kind of organization to grow. I think we should be levelling with other international countries” (respondent A14)

“I believe that we are supposed to find alternative ways of generating revenue. I think we can go into the business of pure water it will help a lot because we have all the facilities. You can see how pure water people are flourishing even though some of them do not have a clue about how to produce water. But we have the skill, we have professionals, we have the infrastructure and all the facilities we have them. We also have our marketing department all we need to do is exploit all these areas I have talked about and we should be able to succeed. I believe, the management should look into that aspect.” (Respondent K1)

“We need good training in revenue collection and generation and PPP arrangement. It can be a PPP arrangement with some private sector people so that they can come in with their new

ideas on how to get this money from customers especially the ones that do not want to pay.”.
(Respondent K2)

Out of the respondents interviewed, 37% of respondents in all utilities stated that preventive Maintenance was something they needed to improve on as an organisation. The quotations below provide evidence relating to why respondents suggested preventive maintenance was an area that needed to improve on.

“A preventive maintenance programme is necessary. We should have we used to have but some few years back the maintenance department was scrapped and since then our assets have just been going downhill and we only rehabilitate when they grind to a halt, now literally grind to a halt” (respondent L2)

“Because most of the mini and micro waterworks are doing either quarter or maybe 30% or at the most 50% of their capacity. Most of them need rehabilitation we also need to maintain them periodically”. (Respondent L1)

“We do not have daily or routine maintenance like developed countries where you flush your system. We are still underserving the populace so we do not have that luxury of water to waste but in developed countries, it is a daily or weekly occurrence. They open the containers, they flush the system but we are not doing that here” (respondent L3-L15)

“Number one we need to fix most of our waterworks they are not performing at the optimum. Because most of them the equipment there are ageing and you know even if you build a house, if you do not maintain it well at the right time it will not last long.” (Respondent L17)

“We need to improve our maintenance” (Respondent L19)

“We hope to improve the way we maintain our waterworks. However, for now, we cannot carry out routine maintenance because we are short-staffed. In Iju waterworks, for example, we only have about 3 staff that are both mechanical and electrical. They are not enough to maintain all the equipment”. (Respondent L20)

“the kind of maintenance that all of these is going to get better we are hoping that our routine maintenances will also get better in terms of basically as we continue every area will get improvement because no area is supposed to be static there are innovations and if we get them, we will be putting them into what we do”. (Respondents P1-P3)

Chapter 8

Verification and Validation of findings

8.1 Modification of the framework based on the research results and findings

This section aims to give detailed insights into the revisions and modifications that occurred from testing the asset management conceptual framework in the four Nigerian case utilities. The additional elements which were inserted the different parts of the framework after the analysis of the case studies and the commentaries of respondents are highlighted in red. The elements which have also been removed completely, transferred to another part of the framework or renamed will also be analysed. The rationale and implication of these modifications in the framework on successful asset management implementation for the Nigerian Urban water sector would also be analysed.

The elements retained in the key stakeholder boxes in figure 8.17 are as a result of the commentaries from most of the respondents (as shown in section 7.2 pages 157-158,163 and Table 7.1) were the customers and utility staff management in the endogenous section. The major classification of customer influence in terms of paying regularly and defaulting in payments which can be seen from summarised commentaries in section page 158 was the rationale for adding the nonpaying/ paying customers next to the customers' element. However, the contractors and consultants providing outsourced services like chemical supplies, maintenance and spare part supplies were newly introduced stakeholders being the 5th predominant key stakeholder found in respondents commentaries in section 7.2 page 163.

The stakeholders retained in the exogenous section were the informal service providers. In the exogenous section, the Federal ministries and government agencies which were previously separated based on how the literature on the Nigerian urban sector had described the functions as separate agencies at different levels were all grouped as Federal and State lawmakers and policymakers as a result of respondent's commentaries describing their influence based on the functions in making laws, policies and regulating utilities (see details in section 7.2 page 166).

Secondly, NGOs and State governments were also grouped as funding institutions and financiers based on the commentaries of all respondents in all utilities as shown in table 7.1 and section 7.2 page 160. The commentaries showed their influence were similarly based on functions associated with funding water projects, training projects and providing grants and loans, unlike the initial separation that occurred from the literature on the Nigerian urban water sector.

Finally, CSOs and community groups were newly introduced in the box for key stakeholders in the endogenous section based on the commentaries of respondents as shown in Table 7.1 and page 164. Their influence was evident in their role as intermediaries between the general public and the utilities when new projects. Even though the responses from respondents associated with the CSO's was low across all four utilities its dominance in utility two was a major rationale for retaining this element.

The results from the analysis of the key challenges impacting the water utilities studied allowed for the retention of elements such as staff management issues, infrastructure challenges in the endogenous section since most respondents were found to have discussed these issues as shown in Table 7.2 and pages 170,171, 174 and 175 in section 7.3. However, there was also a need to represent challenges related to infrastructure and staff management in the exogenous section as well because of a link between governance, political interference and delayed running costs, staff placement and embargo on staff employment as shown in commentaries in pages 172 and 170 which were outside the utilities control.

Climate change as a challenge was removed from the endogenous section framework since most respondents had not made any reference to its impact on their performance as urban water utilities. However, governance, power failure and population growth in the challenges box were retained in the exogenous section because most respondents identified the influence these challenges had on performance as shown in pages 172, 176 and 180 in section 7.3. The financial viability challenge was renamed as funding as all commentaries from respondents in section 7.3 pages 170 and Table 7.2 covered a scope wider than having enough to cover cost to issues covering lack of running cost, having low tariffs, generating low revenue and having no access to revenue, being unable to pay salaries and electrical costs. Water being a social good and unwillingness to pay was also a challenge included newly as an exogenous challenge based on the commentaries from most respondents as shown in Table 7.2 and page 178.

After the analysis of the responses from the respondents in the four case utilities, pro-poor solutions, capacity building and focus on customer needs were removed as enabling factors in the endogenous section because the respondents in the utilities did not believe they were enabling factors that impacted their performance as utilities. However, staff dedication and customers paying regularly, and stakeholder engagement were enabling factors included into the endogenous section framework because these were part of the top 5 enabling factors mentioned by respondents as shown in Table 7.3 of section 7.4. From pages 184 and 187 of section 7.4, it was seen from the commentaries that staff dedication and payment from customers was as a result of a value or character system rather than the incentives arising from training and good salary structure and benefits or regular provision of water in the case of customers. The enabling factors in the exogenous section of the conceptual framework about autonomy, presence of an assurance system and governance were also removed and replaced with new elements such as support from NGOs and governance reforms and leadership. This occurred because these elements were part of the top 5 enabling factors identified by the respondents during the interviews see Table 7.3 and pages 185 and 186 in section 7.4. for details.

The box for the policies and plans section remained unchanged as the trends that emerged from questions about the existing plans and policies and the implementation processes were like what the literature on the Nigerian water sector had shown regarding varying levels of implementation of the policies and varying policy tools and regulatory models in different utilities see Table 7.4 and section 7.5 for details.

The life cycle activities and management processes which were initially in the conceptual framework remained the same however new themes such as water management processes (water treatment, water production, distribution and transportation) and project management were introduced as shown in responses in section 7.6 and table 7.5. Also, specific management processes such as maintenance and rehabilitation, revenue generation bill, staff management, distributions and revenue collection were inserted next to the various management processes related to each asset type as shown in responses in section 7.6 and table 7.5.

Finally, the evaluation and improvement boxes were populated based on the results of assessing the existing management processes and existing assets. The gap analyses and evaluations which

were done as shown in Table 7.7 and figures 7.1 to 7.4 showed that most processes initially mentioned in section 7.6 were at an awareness level. Further the results from respondents' commentaries about the performance of people, infrastructure, financial assets and information systems were also rated low at an awareness level. The use of KPIs were removed because most participants acknowledged their existence however, they were unable to adequately give figures relating to the benchmarking measures and referred the researcher to their technical department. Only two utilities were able to provide documents showing their KPIs (as shown in table 10 and table 11 of appendix 6). The first KPI document was over 6 years old during the field study and the second KPI was for the reform project which was yet to be implemented fully. However, the respondents were able to weight performance using scales and percentages which were adapted to the weighting system of the asset management maturity unlike the KPIs that were only mentioned to be in place but no values were presented by most respondents.

On the other hand, the elements in the improvement box were populated based on the responses of respondents about the areas they need to do better in as organisations. The improvement box was populated based on the top 5 responses amongst the research participants as shown in 7.8 and section 7.8.

8.2 Verification of major findings and the revised framework

One of the criteria for ensuring research has rigour is credibility. Credibility is defined by (Korstjens and Moser, 2018, Lincoln, 1985) as the confidence that can be placed in the truth of the research findings. It establishes if the research findings represent realistic information drawn from the original data of research participants. It also determines if the research findings represent the correct interpretation of the original views of participants. Credibility is concerned with the aspect of truth-value. (Lincoln, 1985, Neuman, 2013, Seale, 1999, Zikmund, 2003). A verification exercise was conducted to ensure the research achieved the credibility criteria factor. Key findings from the data analysis were sent back to 8 professionals who were participants in the previous study to state their level of agreement regarding the key theme which emerged from the analysed data of the four (4) case studies. The verification form consists of two major sections. The first section focused on confirming the key findings which were found during the study while the second section was focused on confirming the level of agreement of participants with respect to the framework. There were 8 questions which were asked in section one which is discussed below.

8.2.1 Verification of findings

The first question asked was regarding the level of agreement for the key stakeholders which were found after the data analysis. The initial findings in section 7.2.1 showed that Customers, Informal service providers, Funding institutions, utility management and staff, consultants, policymakers, and CSOs emerged as key themes for major stakeholders. When 8 participants of the study were asked to state their level of agreement regarding the key stakeholders, the results from the verification exercise showed that a cumulative average of 6 respondents agreed that the findings were true.

Figure 8.1 shows that out of the 6 respondents that agreed to the findings, 2 strongly agreed that the findings were true while 4 respondents agreed the findings were true. Also, 2 respondents were neutral and there were no respondents that disagreed or strongly disagreed. There were also no additional commentaries included in the comment box. Hence since most respondents justified the results regarding key stakeholders as true, the results in the section relating to key stakeholders can be considered to be credible.

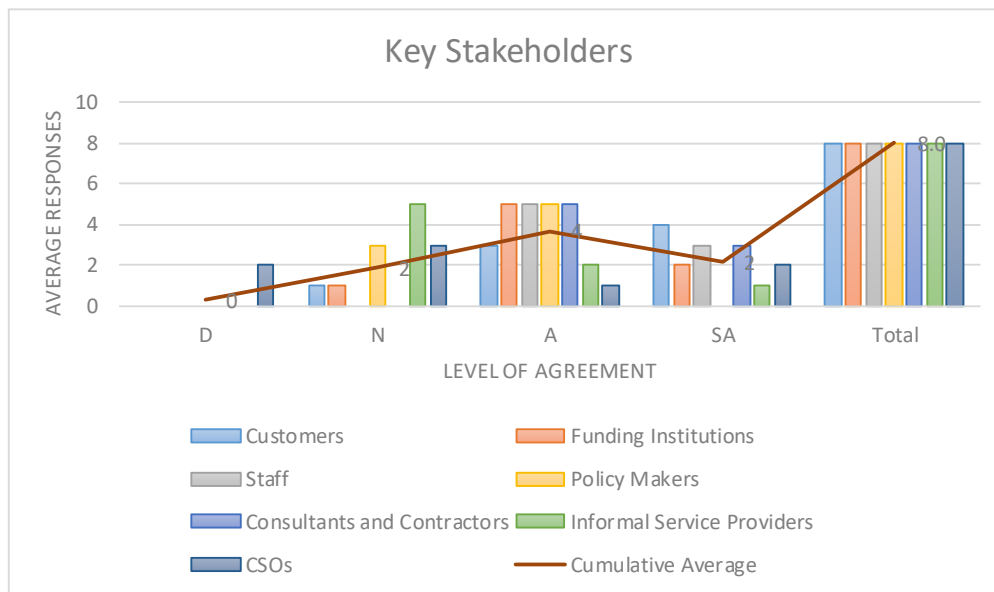


Figure 8.8.1: Verification of findings for Key stakeholders

The next question asked was regarding the level of agreement for the key challenges which were found after the data analysis. The initial findings in section 7.2.2 showed that Funding, Infrastructure challenges, Governance, illegal connection, poor staff management, unwillingness to pay, power failure, population growth and rapid urbanisation and Project-oriented issues were key challenges impacting the case utilities studied. The results from the verification exercise showed that a cumulative average of 7 for respondents agreed that the findings were true (See Figure 8.2).

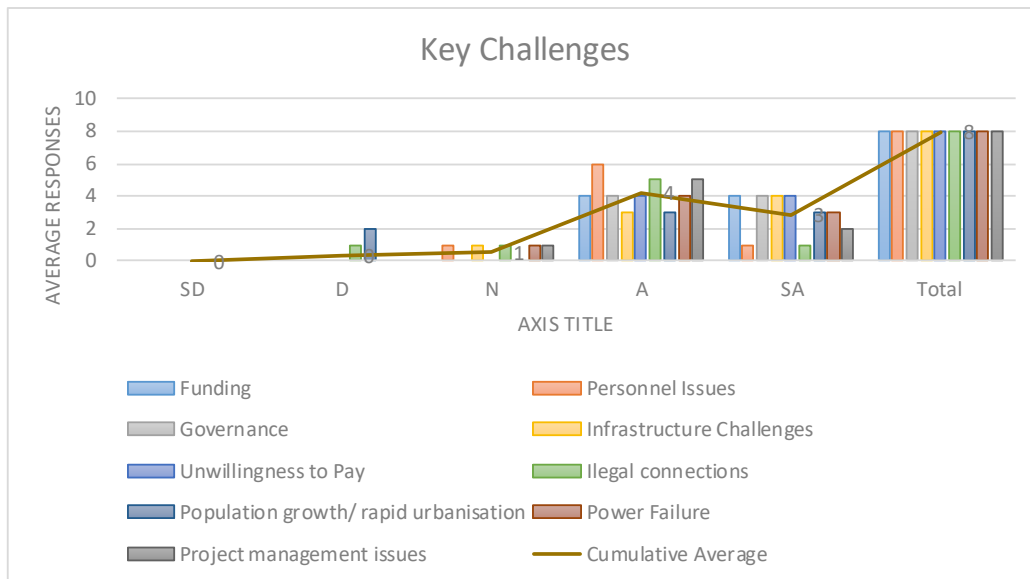


Figure 8.2: Verification of findings for Key challenges

A cumulative average of 3 occurred for participants that strongly agreed while a cumulative average of 4 occurred for participants that agreed that the findings were true. However, a cumulative average of 1 for the responses slated as neutral about the overall findings and there were no responses to suggest that participants disagreed with the findings. Additional comments regarding the political will and willingness to implement major decisions or expansion of infrastructure were included in the comment box. Hence since most respondents justified the results regarding key challenges being true, the results in the section relating to key challenges can be considered to be credible. The new comment regarding the political will and willingness to implement major decisions was also included in the new framework to accommodate the commentary raised by a participant.

The next question asked was regarding the level of agreement for the key enabling factors which were found after the data analysis. The initial findings in section 7.2.3 showed that staff commitment, support from development partners and government, customer paying regularly, governance reforms and leadership and stakeholder engagement were key themes which emerged for key enabling factors. When 8 participants from the verification exercise were asked to state their level of agreement regarding the key enabling factors impacting the studied utilities, the results from the verification exercise showed that a cumulative average of 7 respondents agreed that the findings were true (See Figure 8.3)

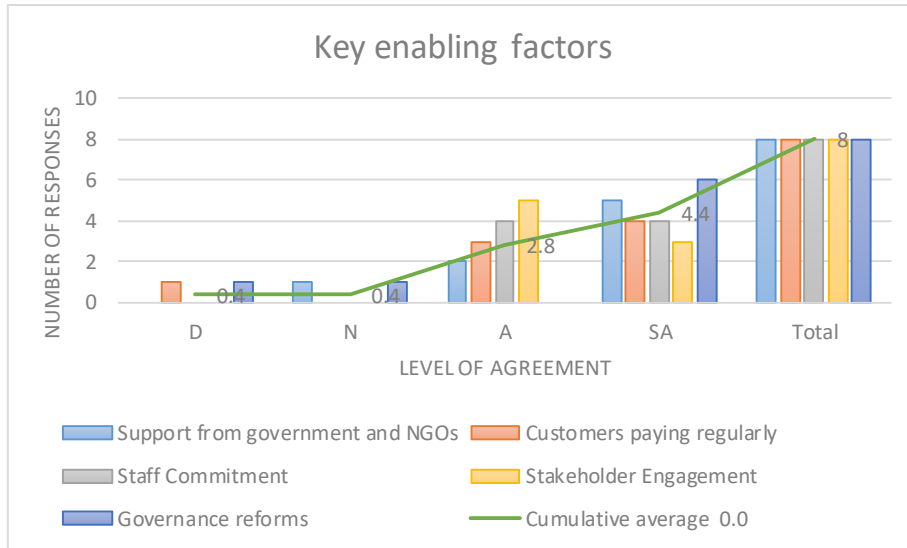


Figure 8.3: Key enabling factors

However, a cumulative average of 1 occurred for responses associated with participants that were neutral and disagreed with the findings. The political will power for the government to invest in water projects was also a comment included in the section for enabling factors which were added to the revised framework. Hence since most respondents justified the results regarding key enabling factors being true, the results in the section relating to key enabling factors can be considered to be credible.

The next question asked was regarding the level of agreement for the finding regarding management policies. The initial findings in section 7.3.1 showed that the key themes that emerged from the data analysis from four utilities for policy implementation were targets similar to NWP, no discrepancy in implementation, ineffective policy implementation, existing mandate and state water master plan. When 8 participants of the study were asked to state their level of agreement regarding the findings from policy implementation, the results from the verification exercise showed that a cumulative average of 7 respondents agreed that the findings were true.

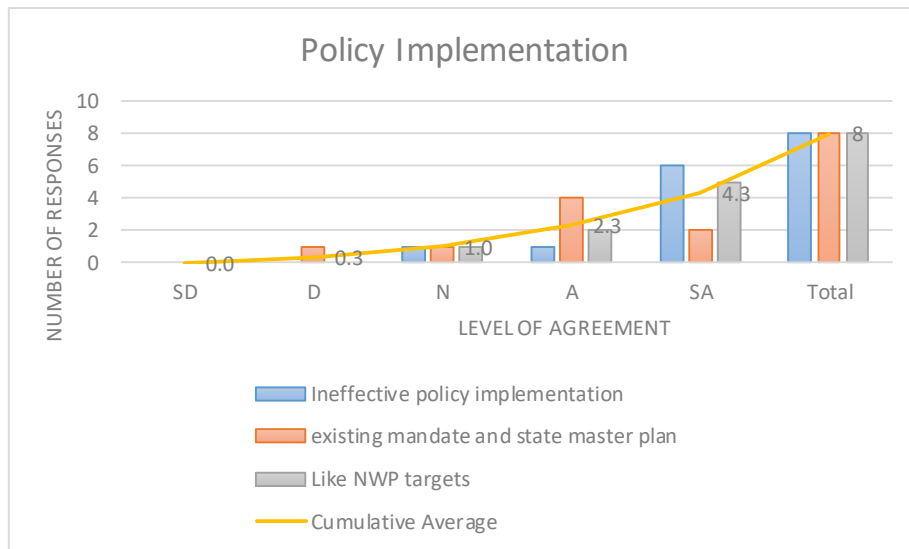


Figure 8.4: Key findings for Policy Implementation

Figure 8.4 shows that out of the respondents that agreed to the findings which were measured at a cumulative average of 6.6, a cumulative average of 4.3 occurred for respondents that strongly agreed that the findings were true while a cumulative average of 2.3 was measured for respondents agreed the findings were true. Also, a cumulative average of 1 occurred for neutral respondents. There were no respondents that disagreed or strongly disagreed. There were also no additional commentaries included in the comment box. Hence since most respondents justified the results associated with management policies as true, the results in the section relating to management policies can be considered to be credible.

The initial findings in section 7.3.2 showed that water management, maintenance and rehabilitation, management of stakeholders (human assets), management of financial assets, monitoring, information management, management of staff (human assets) and developing and executing projects emerged as key themes for major management processes. When participants were asked to state their level of agreement regarding these management processes, the results from the verification exercise showed that a cumulative average of 8 respondents agreed that the findings were true.

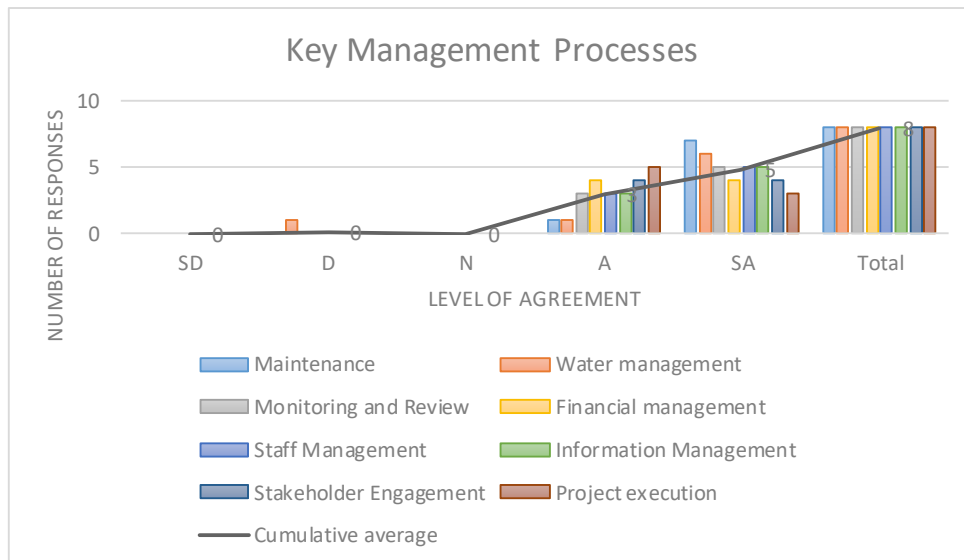


Figure 8.5: Verification for management processes

Figure 8.5 shows that out of the 8 respondents that agreed to the findings, 5 strongly agreed that the findings were true while 3 respondents agreed the findings were true. There were no neutral respondents, and there were no respondents that disagreed or strongly disagreed. There were also no additional commentaries included in the comment box. Hence since most respondents justified the results regarding management processes as true, the results in the section relating to key management processes can be considered to be credible.

The next question asked was regarding the level of agreement for the key performance indicators which were found after the data analysis. The initial findings in section 7.4.1 showed non- revenue water, Billing and collection efficiency, Production capacity, Service coverage, Water Quality, were key themes which emerged for key performance indicators. When 8 participants from the verification exercise were asked to state their level of agreement regarding the key performance indicators applicable to the studied utilities, the results from the verification exercise showed that a cumulative average of 7 respondents agreed that the findings were true (See Figure 8.6)

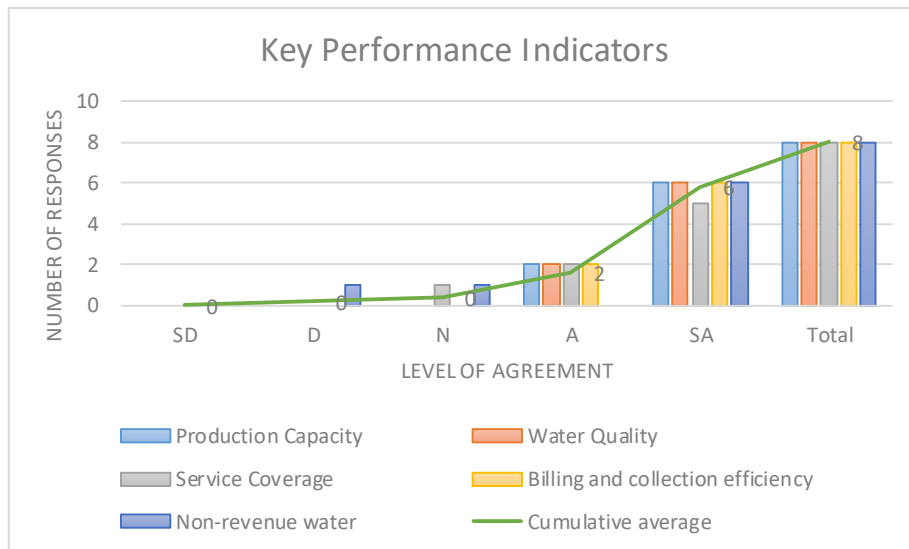


Figure 8.6: Verification for Key Performance Indicators

Figure 8.6 shows that out of the 8 respondents that agreed to the findings, 5 strongly agreed that the findings were true while 2 respondents agreed the findings were true. Also, a cumulative average of 1 occurred for respondents that were neutral there were no respondents that disagreed or strongly disagreed. There were also no additional commentaries included in the comment box. Hence since most respondents justified the results regarding key performance indicators as true, the results in the section relating to key performance indicators can be considered to be credible.

The next question asked was regarding the level of agreement for the key areas for improvement which were found after the data analysis. The initial findings in section 7.2.3 showed that automated services, innovative funding mechanisms, planned maintenance governance reforms and leadership and staff management were key themes which emerged for key areas for improvement. When 8 participants from the verification exercise were asked to state their level of agreement regarding the key enabling factors impacting the studied utilities, the results from the verification exercise showed that a cumulative average of 7 respondents agreed that the findings were true (See Figure 8.7)

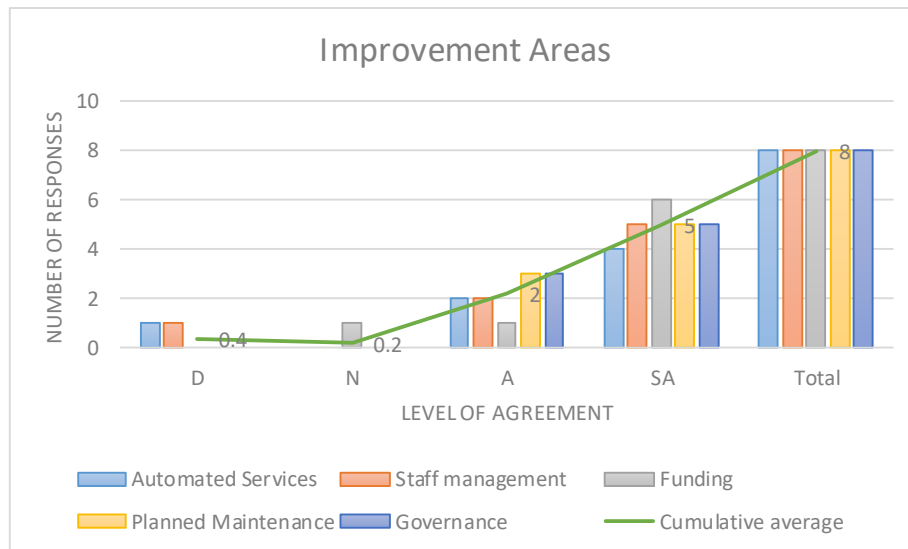


Figure 8.8.7 Verification for Key Improvement Areas

Figure 8.7 shows that out of the seven (7) respondents that agreed to the findings, 7 strongly agreed that the findings were true while two (2) respondents agreed the findings were true. A cumulative average of one (1) was also found for respondents that were neutral and respondents that disagreed. There were also no additional commentaries included in the comment box. Hence since most respondents justified the results regarding key areas for improvement as true, the results in the section relating to key areas for improvement can be considered to be credible.

8.2.2 Framework Verification

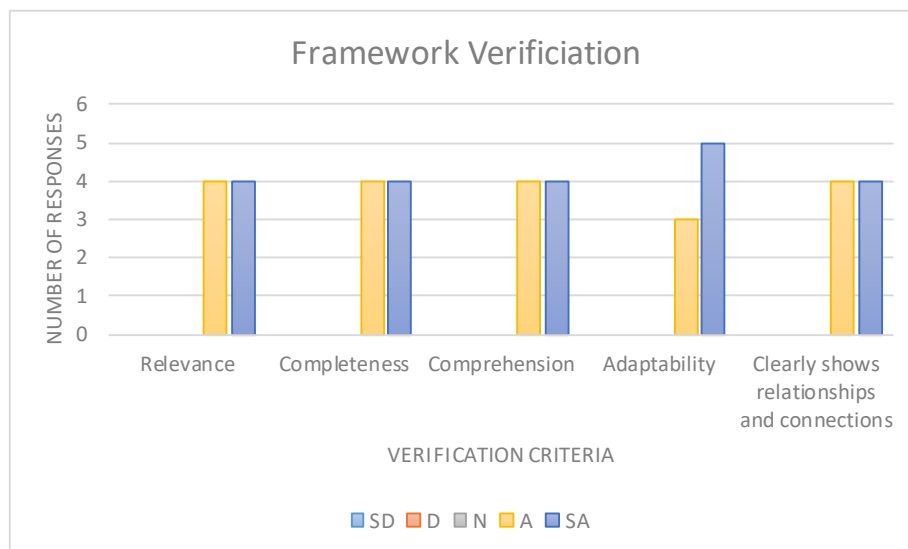


Figure 8.8.8: Verification of framework

In section two of the verification form, respondents were asked to give their level of agreement regarding the relevance, completeness, adaptability, presentation and comprehension of the

developed framework. See figure 8.8 for details. In order to have a deeper understanding regarding why respondents did not agree with certain aspects, a comment box was provided for respondents to provide details regarding their response.

The first question asked was for respondents to state if they agreed that elements of the framework were relevant to Nigerian urban water utilities. The feedback given regarding relevance shows that all participants were within the agreement level. Precisely 4 participants agreed that the framework was relevant while 4 selected they strongly agreed that the framework was relevant. There were also no additional comments provided by respondents. Participants of the verification exercise were also asked to state the level to which they agreed that the framework covers all critical aspects of the Nigerian Water Sector completely. From the feedback given, 4 respondents agreed that the framework will completely cover critical aspects of the Nigerian water sector while 4 respondents strongly agreed. There were also no additional comments provided by respondents.

Since developing a complex framework has the potential to impact the successful implementation in the real-life context of the Nigerian water sector. There was a need to ask participants to state the level to which they agreed the framework was easy to understand. From Fig 7.12, the analysis of the verification exercise shows that 4 respondents agreed that the framework was easy to understand while 4 respondents strongly agreed that the framework was easy to understand. To have a deeper understanding regarding which aspects were not clear to the respondents, a comment box was provided for respondents who disagreed with the fact that the framework was easy to understand. There were no additional commentaries provided in that regard.

In order to examine the potential of adapting the framework to the Nigerian water context, the respondents were stated to ask the level in which they felt the framework was adaptable to the Nigerian context. From Fig 8.8, the analysis of the verification exercise shows that 3 respondents agreed that the framework was adaptable to the Nigerian Urban Water Context while 5 respondents strongly agreed that the framework was adaptable to the Nigerian Urban water context. There were also no additional comments provided by respondents.

Finally, feedback from respondents regarding if elements of the framework are linked properly, the framework clearly shows linkages and relationships between its key components. Precisely 4 participants agreed that elements of the framework were linked properly, and the framework clearly shows linkages and relationships between its key components while 4 respondents

stated they strongly agreed the framework was presented properly. There were also no additional comments provided by respondents.

8.3 Validation of Findings and the revised framework

Transferability is the degree to which the results of the research can be transferred to other contexts or setting with other respondents. Dependability deals with the stability of findings over time. Confirmability deals with the degree to the findings of the research could be confirmed by other researchers (Lincoln, 1985). Confirmability involves establishing that the data and interpretation of findings is not a figment of the imagination of the researcher but evidently derived from data. In order to validate the findings and key results from the study conducted, a validation exercise was conducted with fourteen (14) personnel in the Federal Ministry of Water Resources in Nigeria, a ministry that is responsible for the overall management of water resources in Nigeria and performs oversight functions of formulating policies and laws for the country. Questions were asked regarding their level of agreement regarding the key challenges, stakeholders, management processes, infrastructure, performance systems and enablers affecting the water companies.

8.3.1 Development of Validation form

A more structured approach was carried out when developing the validation form. The validation form was developed in the form of a questionnaire making use of close-ended questions using yes or no answers. The validation form was used to get feedback from new respondents regarding the revised framework which had been populated based on the literature review and cross-case analysis of the four utilities that were studied.

The validation form was split into two sections. In the first section, a total of eight (8) questions were asked based on the key findings which had resulted from the analysed data. The questions asked were like the main questions asked in the interview guide previously used to test the conceptual framework. The eight (8) questions covered areas such as key stakeholders, key challenges, key enabling factor, Management policies, Management processes, Key performance indicators and Asset Maturity. The respondents were asked to rank the level to which they agreed that the key themes that emerged from the 8 focal areas were accurate. A comment box was also provided for detailed comments from respondents who did not agree to the key themes which had occurred from the data analysis. The rationale for these sections was

to ensure that each element of the conceptual framework was adequately populated with key elements that were relevant to the Nigerian sector.

The second section had the first revised framework for the participants to go through. Questions asked were more focused on the framework presentation, relevance, flow, extensiveness, simplicity and clarity (See Table 8.4 for details). The rationale for this section was to ensure that the framework was developed in a way that was easy to understand and it clearly showed all the information that had been obtained from the interviews and the literature review.

8.3.2 Selecting professionals for the validation exercise

Respondents selected for the validation exercise were experts that were conversant with the urban water sector in the Nigerian sector. The selection criteria were based on

- the organisations they were working which were key federal and state ministries associated with water resources in the Nigerian water sector as shown in table 8.3
- respondents that had not been interviewed previously during the initial data collection process
- Their gathered years of experience and exposure to the Nigerian water sector and strategic positions held within their organisations.
- Their levels and areas of speciality

The profile of selected validation experts in Table 8.3 clearly demonstrates that meet the selection criteria for respondents that can provide enlightening responses for the framework validation. Also in this section, the use of simple frequencies was used to count and analyse the responses from participants.

Table 8.1: Profile of validation experts

| Name | Organisation | Department | Years of Experience | Designation | Gender |
|-----------------------|---|------------------------------------|----------------------------|---|---------------|
| VAL-WS-UWS-1 | EU- WSSSRP III | (CSO Grant Project) Ekiti state | 16 | Urban Water Supply and Sanitation specialist | Male |
| VAL-NHSA-HYD-2 | Nigeria Hydrological Services Agency | Engineering Hydrology | 4 | Hydrologist | Male |
| VAL-UB-ENG-3 | Upper Benue River Basin Development Authority Yola | Engineering | 28 | Deputy Director – Engineering | Male |
| VAL-FMWR-ENG-4 | Federal Ministry Of Water Resources | DAMS AND RESERVOIR OPERATIONS | Over 18 | Deputy Director – Engineering | Female |
| VAL-SMWR-ENG-5 | Ministry of Water resources Zamfara | Water Supply | Over 20 | Director -Water Supply (Engineer) | Male |
| VAL-SMWR-ENG-6 | Ministry of Water Resources Kano | Dams and Irrigation Engineering | 34 | Director - irrigation engineering | Male |
| VAL-FMWR-ENG-7 | Federal Ministry Of Water Resources | Dams and Reservoir Operations | 24 | Assistant Director - Dams and Reservoir Operations (Engineer) | Male |
| VAL-FE-ADM-8 | Federal Ministry of Environment | Admin | 15 | Admin Officer | Male |

| | | | | | |
|-------------------------|---|-------------------------------|----|---------------------|--------|
| VAL-FMWR-WSE-9 | Federal Ministry Of Water Resources (3rd NUWSRP) | Water Supply | 23 | Water Supply Expert | Male |
| VAL-FMWR-WSE-10 | Federal Ministry Of Water Resources (Federal Project Implementation Unit | Water Supply | 10 | Water Supply Expert | Female |
| VAL-FMWR-PE-11 | Federal Ministry Of Water Resources (Federal Project Implementation Unit) | Water Supply | 12 | Project Engineer | Male |
| VAL – FMWR-ID-12 | Federal Ministry Of Water Resources | Irrigation and Dams | 37 | Engineer | Male |
| VAL-FMWR-ENGR-13 | Federal Ministry Of Water Resources | Dams and Reservoir Operations | 17 | Engineer | Female |
| VAL-FMWR-WSE-14 | Federal Ministry Of Water Resources | Water Supply | 15 | Engineer | Male |

8.3.3 Validation of findings

In the first section, a total of 8 questions were asked based on the key findings which had resulted from the analysed data. The questions asked were similar to the main questions asked in the interview guide previously used to test the conceptual framework. The 8 questions covered areas such as key stakeholders, key challenges, key enabling factor, Management policies, Management processes, Key performance indicators and Asset Maturity.

The first question asked was regarding the level of agreement for the key stakeholders which were found after the data analysis. The initial findings in section 7.2.1 showed that Customers, Informal service providers, Funding institutions, utility management and staff, consultants, policymakers, and CSOs emerged as key themes for major stakeholders. When 14 participants of the study were asked to state their level of agreement regarding the key stakeholders, the results from the validation exercise showed that a cumulative average of 8 respondents agreed that the findings were true.

Figure 8.9 shows that out of the 8 respondents that agreed to the findings, 4 strongly agreed that the findings were true while 4 respondents agreed the findings were true. Participants who had stated the stakeholder had a moderate impact was a cumulative average of 3. The cumulative average for not important and weak was measured at 1 and 0 respectively. Hence since most respondents justified the results regarding key stakeholders as true, the results in the section relating to key stakeholders can be considered to be relevant and transferable.

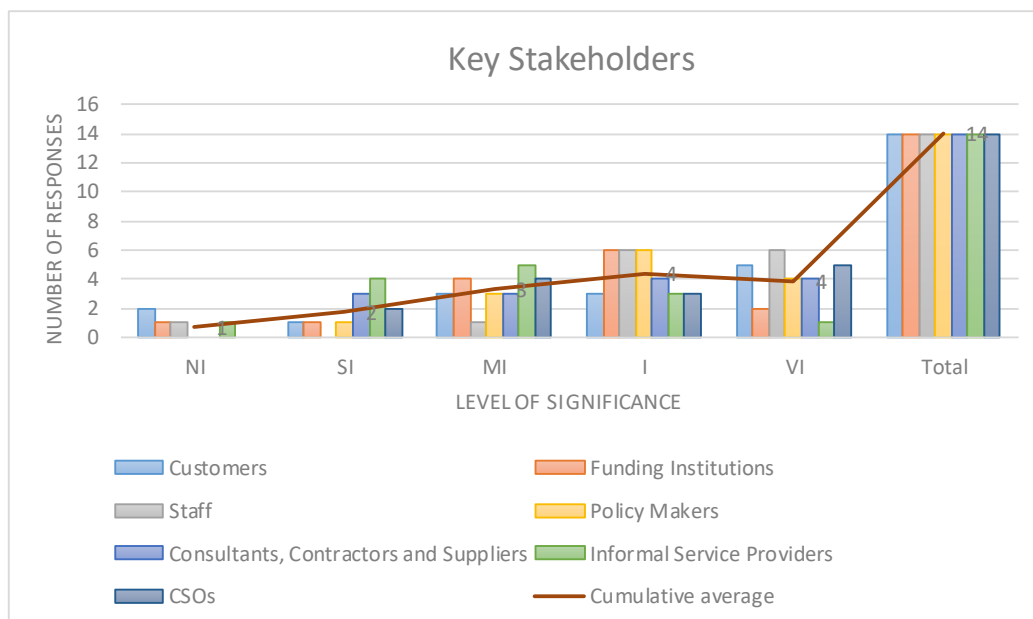


Figure 8.9: Validation for key stakeholders

The next question asked was regarding the level of agreement for the key challenges which were found after the data analysis. The initial findings in section 7.2.2 showed that Funding, Infrastructure challenges, Governance, illegal connection, poor staff management, unwillingness to pay, power failure, population growth and rapid urbanisation and Project-oriented issues were key challenges impacting the case utilities studied. The results from the validation exercise showed responses for participants that agreed to the findings for key challenges was measured at a cumulative average of 9. (See Figure 8.10).

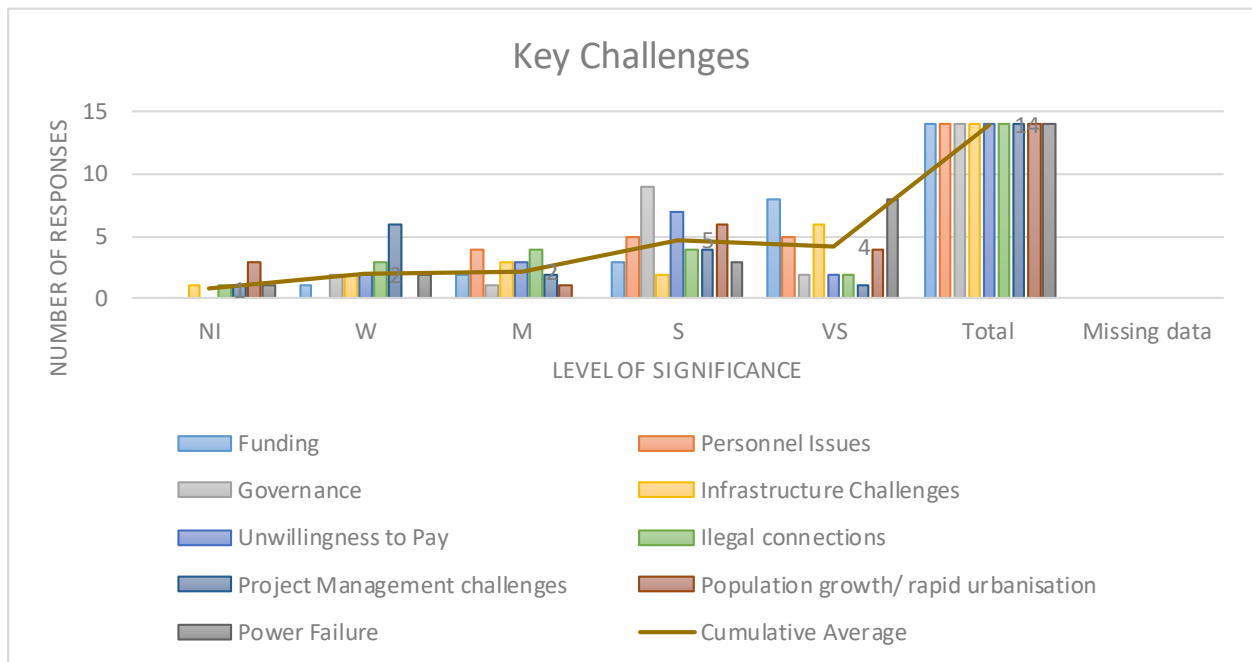


Figure 8.10: Validation of findings for Key challenges

A cumulative average of 4 occurred for participants that strongly agreed while a cumulative average of 5 occurred for participants that agreed that the findings were true. The average responses for participants that stated the key findings were not important were measured at 2 while the average responses for participants that stated the key findings for challenges were weak were measured at 1. In addition, a cumulative average of two occurred for participants that measured the key findings at a moderate level. There were also no additional commentaries included in the comment box. Hence since most respondents justified the results regarding key challenges being true, the results in the section relating to key challenges can be considered to be credible.

The next question asked was regarding the level of agreement for the key enabling factors which were found after the data analysis. The initial findings in section 7.2.3 showed that staff commitment, support from development partners and government, customer paying regularly,

governance reforms and leadership and stakeholder engagement were key themes which emerged for key enabling factors. When 14 participants from the verification exercise were asked to state their level of agreement regarding the key enabling factors impacting the studied utilities, the results from the verification exercise showed that a cumulative average of 12.8 respondents agreed that the findings were true (See Figure 8.11)

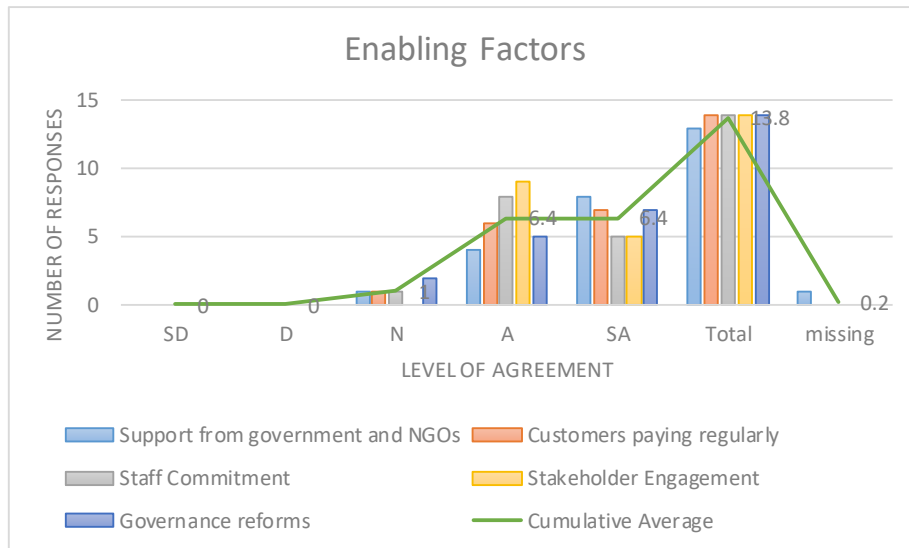


Figure 8.11: Key enabling factors

However, a cumulative average of 1 occurred for responses associated with participants that were neutral and disagreed with the findings. There were no additional comments. Hence since most respondents justified the results regarding key enabling factors being true, the results in the section relating to key enabling factors can be considered to be credible.

The next question asked was regarding the level of agreement for the finding regarding management policies. The initial findings in section 7.3.1 showed that the key themes that emerged from the data analysis from four utilities for policy implementation were targets similar to NWP, no discrepancy in implementation, ineffective policy implementation, existing mandate and state water master plan. When 14 participants of the study were asked to state their level of agreement regarding the findings from policy implementation, the results from the verification exercise showed that a cumulative average of 11.7 respondents agreed that the findings were true.

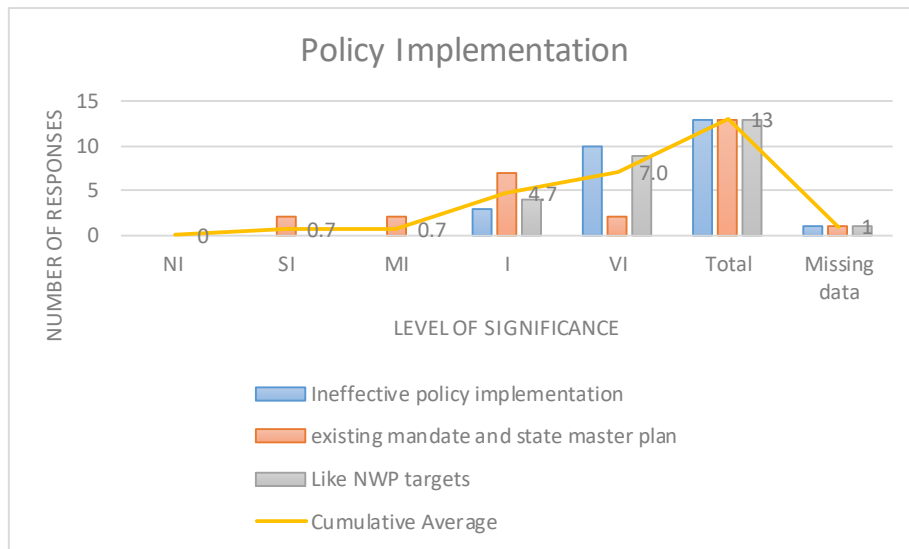


Figure 8.12: Validation of key findings for Policy Implementation

Figure 8.12 shows that out of the respondents that agreed to the findings which were measured at a cumulative average of 11.7, a cumulative average of 7 occurred for respondents that strongly agreed that the findings were true while a cumulative average of 4.7 was measured for respondents agreed the findings were true. Also, a cumulative average of 0.7 occurred for respondents that were neutral while respondents that disagreed were at a cumulative average of 0.7. There were no respondents that disagreed to any of the key findings for policy implementation. There were also no additional commentaries included in the comment box. Hence since most respondents justified the results associated with management policies as true, the results in the section relating to management policies can be considered to be credible.

The initial findings in section 7.3.2 showed that water management, maintenance and rehabilitation, management of stakeholders (human assets), management of financial assets, monitoring, information management, management of staff (human assets) and developing and executing projects emerged as key themes for major management processes. When participants were asked to state their level of agreement regarding these management processes, the results from the verification exercise showed that a cumulative average of 14 respondents agreed that the findings were true.

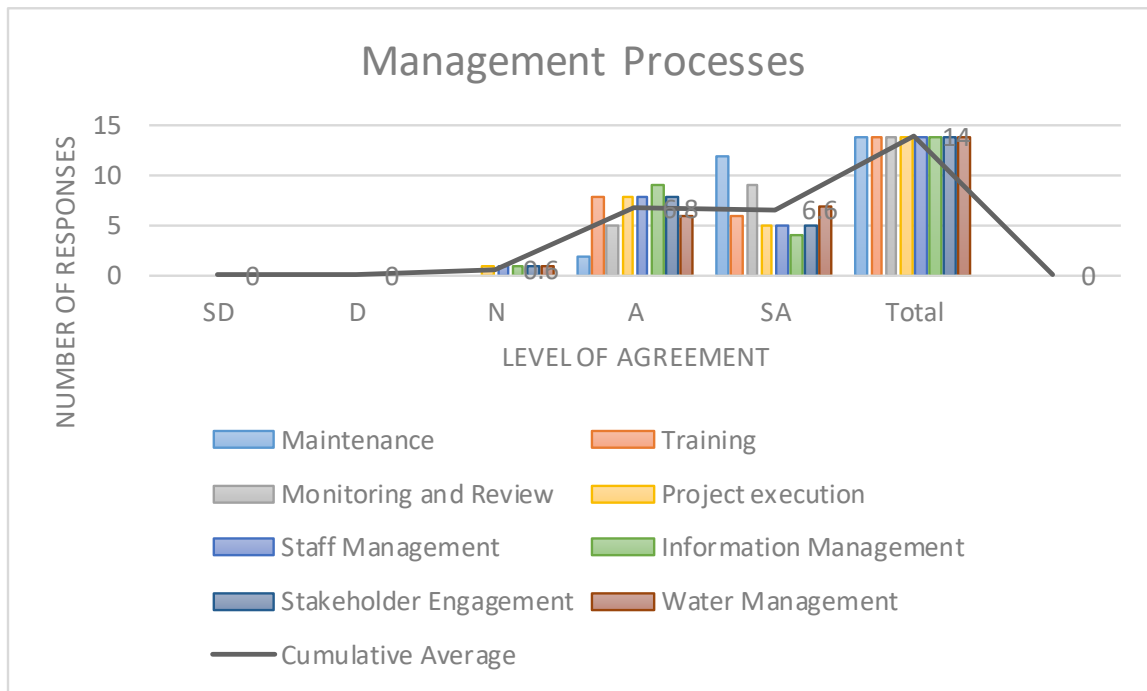


Figure 8.13: Validation for management processes

Figure 8.13 shows that out of the 14 respondents that agreed to the findings, 6.6 strongly agreed that the findings were true while 5.8 respondents agreed the findings were true. There were 0.6 average responses that were neutral while there were no participants that disagreed or strongly disagreed to the findings for management processes. There were also no additional commentaries included in the comment box. Hence since most respondents justified the results regarding management processes as true, the results in the section relating to key management processes can be considered to be credible.

The next question asked was regarding the level of agreement for the key performance indicators which were found after the data analysis. The initial findings in section 7.4.1 showed non- revenue water, Billing and collection efficiency, Production capacity, Hours of supply, Service coverage, Staff productivity, and Response time to repairs/customer complaints were key themes which emerged for key performance indicators. When 14 participants from the verification exercise were asked to state their level of agreement regarding the key performance indicators applicable to the studied utilities, the results from the validation exercise showed that a cumulative average of 13.8 signified respondents agreed that the findings were true (See Figure 8.14)

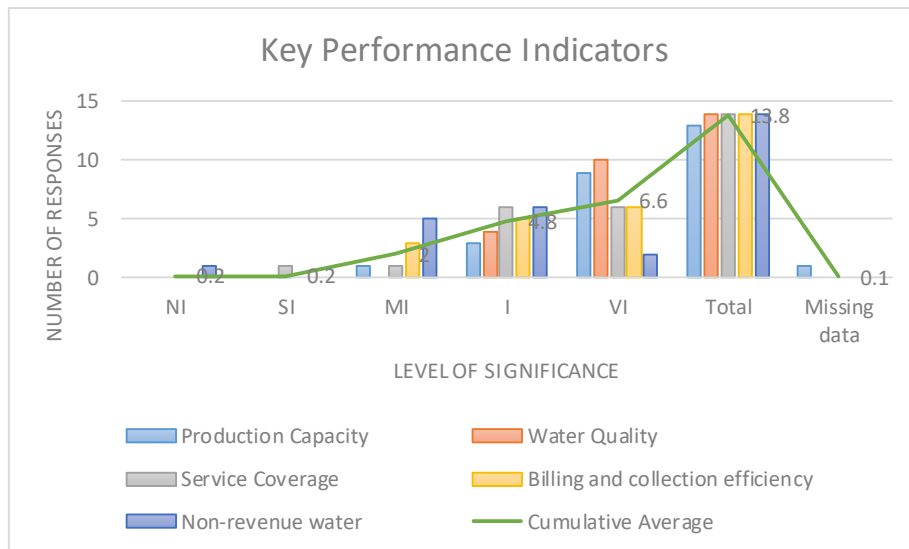


Figure 8.14: Validation of Key Performance Indicators

Figure 8.6 shows that respondents that strongly agreed to the findings being true were measured at 6.6 while respondents that agreed the findings were true were measured at a cumulative average of 4.8. Also, a cumulative average of 2 occurred for respondents that stated they had a moderate impact while responses for slightly important and not important were measured at 0.2 and 0.2 respectively. There were also no additional commentaries included in the comment box. Hence since most respondents justified the results regarding key performance indicators as true, the results in the section relating to key performance indicators can be considered to be valid and transferable.

The next question asked was regarding the level of agreement for the key areas for improvement which were found after the data analysis. The initial findings in section 7.2.3 showed that automated services, innovative funding mechanisms, planned maintenance governance reforms and leadership and staff management were key themes which emerged for key enabling factors. When 14 participants from the verification exercise were asked to state their level of agreement regarding the key enabling factors impacting the studied utilities, the results from the verification exercise showed that a cumulative average of 12 respondents agreed that the findings were true (See Figure 8.15).

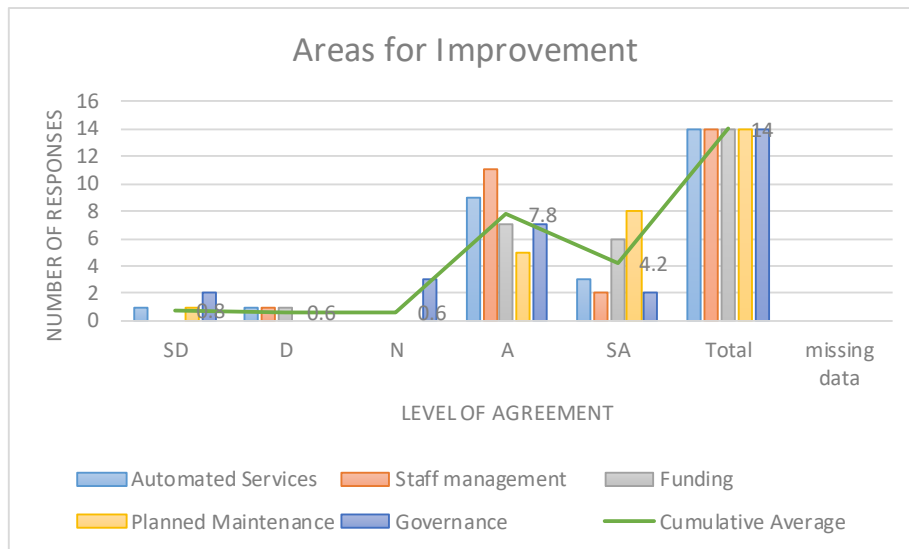


Figure 8.15: Validation of key findings for areas of improvement

Figure 8.15 shows that out of the 12 respondents that agreed to the findings, 4.2 strongly agreed that the findings were true while 7.8 respondents agreed the findings were true. A cumulative average of 1 was also found for respondents that were neutral and respondents that disagreed. A respondent had stated that licensing should be included as an area for improvement and this was added to the framework. Hence since most respondents justified the results regarding key areas for improvement as true, the results in the section relating to key areas for improvement can be considered to be credible.

8.3.4 Validation for framework

In section two of the validation form, respondents were asked to give their level of agreement regarding the relevance, completeness, adaptability, presentation and comprehension of the developed framework. See figure 8.16 for details. In order to have a deeper understanding regarding why respondents did not agree with certain aspects, a comment box was provided for respondents to provide details regarding their response.

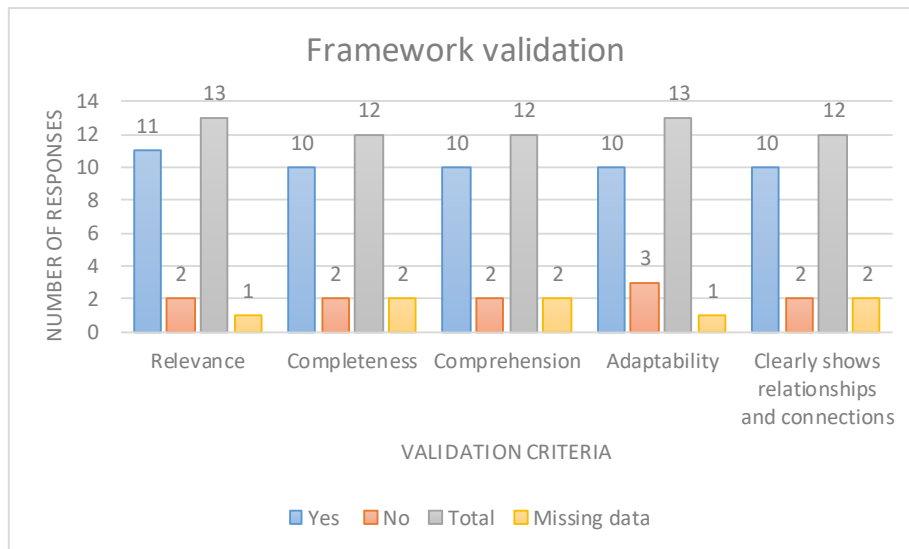


Figure 8.16: Framework Validation

Participants were asked to state if they agreed that elements of the framework were relevant to Nigerian urban water utilities. The feedback given regarding relevance shows 11 respondents agreed that the framework was relevant to the Nigerian urban water sector while 2 participants did not agree that the framework was relevant. There was also no data provided by one participant. Precisely 12 participants agreed that the framework was relevant while 4 selected they strongly agreed that the framework was relevant. There were also no additional comments provided by respondents. Since more respondents stated the framework is valid them.

Secondly, participants of the validation exercise were also asked to state the level to which they agreed that the framework covers all critical aspects of the Nigerian Water Sector completely. From the feedback given, 10 respondents agreed that the framework will completely cover critical aspects of the Nigerian water sector while 2 respondents did not agree that the framework covered all aspects of the Nigerian urban water sector. There was no data from the two participants in this section. There were two additional comments provided by respondents.

To corroborate their views some of them made the following statements

board of directors, management staff, staff, financiers, customers, etc are not stated

“the management processes for managing the different assets could be more detailed to clearly show how they are implemented and which assets they have implemented most especially the funding structures and control mechanisms”.

To accommodate the views of the 2 participants, utility staff were changed from staff only to utility management and staff while NGOs and state government were readjusted to financiers. In addition, all management processes for various assets were detailed in the revised framework. In order to examine the potential of adapting the framework to the Nigerian water context, the respondents were asked to state the level in which they felt the framework was adaptable to the Nigerian context. From Fig 8.16, the analysis of the validation exercise shows that 10 respondents agreed that the framework was adaptable to the Nigerian Urban Water Context while 3 respondents did not agree that the framework was adaptable to the Nigerian Urban water context. There were missing data from one respondent. The three respondents that disagreed to the framework being adaptable expressed scepticism regarding the implementation of the framework in the following ways.

“The framework is good however barriers such as lack of effective policy, weak or no political will and water still being treated as a social good could impact its implementation.”

“There are agreeable elements of the framework which can be adapted to the Nigerian context however lip service”

“We need to include pro-poor strategies for delivering water to blighted areas”

These comments were addressed by ensuring the governance issues and the funding issues raised were included in the areas of improvement section for the framework.

Since developing a complex framework has the potential to impact the successful implementation in the real-life context of the Nigerian water sector. There was a need to ask participants to state the level to which they agreed the framework was easy to understand and simple enough to apply to the Nigerian urban water context. From Fig 8.16, the analysis of the validation exercise shows that 10 respondents agreed that the framework was easy to understand while 2 respondents did not agree that the framework was easy to understand. There was no data provided by 2 participants. In order to have a deeper understanding regarding which aspects were not clear to the respondents, a comment box was provided for respondents who disagreed with the fact that the framework was easy to understand. The areas where the 2 respondents were unclear about are summarised below.

“I do not understand which specific stakeholders you are referring to. Also, the specific management processes for financial elements are not clear. Probably show it in details”

“The relationship between support system elements, the management processes and stakeholder actions are unclear”.

The comments were addressed by ensuring the elements in each of the key components were written in great detail.

While conducting the validation exercise, respondents were asked to give views regarding the framework structure and presentations. From the feedback given, 10 respondents stated that they believed the framework had a good structure and presented properly while 2 respondents stated that they did not believe the framework was well structured and clear. There was no response from two respondents in this section. The comments provided in the comment box by the 2 respondents who did not agree with the framework structure are detailed below.

“It is not visible and clear”

“The framework could be structured better. It seems some elements are not linked properly and it will need to be reorganised”

To address these comments, the conceptual framework was reorganised completely from Figure 5.1 to Figure 8.17 to show the key steps, in addition, the elements in each of the key components were written in great detail.

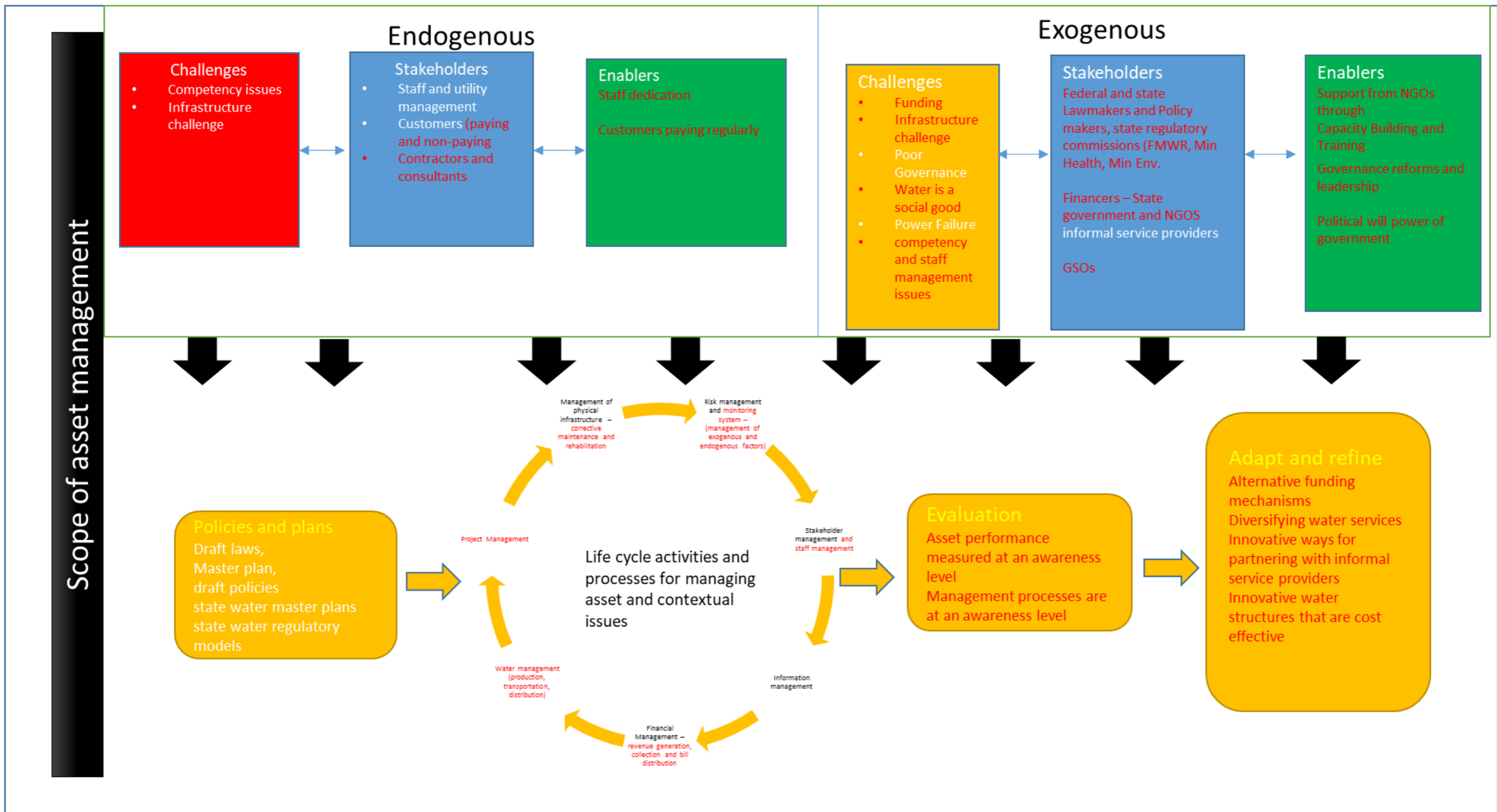


Figure 8.17: Revised Framework

Chapter 9

General Discussion

9.1 Introduction

This chapter discusses the findings from the data analyzed in chapter seven. The primary aim of this research was to explore how asset management can be adapted to the urban water utilities lacking the required institutional capacities. The similarities and differences between the exploratory case studies and the validation exercise with 14 water professionals will also be identified. This chapter also shows the links between the research findings, the conceptual framework and literature review thus providing answers to the primary research aim.

9.2 Developing sustainable Funding systems for good asset management practices

The results from section 7.2.2 had shown that all utilities had serious financial challenges. Key financial issues were related to low internal generated revenue, and running costs not being sufficient to fund operational activities like training, maintenance, staff salaries, water production, water treatment and supply of goods and equipment required to work. It was also inferred from the results from the enabling factors section in 7.2.3 and 7.2.1 that all the studied utilities depended more on government subsidies and International donor grants compared to the internally generated revenue.

The maturity analysis in section 7.4.2 also showed in detail that the financial assets in terms of tariff rates and revenue generated were not able to sustain the utilities. Dependence on the government and international donors could also be inferred from the key stakeholder analysis in Section 7.2.1 since the government and international donors emerged as key stakeholders. These findings related to funding corroborates the literature in 4.3.4 on the Nigerian sector where (Independent Evaluation Group, 2017, Nwankwoala, 2014, Odigie and Fajemirokun, 2005, Olajuyigbe, 2010, Owolabi, 2014, Oyebode, 2014, World Bank, 1994, World Bank, 2004, World Bank, 2011a, WorldBank, 2011a, World Bank, 2000) identified dependence on government subsidies, low internal generated revenue as financial issues impacting the Nigerian water sector.

However, in terms of the financial requirements for successfully implementing asset management and good management practices respectively, there was a major variance with regards to the required financial maturity level for successful asset management and the financial maturity found in the case utilities investigated. The findings had shown that the financial viability of the utilities was at a learning maturity owing to low tariff structures, low internal generated revenue and customers with the mentality that water should be free.

The literature in section 3.3.1 and 3.3.5 had previously shown that financial viability criteria for success were the ability for utilities to recover production cost, assume debts, depend less on government subsidies and have a consistent inflow of revenue streams (Mugabi et al., 2007, Baietti et al., 2006). This was evidently not seen in the four utilities studied as the results showed that the assessed management processes such as training and maintenance in section 3.3.5 were slated at an awareness level due to funding issues. Furthermore, a major dependence on government subsidies and international donor grants, in the long run, is clearly an unsustainable system as the results in section 7.2, 7.3 and 7.4 showed a major dependence on government subsidies, international donors and poor financial structures.

However, from section 7.5 of the findings which was focused on major areas for improvement, it was interesting to find that solutions such as have diverse revenue streams apart from piped connections. Suggestions may include carrying out water sampling, partnering with informal service providers and sachet water companies and setting up PPP arrangements and contract arrangements with private investors. The potential for these new funding arrangements to end up being sustainable and innovative are unknown at this stage as these are seemingly new schemes which are only being developed. However, this is in line with the observations made by (Collignon and Vézina, 2000, Collignon, 2002) regarding developing innovative and diverse funding arrangements adaptable to the context of water utilities. This result implies that water utilities in Nigeria will need sustainable funding mechanisms that can enable the asset management process to deliver the organisational mandate. Furthermore, the pro-poor factor is not achieved and targeted to poor customers alone since tariff structures are set at low rates, are hardly reviewed and applicable to all domestic customers. If revenue is not improved to a level which covers operational and maintenance costs, the potential of implementing a successful asset management process could be impacted greatly. Alternatively, investing in water structures and power generating equipment that are cost-effective and adapted to suit the working context of water utilities in Nigeria could be a potential solution for reducing high production and capital costs.

9.3 The role of stakeholders in delivering good asset management practices

In terms of major stakeholders influencing the case water utilities, the data in section 7.2 revealed that Customers, Informal service providers, Funding institutions, utility management and staff, consultants, policymakers, and CSOs were major stakeholders. The influence of stakeholders as shown in section 7.2 varied in terms of the types of assets.

Customers had a major impact on the revenue generated, staff and the utility had a major influence in terms of running the organisation and carrying out processes for managing all asset types. In addition, more customers were unwilling to pay for services compared to customers that were willing to pay for services rendered. Lawmakers and policymakers had a major influence on the institutional and legal environment. Consultants had an influence on outsourced roles and services while funding institutions like NGOs and the state government were very influential and had an impact on the financial stance of the utilities and the state government also influenced the capacity of the utilities as well. Informal service providers also had an influence on the commercial market of the water utilities which is similar to trends stated by (Dos Santos et al., 2017, Collignon and Vézina, 2000) while the CSO's were instrumental to getting public buy-in during public sensitization. Also, emerging trends were found for enabling factors in section 7.4 about staff dedication and regular payment from customers even in the presence of low salary structures, poor staff placement and lack of training and unreliable water services with respect to customer. This could suggest that having stakeholders with good character and value systems also impacts delivery of sustainable services rather than the incentives arising from training and good salary structure and benefits as suggested by (Olajuyigbe, 2010, World Bank, 1994, WorldBank, 2011a, Independent Evaluation Group, 2017, World Bank, 2011a, World Bank, 2004, Odigie and Fajemirokun, 2005, Nwankwoala, 2014, Oyeboode, 2014, Owolabi, 2014, World Bank, 2000) or regular provision of water and focusing on the needs suggested by in the case of customers (Aduda, 2007, Oyeboode, 2014, Ajibade et al., 2015, Goldface–Irokalibe, 2006, Chukwu, 2015, Adah and Abok, 2013, Onugba, 2009, Ajiboye et al., 2012, Nwankwoala, 2014, Owolabi, 2014, Omole, 2013). The implication of this will be developing stakeholder engagement strategies that can exploit good values and character found with staff and customers.

According to (Akhmouch and Clavreul, 2016, Megdal et al., 2017, Mott Lacroix and Megdal, 2016) effective stakeholder engagement is fundamental for delivering sustainable water services. The implication of the influence of stakeholders is that there would need to be a way of effectively managing the activities of key stakeholder before asset management can be

implemented successfully in the urban water sector in Nigeria. Furthermore, based on varying nature of stakeholder activities from analysed key stakeholders in section 7.2 utilities will need to make decisions in regards to stakeholders they could empower, involve, consult, and sensitise and stakeholders they could partner and control.

The findings in section 7.3.2 had shown that there were stakeholder engagement strategies in place and mitigating strategies for controlling the impact of informal service providers. However, the results showed that the engagement practices seemed to only occur when water projects were about to commence or during major projects. Secondly, public sensitisation seemed to focus more on enlightening customers majorly. The discussions about stakeholder engagement practices by respondents did not refer to stakeholders such as policymakers and NGOs. In addition, funding and lack of resources impacted the effectiveness of monitoring activities for managing the impact of informal service providers. The findings did not clearly state if lack of funding impacted the level of stakeholder engagement required.

Also, in section 7.5, the extent to which contractual arrangements impacted the activities of consultants and contractors was not evident from the findings. However, the way in which consultants received delayed payments and supplied services on credit as shown in section 7.2 is not considered as sustainable.

The implication of the findings is that implementing more engagement strategies with the public during the policy development process and not only when projects occur could go a long way in determining the success of formalised asset management systems in the Nigerian context. The lawmakers most especially who were stated to have delayed the passage of the bill in section 7.2.2 would also need to be engaged. The potential of the use of AMP and financial statements which were stated in section 2.3.2 for defending finances required for running water services or capital investments could also be a route where utilities get buy-ins and support from stakeholder like the government, NGOs and the law and policymakers. Public sensitisation for customers should encompass the need to place more value on water because of the investment and resources that go into water production and distribution.

Proper engagement structure also has the potential to reduce the impact of unwilling customers has proper education about the importance of paying for services can occur during stakeholder engagement. Educating stakeholders before projects are conceived, when all asset types are in use, when assets are being decommissioned and before plans and asset management plans, policies and budgets are developed will improve asset management implementation. Also,

stakeholder management practices should ideally encompass all stakeholders and not only customers. The previous literature had shown that people are assets and the management of people are required for delivering successful asset management. The results in section 7.2 had also shown that the activities of key stakeholders such as customers, Informal service providers, funding institutions, utility management and staff, consultants, policymakers, and CSOs impacted the water utilities in delivering value.

Hence developing an effective stakeholder engagement will depend on how well it is able to ensure that activities of key stakeholders identified in section 7.2 do not impact the utilities' ability to achieve value. The presence of effective stakeholder management that manages people in a way they become assets to an organisation will, therefore, go a long way in determining the success of modern-day asset management practices in the Nigerian context.

9.4 The importance of resilient infrastructure for delivering good asset management

In terms of the role infrastructure played in the Nigerian urban water sector. The results in section 7.3 showed that infrastructure challenges were a key challenge that impacted the services of water companies. Also, infrastructure evaluations and infrastructure management maturity were associated with terms such as infrastructure decay, lack of infrastructure, infrastructure operating below capacity and poor maintenance. Activities of informal service providers in section 7.2 such as illegal connections and pipe vandalism were also key issues which emerged from the results.

The impact of physical infrastructure in section 4.3.5 on the Nigerian urban water sector was also established in works by (Owolabi, 2014, Oyegoke S. O., 2012, World Bank, 2000) where issues such as ageing infrastructure, old pipe reticulation, and illegal connections were also raised. The importance of infrastructure in other asset performance was also evident from the results as high maintenance costs were associated with infrastructure maintenance impacted the revenue generated.

The implication of the finding on infrastructure maturity is that unless water utilities develop innovative infrastructure designs that are cost-effective and can easily be managed at each life cycle of the asset. The performance of other assets such as staff and revenues will be impacted greatly. The implication of the results associated with operating below design capacities, infrastructure decay, lack of infrastructure, infrastructure operating below capacity and poor maintenance means that utilities in the Nigerian urban water sector will need to take more

credible decisions in regards to infrastructure projects that achieve the following factors resilience, cost efficiency, cost effective maintenance, and adaptable designs for easy whole-life cycle management.

9.5 Governance

A key challenge which emerged from the analysed data in section 7.2.2 was governance. The utilities were lacked autonomy for making decisions associated with the management of human, financial and physical resources. The case utilities did not have the required powers to make decisions relating to personnel recruitment and placement, tariff setting, control on water resources and spending revenue generated.

The findings in section 7.3.1 had shown that their policies and mandates in place that were focused on water targets similar to the National Water policy. However, it was interesting to also find that the actual implementation of these policies was non-existent. The results also stated that there were major discrepancies in policy implementation due to funding challenges. There was also a high level of government interference and political campaigns that influenced the willingness of customers paying for services. These findings are in line with observations made by (Ajai, 2012b, Akpabio, 2012a, Goldface–Irokalibe, 2006, Macheve et al., 2015, WorldBank, 2011b) which identified the issues of autonomy in Nigerian Water Utilities.

The state government through governing ministries depending on the utility context were responsible for making decisions regarding how financial and human resources were to be utilised. The results of this sometimes were the fact that funds were not received as at when due, staff placed wrongly, staff were inadequate in some cases, there were cases of wrong staff placement, competent staff lacking the required level of training and resources to carry out processes effectively.

Furthermore policies, projects and plans developed were developed did not have accurate information. Alternatively, government organisations could be empowered in making decisions that can sustain the performance of all assets. Before staff are employed, utilities should engage the parent bodies involved early enough about their requirements for staff competencies, policies, infrastructure and processes and information system. AMPs could be a way for equipping utilities with all the required asset. AMPs should, therefore, include information on all asset types and contextual factors the utilities and should be developed by actively involving all key stakeholders analysed in section 7.2.

Utilities need to be given an acceptable level of autonomy capacity to operate effectively (Akpabio, 2012, Danilenko et al., 2010). There is, therefore, a major variance in the governance structure of the Nigerian utilities analysed in section 8.2.3 and the analysed utilities with asset management best practices in section 2.2.1 that had clear governance structure and laws that had stipulated the need for implementing formalised asset management systems and

Key players involved in the implementation process can act accordingly when they have the powers to make decisions regarding staff management, infrastructure management and financial expenditures otherwise any efforts they put in will only bring futile results. (Danilenko et al., 2010, Hartvelt and Okun, 1991) assert the need for autonomy and capacity building because it makes it easier for utilities to deliver water management processes. Autonomy is important because it will allow Utilities to move from developing tactical plans, business cases and project proposals to actually implementing them without having to go through long and tough bureaucratic processes. At the same time, Parent Organisations will also need to support utilities and monitor the performance of utilities without necessarily disrupting their capacity to function properly.

(Chiplunkar et al., 2012, Cooley et al., 2013, Furlong et al., 2016, Megdal et al., 2017, OECD, 2015, OECD, 2016b, PAI, 2011, Tortajada, 2010, Tropp, 2007), argues for good governance in the urban water sector. Hamdy et al. (1998) also state that the development of appropriate policies and legislation creates an enabling environment for water utilities to deliver sustainable services. The implication of the findings in regards to governance is that unless established laws which give utilities the legal backing they need to carry out activities effectively are enacted; and the haze of implementation is resolved where the utility managers and the government adhere to what the law clearly states, the implementation of formalised asset management systems could be impacted adversely.

9.6 Establishing effective mitigating strategies

In terms of major challenges in section 7.2.2, the analysed data revealed key challenges such as Funding, Infrastructure challenges, Governance, illegal connection, poor staff management issues, unwillingness to pay, power failure and population growth as key challenges. These were similar challenges identified by (Adah and Abok, 2013, Aduda, 2007, Ajibade et al., 2015, Ajiboye et al., 2012, Chukwu, 2015, Goldface–Irokalibe, 2006, Oyeboode, 2014, Nwankwoala, 2014, Onugba, 2009, Owolabi, 2014, Omole, 2013) in section 4.3 of the literature.

The implication of the issue of illegal connection and pipe vandalism is that water utilities will lose monies that were supposed to be put into their business to wastage. The Implication of lack of infrastructure capacity is that Water utilities can only be effective when utilities have the required infrastructure capacity that can meet the needs of its population. The water industry relies heavily on infrastructure for sustaining its business, thus utilities tend to invest in infrastructure. (Kang and Lansey, 2012). Additionally, investments should be made on cost-effective infrastructure that can be maintained in the long run so maintenance costs and capital costs can be recovered. In addition, investing in cost-effective infrastructure that can be maintained easily would go a long way in delivering value an implementing an effective asset management system for Nigerian Urban water utilities.

The issues with staff placement, capacity building and lack of autonomy for managers to make decisions regarding staff recruitment impact the successful implementation of water management processes. The unwillingness to pay factor impacts the revenue generated by water utilities. The implication of power failure is that water production and distribution are affected, and alternative power generation costs are prohibitive. In terms of population growth, policies and master plans tended to become outdated since policy implementation was still a haze and population growth in Nigeria is increasing rapidly. The results had also shown that the key challenges that emerged were a mixture of asset-related issues such as Funding (financial assets), Infrastructure challenges (physical assets), illegal connection (people and contextual), poor staff management issues (people), unwillingness to pay (contextual, people, financial), power failure (Physical) as well as contextual issues such as governance and population growth (information and contextual).

Furthermore, some of the management processes associated with the identified challenges were observed to be at an awareness maturity level which was low and clearly inadequate for managing the key challenges impacting the case utilities. These findings are similar to (Aduda, 2007, Ajibade et al., 2015, Oyebode, 2014) description of maintenance and training of personnel as non-existent. Also, the monitoring tasks force tackling illegal connections and informal service provisions was measured at an awareness level because of reconnections by informal service providers and people unwilling to pay.

The implication of this is that utilities will need to move to an optimal level of implementing their mitigation strategies before asset management can successfully occur in the Nigerian water sector. An optimal level for mitigating strategies refers to mitigating strategies that are

developed to manage key challenges and enabling factors identified in section 7.3. Secondly, an optimal mitigating strategy is one that can monitor how successful all management systems related to all asset types are effectively implemented. Utilities could explore the option of actively educating and sensitising informal service providers and people unwilling to pay as against forcefully evicting or prosecuting offenders. Also, key stakeholders responsible for various mitigation tasks should be empowered to carry their activities which encompasses being involved in the process at the right time, have the right information (both contextual and asset) related so they carry their activities successfully and given the relevant resources, equipment and training that allows them carry out their mitigating functions successfully. In summary for asset management to be successful in the Nigerian water sector, effective mitigating systems for the key challenges identified in section 7.2.2 would need to actively need to address both contextually related factors and asset-related challenges before asset management benefits can start to occur. All key stakeholders will also need to be involved in and engagement before and after mitigating strategies are developed and while they are being implemented.

9.7 Improving maturity levels of the management process and associated assets

The scenarios presented in section 8.2.7 regarding the maturity of management processes and various asset types for all case utilities analysed in section 8.2.7 does not show the achievement of sustainable service delivery. The results had shown in section 7.6 that the existing management processes implemented by the studied utilities were related to all asset types and mitigating processes such as stakeholder management and monitoring processes were suited to contextual factors. However, the management processes for various assets types and contextual factors in the utilities were slated to be at an innocent level of maturity. For example, maintenance which was a management process found in water utilities was measured at an awareness maturity level because the studied utilities carried out corrective rather than preventive or planned maintenance. Stakeholder management also was only at a stage where customers and policymakers were informed and consulted unlike (Ugbah et al., 2017) ideology of effective stakeholder management where stakeholders are actively involved, empowered and partnering occurs with key stakeholders.

The maturity level for processes that dealt with the management of staff was also at an awareness level because of poor training and staff placement that was observed from the results. Thus, staff were not empowered to carry out the operations of the organisation even though they possessed relevant qualification and skills. Projects were also at an awareness

level because they were attributed to by project management issues such as project delays, abandoned projects and no value for money. Revenue generation was low and unable to recover the cost. Automated systems and information systems were only being newly developed. Monitoring and control system was not implemented fully which was attributed to lack of funds. There is, therefore, a major variance between the stipulated requirements for implementing asset management and good management practices in section 2.3 and 3.3.2.

The existence of assurance systems, continuous improvement and training for asset management implementation are two major fundamentals identified by (Alegre, 2010, Ganjidoost et al., 2018, Godin et al., 2012, Matichich et al., 2014a, Matichich et al., 2014b, Sneesby et al., 2012) in section 2.3. 3 and 2.3.4. Furthermore, knowledge management was a stated requirement and element for asset management in section 2.4.4 and 2.3.5.

The implication of the findings in terms of maturity of management processes associated with assets is the Nigerian urban water sector is currently at an awareness level for management processes associated with all asset types and contextual factors. This implies that the Nigerian utilities are aware of the importance of implementing management processes associated with all asset types and contextual factors however these processes were not delivered effectively. Thus, Nigerian urban water utilities will need to move to an optimal level of achieving successful asset management by looking for ways to improve the processes that are suited to all asset types and contextual factors. An optimal level for management processes associated with people will mean stakeholder engagement processes and people management processes are at a level where all key stakeholders are actively involved, empowered, sensitised, partnered with and controlled based on their activities and level of influence.

It also encompasses maintenance systems that are preventive and not corrective in nature and infrastructure management systems that are able to develop and manage resilient infrastructure adaptable to issues such as vandalism and illegal connections. It encompasses developing financial management systems that can produce sustainable and diverse revenue streams. Additionally, it involves adopting information systems, plans and policies that are developed to accommodate key stakeholder issues, all asset types and contextual issues. Also key stakeholders responsible for management processes should be empowered to carry their activities which encompasses being involved in the process at the right time, have the right information (both contextual and asset) related so they carry their activities successfully and given the relevant resources, equipment and training that allows them carry their mitigating functions successfully.

Chapter 10

Conclusion and Recommendations

10.1 Introduction

This chapter concludes the research by identifying how the aim and objectives of the study were successfully achieved. Conclusions and recommendations for future works are stated and contributions to the body of Knowledge is carefully identified including publications which have been made during the research.

10.2 Achievement of Aims and Objectives

The principal aim of the research is to adapt modern-day asset management to the Nigerian urban water context. To achieve this aim, the following objectives were developed.

- **Objective 1 - Examine the features of asset management best practices**

This was achieved first, by understanding the concept of asset management and establishing its relevance and emergence globally. Features of successful asset management practices and principles of good asset management practices were also established. Also, International Standards and Guidelines predominantly used in the water industry were explored to identify what key elements are required for successful asset management.

However, a critical analysis of the weakness and strengths of best practices in asset management the literature exposed issues such as expanding that the scope of asset management to remove focus from physical assets particularity to focus on all asset types including people, information, financial and intangible assets. The review of international asset management standards also revealed the need for creating standards that established how asset management can be implemented successfully rather than solely focusing on what needs to be in place for asset management to be established. The literature showed that best practices for asset management occurred when there are clear governance structures, effective performance assessment systems, training schemes and existing bodies of knowledge for continuous learning and improvement. However, countries regarded as AM schools were seen to be predominantly high-income countries therefore, the need to develop asset management to the Nigerian urban water sector was established.

- Objective 2 - examine and clearly outline the inherent unique characteristics of a developing African water context

This objective was achieved in chapters 3 through a critical review of good management practices in Senegal, Burkina Faso, Cote d'Ivoire and Uganda. The first section of literature explored the context of developing countries and the literature showed that the urban water sector in developing countries faced challenges such as population growth, urbanisation, lack of infrastructure, political interference, low-cost recovery, inadequate governance, were also found to be common among developing African countries.

The factors impacting the African urban water sector were both contextual and asset-related (people, infrastructure, financial resources). A comparison of countries with good management practices showed that these countries recorded success because the management of contextual factors such as autonomy, governance, population growth and urbanisation (prevalence of slums) was considered with asset-related issues such as financial viability and capacity building and increase in resilient infrastructure. Lessons learnt from this chapter showed the influence contextual factors had on urban water management in the four countries. Also, the importance of integrating the management of contextual factors for successful management of the urban water context of middle-income and low-income African countries.

- Objective 3 - examine the features of good management practices in African countries

The achievement of this objective was evident in chapter 3 through a critical review of good management practices in Senegal, Burkina Faso, Cote d'Ivoire and Uganda. These countries were able to develop good management practices because of clear governance structures, external autonomy, financial sustainability, capacity building and development of pro-poor solutions.

A comparison of countries with good management practices showed that these countries recorded success because the management of contextual factors such as autonomy, governance, population growth and urbanisation (prevalence of slums) was considered with asset-related issues such as financial viability and capacity building and increase in resilient infrastructure. The lessons about integrating contextual issues and asset-related issues from the studied African countries with good management practices were transferred to the Nigerian urban water and sanitation sector for asset management adaptation.

- **Objective 4** - examine the maturity levels and factors required for delivering modern-day asset management practices

In chapter 2, the review of common asset maturity models from IIMM, ISO55000 in the literature showed that best practices for asset management occur when there are clear governance structures, effective performance assessment systems, training schemes, a systematic system for asset management planning and existing bodies of knowledge for continuous learning and improvement. However, countries operating at maturity levels beyond asset management excellence were seen to be predominantly high-income countries therefore, the need to develop asset management to the Nigerian urban water sector was established.

- **Objective 5** - examine the existing urban water management practices of Nigeria and its impact on the performance of water utilities

The fifth objective was achieved from the review of literature on the Nigerian urban water context in chapter four. The literature reviewed showed that Nigerian utilities performed poorly and were unable to meet due to factors which were related to the management of all asset types and contextual factors. The contextual factors were issues such as poor governance, population growth and rapid urbanisation. While asset-related issues were related to ageing infrastructure, lack of competency and poor capacity building, customer issues, limited financial resources and lack of proper data management.

Three urban water management reforms had also occurred with the aim of improving asset performance such as the extension of piped connections, rehabilitation of water treatment plants, financial viability of utilities and capacity building. However, these reforms had not succeeded due to the influence of contextual factors such as economic recession and political instability, lack of performance assessment systems, no proper feasibility studies, lack of autonomy and placement of SWAs within the civil services.

Therefore, the following propositions can be taken from the review of the Nigerian water sector. Asset management can be adapted to the Nigerian urban water sector when all asset types are actively managed. Asset management can also be adapted to the Nigerian urban water context when existing risk management processes are able to tackle contextual issues, stakeholders' interest and risks related to managing all asset types simultaneously. Additionally, Asset management can be adapted to the Nigerian urban water context when

performance measures are in place to evaluate the asset management process outlined in points 1 and 2. Finally, Asset management can be adapted to the Nigerian urban water sector where contextual factors are integrated into the asset management system.

- Objective 6 - explore how modern-day asset management can be adapted to the Nigerian Urban Water context

This was achieved by developing a conceptual framework that tested the feasibility of adapting asset management theory to the Nigerian Urban water sector. The conceptual framework was developed based on the synthesis of existing literature of asset management best practices, good urban water management practices in middle-income and low-income countries and the Nigerian urban water context.

The following propositions from the review of literature in chapters 2, 3 and 4 formed the basis of the conceptual framework. Asset management can be adapted to the Nigerian urban water sector when all asset types are actively managed. Asset management can be adapted to the Nigerian urban water context when existing risk management processes are able to tackle contextual issues, stakeholders' interest and risks related to managing all asset types simultaneously. Asset management can be adapted to the Nigerian urban water context when performance measures are in place to evaluate the management process outlined 1 and 2. Asset management can be adapted to the Nigerian urban water sector where contextual factors are integrated into the asset management system.

For asset management to be successful in the Nigerian water sector, effective mitigating systems for the key challenges identified in section 7.2.2 would need to be developed and implemented successfully before asset management benefits can start to occur. Secondly, more engagement strategies with the public during the policy development process and not only when projects occur could go a long way in determining the success of formalised asset management systems in the Nigerian context. In addition, stakeholder management practices should ideally encompass all stakeholders and not only customers.

Additionally, unless established laws which give utilities the legal backing they need to carry out activities effectively are enacted; and the haze of implementation is resolved where the utility managers and the government adhere to what the law clearly states, the implementation of formalised asset management systems could be impacted adversely. The analysis of the results also showed that water utilities in Nigeria will need sustainable funding mechanisms

that can enable the asset management process to deliver the required levels. If revenue is not improved to a level which covers operational and maintenance costs, the potential of implementing a successful asset management process could be impacted greatly.

10.3 Contributions to the body of Knowledge

Frameworks and standards usually developed in asset management are focused on the internal context of organisations and little focus is on the external context because of the assumptions that external enabling environments with governance, policy implementation, established legislation, regulatory frameworks and required competencies and information system and financial resources exist already exist (Amadi-Echendu et al., 2010, Stapelberg, 2006). The novelty and theoretical contribution the research brings is based on establishing asset management models that integrate the management of contextual factors with the management of all types of assets and consider contextual issues and stakeholder issue within the scope of the asset management system.

Also, most asset management standards developed tend to focus sole of physical asset management even though people, finances and information are all critical for meeting required service levels. Additionally, water supply and sanitation involve coordinating and managing all asset types. Thus, another theoretical contribution will be to research on how asset management can be adapted to all types of assets simultaneously i.e. human assets, information assets, physical infrastructure and financial resources.

Secondly, a considerable body of literature on asset management have been produced with reference to high-income countries with little attention to low-income and middle-income countries (Alegre and do Céu Almeida, 2009, AWWA, 2001, Bhagwan and Wall, 2008). Asset management is relatively new to the Nigerian water context as most literature focus on an aspect of asset management such as maintenance and facility management. This research will, contextually contribute to the urban water sector of low-income countries and middle-income countries, sub-Saharan African countries and the Nigeria because issues such as governance, low resources and funding, political interference, human competencies, population growth and urbanisation which are associated to their context have been addressed.

Contrasting Nigeria with other African countries that have existing good urban water management practices will demonstrate the impact of these good practices within similar operating context. Furthermore, this will elucidate the main aspects of the current practices of the Nigerian urban water sector that needs to be changed.

Conducting research using the Nigerian Scenario which is a country where asset management is novel and can be regarded as a steppingstone and progress towards the broader Sub-Saharan African context as lessons learnt are transferrable to other developing African countries. Successful completion of this research using the context Nigeria will contribute to existing asset management bodies of knowledge in countries in sub-Saharan Africa like South Africa and Kenya which have applied formal asset management approaches successfully.

Focus on Nigerian Utilities only is because of how improvements in the Nigerian urban water sector could potentially impact the achievement of SDG goals of West African and Sub-Saharan African region; Nigeria is the most significant contributor to Sub-Saharan Africa ranking as the lowest in the world for access to improved drinking water and sanitation. Thus, the industrial rationale and contribution for this research is established because developing modern-day asset management practices for Nigeria has the potential to impact the overall performance of the Nigerian Urban water sector, the West African region and sub-Saharan African region simultaneously.

10.4 Recommendations for Future Research

The importance of implementing asset management for successfully delivering urban water services in the Nigerian urban water sector has been established in the research. However, the following recommendations are made for future research that could be added to existing asset management and good management practices literature for developing countries. The research had established the importance of developing an enabling environment that empowers all key stakeholders associated with the urban water sector. Future research will be required on how to establish an enabling environment that will enable Nigerian urban water sector stakeholders collaboratively improve the urban water sector. Future research could also occur in showing how stakeholder collaboration and involvement during policy development and policy implementation can solve the policy implementation haze that occurs in Nigeria.

The analysis of the results also showed that water utilities in Nigeria will need sustainable funding mechanisms that can enable the asset management process to deliver the required levels. Future research and works on developing financial management systems that are adaptable to the Nigerian context will also require because of the existing issues of funding systems that are not going to be sustainable in the long run for the Nigerian urban water sector. Furthermore, more studies will need to be conducted for finding innovative ways for ensuring

their funds and resources are able to turn into worthwhile actions and ventures for good service delivery.

The implication of the findings in terms of the awareness maturity level of management processes associated with assets showed the potential of developing and implementing an asset management plan that could be adaptable to the Nigerian urban water context. However future research focused solely on developing and testing an asset management plan adaptable to the Nigerian water sector which incorporates all asset-related factors and all contextual factors could also be conducted.

In addition, establishing stakeholder engagement strategies while developing water policies could be a way of forming collaborations with influential stakeholders in the water sector and receiving support from the public. This will allow the creation of relevant water policies that can provide water services, mitigate the interferences from stakeholders with negative impact and at the same continuously exploit the benefits gotten from stakeholders with positive impact and receives public support. Hence future studies on developing successful stakeholder engagement systems that cut across all key stakeholders for urban water utilities in Nigeria and actively engages them could also be considered.

Since infrastructure challenges related to operating below design capacity, poor maintenance, high operational costs, depreciated assets and the need for adaptable designs were found during the research; the need for future studies on developing infrastructure that takes factors like resilience, cost, maintenance, contextual factors into consideration is established.

Key factors such as unwillingness to pay, informal service providers and positive influence, the dependence of government subsidies and international donor grants showed the importance of stakeholder engagement. However, the maturity level for stakeholder engagement was measured at an awareness level for the Nigerian urban water sector because elements of public sensitisation and consultation occurred compared to effective stakeholder systems that are meant to empower and actively engage stakeholders. Future research will, therefore, need to occur for developing a stakeholder engagement framework that is adaptable to the Nigerian urban water sector.

Also, emerging trends were found for enabling factors in section 7.4 about staff dedication and regular payment from customers even in the presence of low salary structures, poor staff placement and lack of training and unreliable water services with respect to customers. This could suggest that having stakeholders with good character and value systems also impacts the

delivery of sustainable services rather than the incentives arising from training and good salary structure and benefits or regular provision of water and focusing on the needs suggested by in the case of customers. Hence future research can be carried out to understand how the value system and morals of stakeholders impact the performance of urban water utilities and therefore develop management systems that exploit the values of people in delivering efficient and effective services.

Furthermore, the extent to which information management systems were successfully implemented were measured at an awareness level from the results as most utilities were only developing new projects associated with managing information assets. A lot of future works associated with information management systems adaptable to the Nigerian urban water sector will, therefore, need to be conducted.

This research forms a part of wider research that involves developing an asset management framework which could potentially help urban water utilities in middle-income and low-income countries. Asset management (AM) is seen as a potential route because of its inherent characteristics of being multi-disciplinary, holistic, and applicable to all types of assets (human, financial, physical and information assets) and contextual issues. Thus, the rationale for developing an asset management framework adaptable to middle-income and low-income countries has been established.

Appendix 1

Table 1: Number of Participants and assigned Pseudonyms

| Utility | Number of Respondents | Assigned Pseudonyms |
|----------------------|------------------------------|----------------------------|
| Utility one | 23 | Respondents A1 -A23 |
| Utility two | 23 | Respondents L1-L23 |
| Utility three | 9 | Respondents P1-P9 |
| Utility four | 6 | Respondents K1-K6 |

Table 2: Designation of Participants and numbers in each Utility

| S/N | Designation | Utility one | Utility two | Utility three | Utility four |
|------------|---------------------------------|--------------------|--------------------|----------------------|---------------------|
| 1 | HOD/ Director | 6 | 4 | - | - |
| 2 | Assistant General Manager | - | 8 | - | 6 |
| 3 | Deputy Director | 1 | 1 | - | - |
| 4 | Head of unit | 4 | - | - | - |
| 5 | Senior technical officer | 3 | - | 1 | - |
| 6 | Principal Officer | 8 | 6 | - | - |
| 7 | Technical officer | 3 | - | 3 | 1 |
| 8 | Manager | - | - | 5 | - |
| 9 | Executive Director | - | 1 | - | - |
| 10 | Middle-level officer | | 3 | | |

Table 3: Profile of Participants

| S/N | Name | Dept. | Years of experience |
|------------|-------------------|---|----------------------------|
| 1 | Respondent A1 | Administration/ Human Resources | 20 |
| 2 | Respondent A2 | GIS /Administration | 12 |
| 3 | Respondent A3 | Rural Water | 30 |
| 4 | Respondent A4 | Quality Control | 22 |
| 5 | Respondent A5 | Quality Control (Water quality monitoring urban) | 18 |
| 6 | Respondent A6 | Quality control | 5 |
| 7 | Respondent A7 | Quality Control | 15 |
| 8 | Respondent A8 | Quality Control | 16 |
| 9 | Respondent A9 | Planning Research and Statistics | 22 |
| 10 | Respondent A10 | Commerce | 17 |
| 11 | Respondent A11 | Finance and Accounts | 15 |
| 12 | Respondent A12 | Finance and Accounts | 15 |
| 13 | Respondent A13 | Finance and Accounts | 12 |
| 14 | Respondent A14 | Internal Audit | 15 |
| 15 | Respondent A15 | Management Information System | 20 |
| 16 | Respondent A16 | Distribution | 16 |
| 17 | Respondent A17 | Distribution | 17 |
| 18 | Respondent A18 | Quality Control (Laboratory) | 15 |
| 19 | Respondent A19 | (Laboratory) | 5 |
| 20 | Respondent A20 | (Laboratory) | 10 |
| 21 | Respondent A21 | (Laboratory) | 10 |
| 22 | Respondent A22 | (Reservoir & Production) | 29 |
| 23 | Respondent A23 | (Reservoir & Production) | 15 |
| 24 | Respondent L1 | Operation | 25 |
| 25 | Respondent L2 | Water quality assurance | 20 |
| 26 | Respondent L3 | Distribution | 30 |
| 27 | Respondent L4 | Distribution | 28 |

| S/N | Name | Dept. | Years of experience |
|------------|----------------|--|----------------------------|
| 28 | Respondent L5 | Distribution | 13 |
| 29 | Respondent L6 | Distribution | 12 |
| 30 | Respondent L7 | Distribution | 24 |
| 31 | Respondent L8 | Distribution | 18 |
| 32 | Respondent L9 | Distribution | 31 |
| 33 | Respondent L10 | Distribution | 10 |
| 34 | Respondent L11 | Distribution | 13 |
| 35 | Respondent L12 | Distribution | 14 |
| 36 | Respondent L13 | Distribution | 18 |
| 37 | Respondent L14 | Distribution | 13 |
| 38 | Respondent L15 | Distribution | 12 |
| 39 | Respondent L16 | Comm | 20 |
| 40 | Respondent L17 | HR | 29 |
| 41 | Respondent L18 | Project Implementation Unit | 23 |
| 42 | Respondent L19 | Prod. | 30 |
| 43 | Respondent L20 | Prod. | 22 |
| 44 | Respondent L21 | F&A | 20 |
| 45 | Respondent L22 | PGS | 20 |
| 46 | Respondent L23 | PIU | 10 |
| 47 | Respondent P1 | Customer care (Eagle Island Pilot Project) | 12 |
| 48 | Respondent P2 | Customer care (Eagle Island Pilot Project) | 10 |
| 49 | Respondent P3 | Customer care (Eagle Island Pilot Project) | 4 |
| 50 | Respondent P4 | Operations (Distribution and Production) | 19 |
| 51 | Respondent P5 | Commercial and Business Production | 12 |
| 52 | Respondent P6 | Project / Planning | 10 |
| 53 | Respondent P7 | Administration and Human Resource | 13 |
| 54 | Respondent P8 | Quality | 12 |
| 55 | Respondent P9 | Wastewater Operations | 7 |
| 56 | Respondent K1 | Operations | 20 |
| 57 | Respondent K2 | Projects | 25 |
| 58 | Respondent K3 | Finance | 24 |
| 59 | Respondent K4 | Admin | 21 |
| 60 | Respondent K5 | Commercial | 27 |
| 61 | Respondent K6 | Planning | 20 |

Appendix 2



Figure 1: ISO55001 Asset Maturity Scale

Source: (Institute of Asset Management, 2015b)

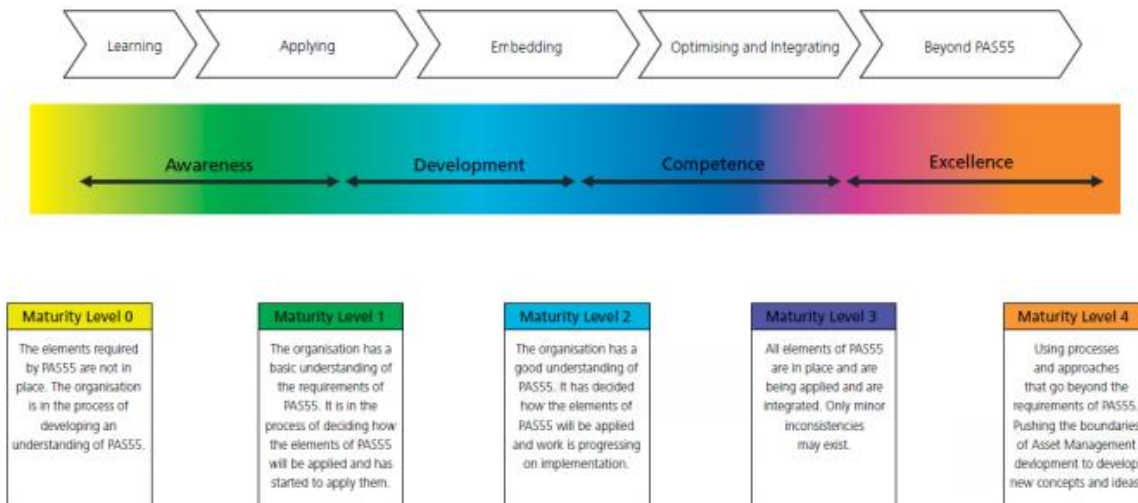
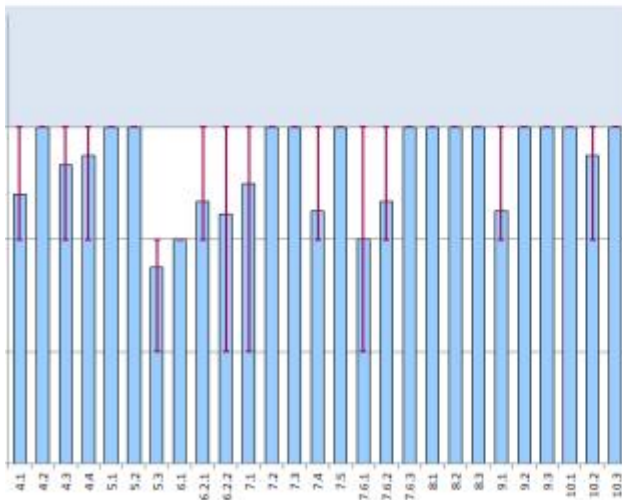
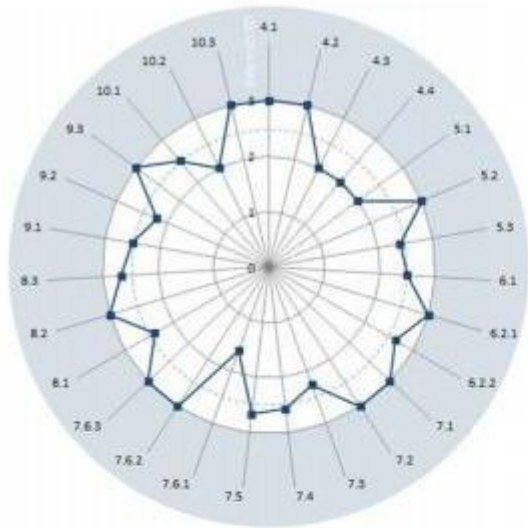
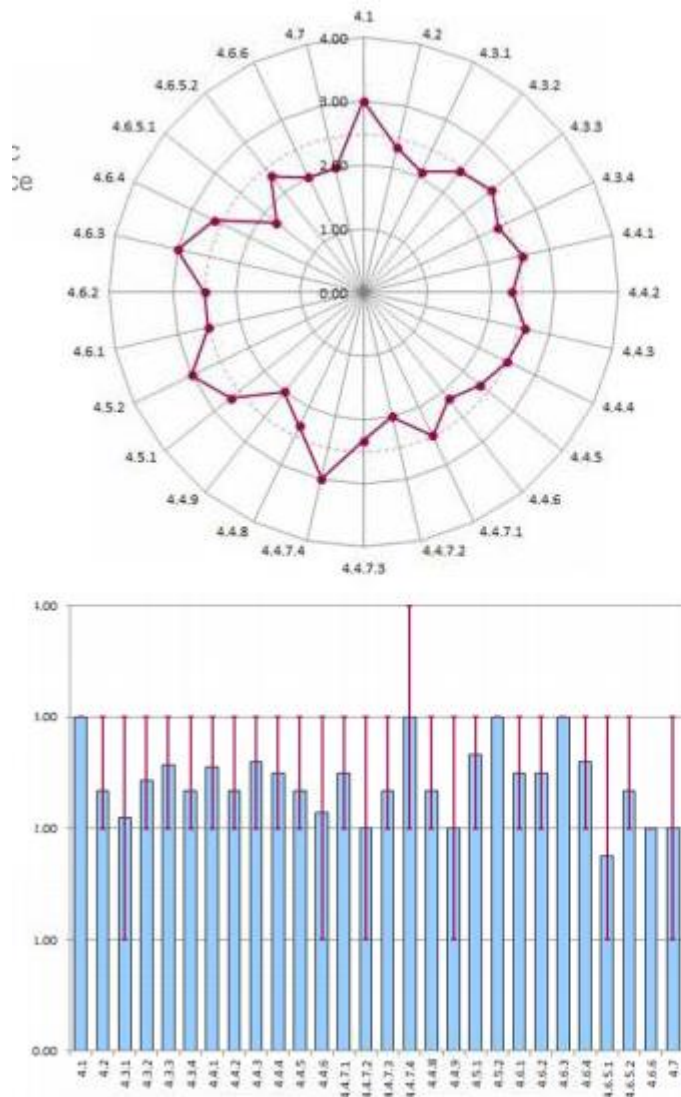


Figure 2: BSI-PAS55 2008 Maturity Scale



- 4.1 Understanding the organisation and its context
- 4.2 Understanding the needs and expectations of stakeholders
- 4.3 Determining the scope of the asset management system
- 4.4 Asset management system
- 5.1 Leadership and Commitment
- 5.2 Policy
- 5.3 Organisational roles, responsibilities and authorities
- 6.1 Actions to address risks and opportunities for the asset management system
- 6.2.1 Asset management objectives
- 6.2.2 Planning to achieve asset management objectives
- 7.1 Resources
- 7.2 Competences
- 7.3 Awareness
- 7.4 Communication
- 7.5 Information requirements
- 7.6.1 Documented information general
- 7.6.2 Creating and updating documented information
- 7.6.3 Control of documented information
- 8.1 Operational planning and control
- 8.2 Management of change
- 8.3 Outsourcing
- 9.1 Monitoring, measurement, analysis and evaluation
- 9.2 Internal audit
- 9.3 Management review
- 10.1 Nonconformity and corrective action
- 10.2 Preventive action
- 10.3 Continual improvement

Figure 3: Asset Maturity Criteria for conforming with ISO55001
 Source: (Institute of Asset Management, 2015b)



- 4.1 General requirements
- 4.2 Asset management policy
- 4.3.1 Asset management strategy
- 4.3.2 Asset management objectives
- 4.3.3 Asset management plan(s)
- 4.3.4 Contingency planning
- 4.4.1 Structure, authority and responsibilities
- 4.4.2 Outsourcing of asset management activities
- 4.4.3 Training, awareness and competence
- 4.4.4 Communication, participation and consultation
- 4.4.5 Asset Management System documentation
- 4.4.6 Information management
 - 4.4.7.1 Risk management processes
 - 4.4.7.2 Risk management methodology
 - 4.4.7.3 Risk identification and assessment
 - 4.4.7.4 Use and maintenance of asset risk information
- 4.4.8 Legal and other requirements
- 4.4.9 Management of Change
- 4.5.1 Life Cycle Activities
- 5.5.2 Tools, facilities and equipment
- 4.6.1 Performance and condition monitoring
- 4.6.2 Investigating asset-related failures, incidents and nonconformities
- 4.6.3 Evaluation of compliance
- 4.6.4 Audit
 - 4.6.5.1 Corrective & Preventative action
 - 4.6.5.2 Continual Improvement
- 4.6.6 Records
- 4.7 Management review

Figure 4: Asset Maturity Criteria for conforming with PAS55

Source: (Institute of Asset Management, 2015b)

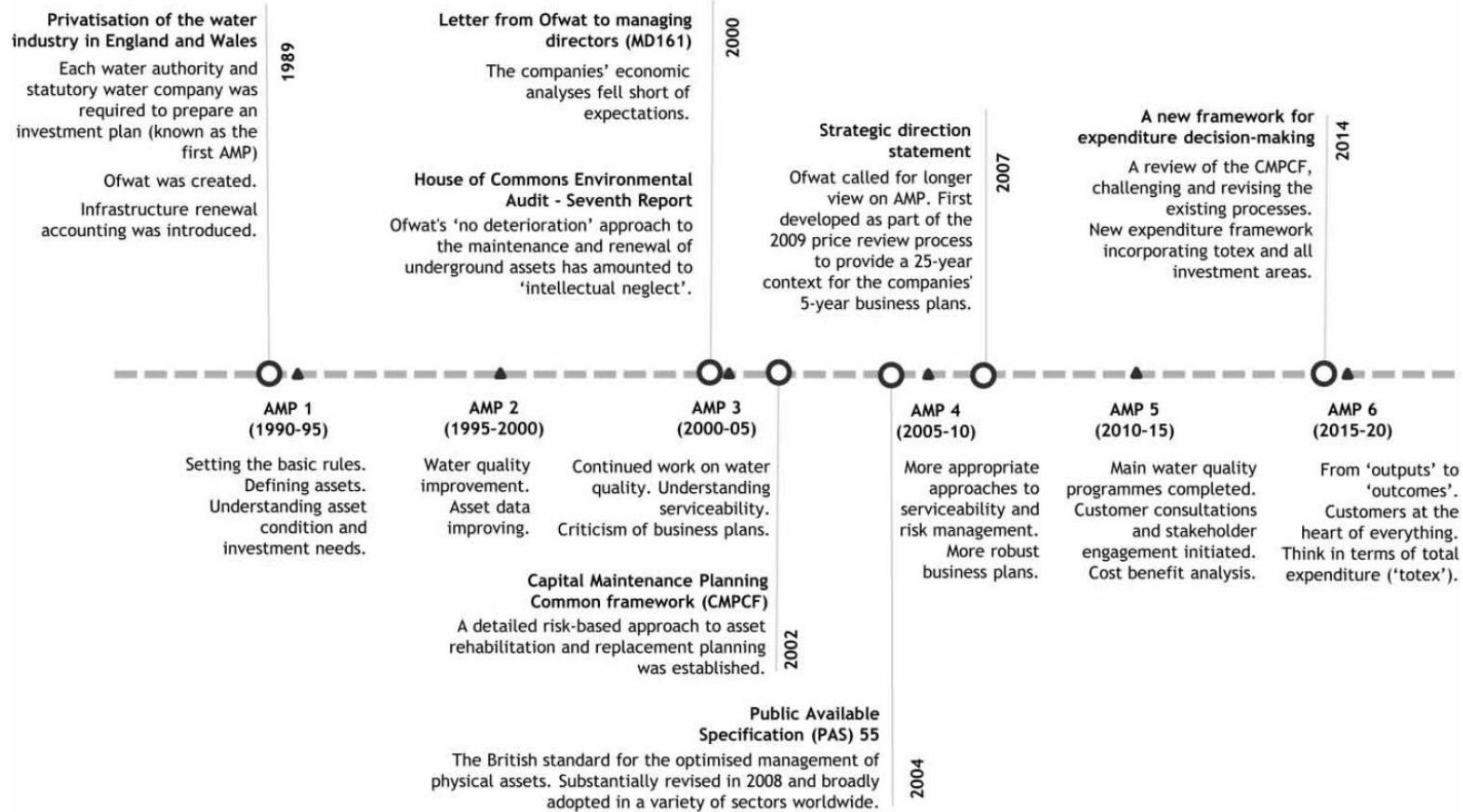


Fig 5: Key Initiatives for AM in England and Wales

Source: (Amaral et al., 2017)

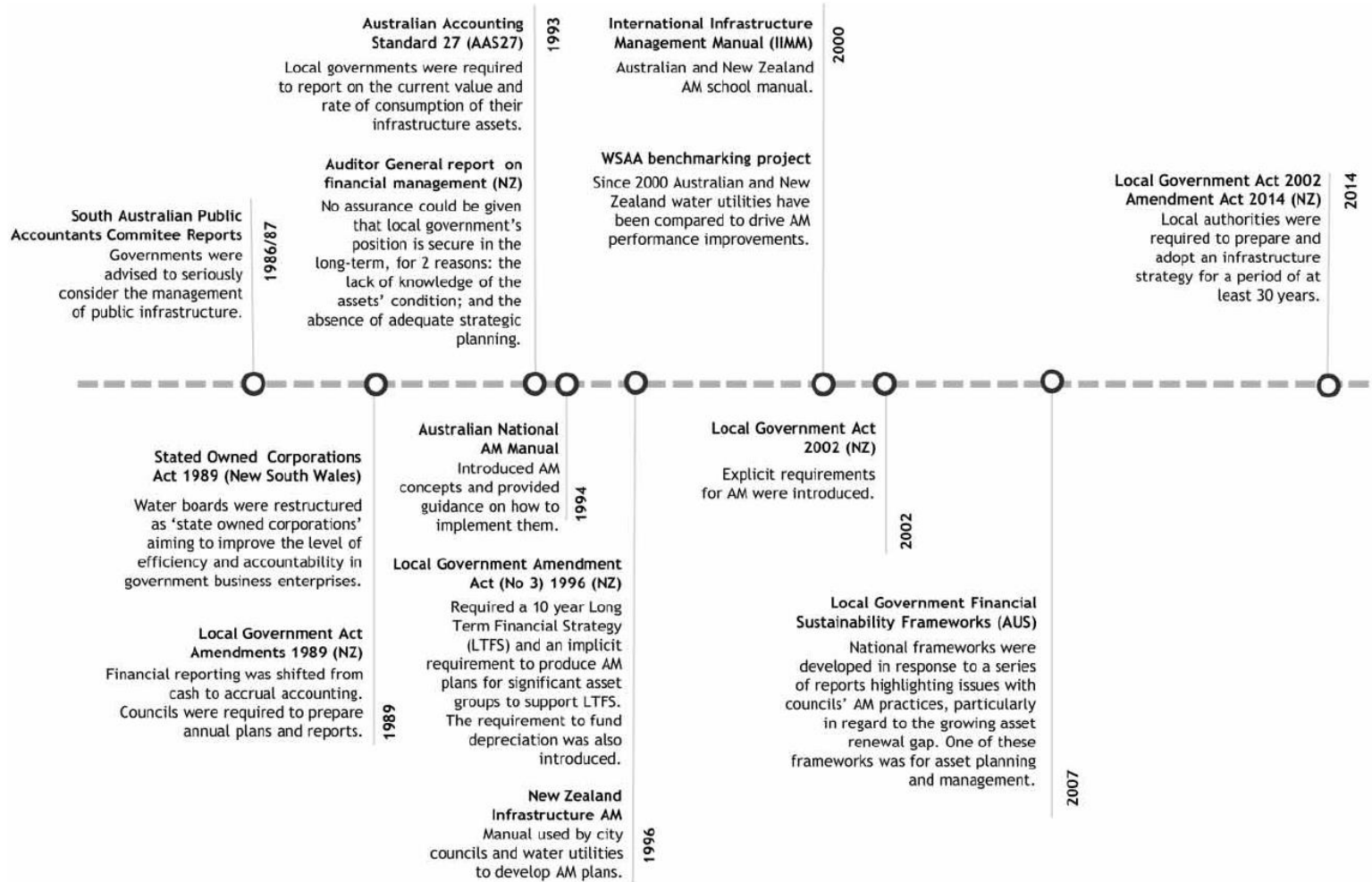


Fig 6: Key Initiatives for AM in Australia and New Zealand

Source: (Amaral et al., 2017)

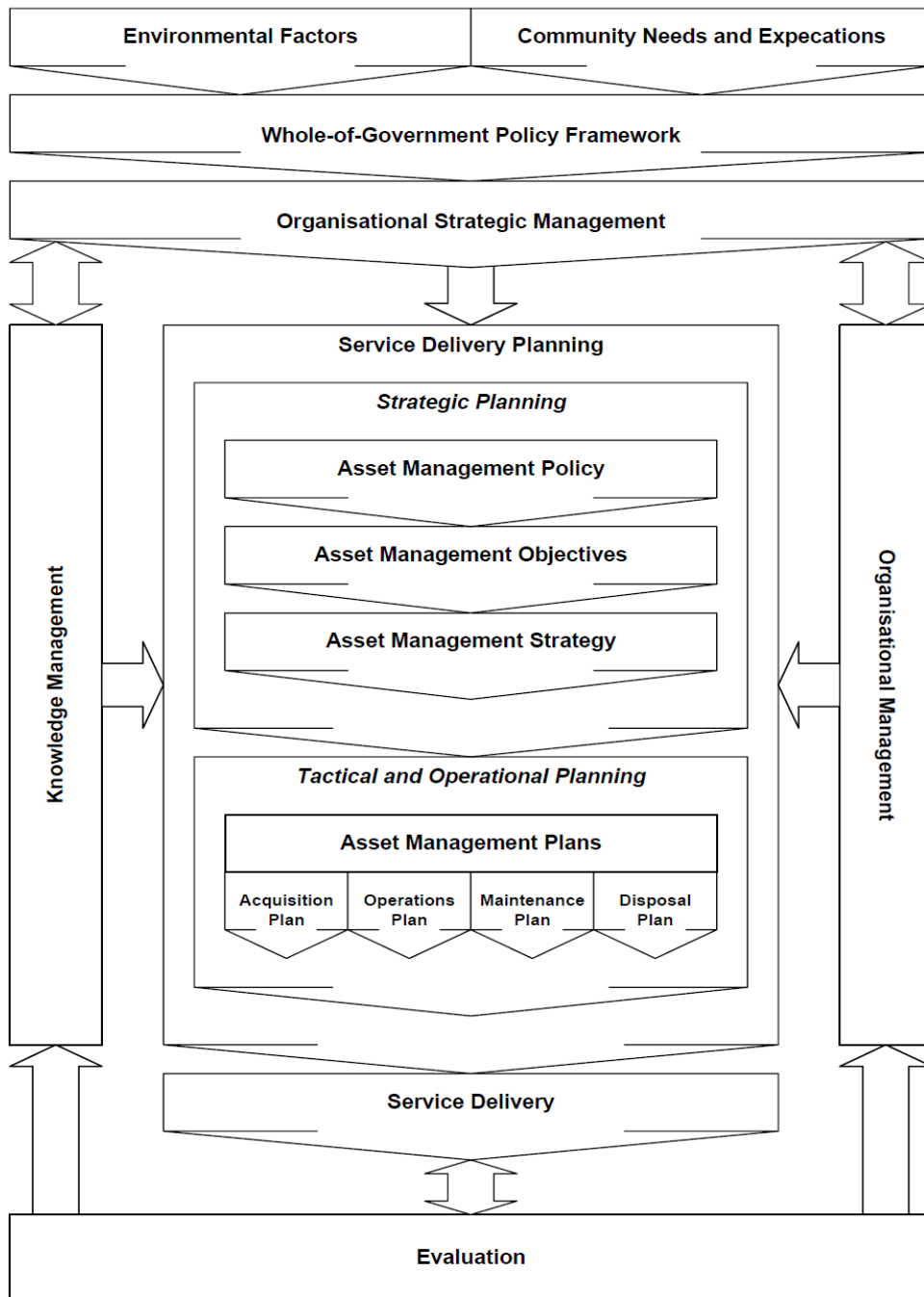


Figure 7: Guidelines highlighted in AAMCOG Framework

Source: (AAMCoG, 2001)

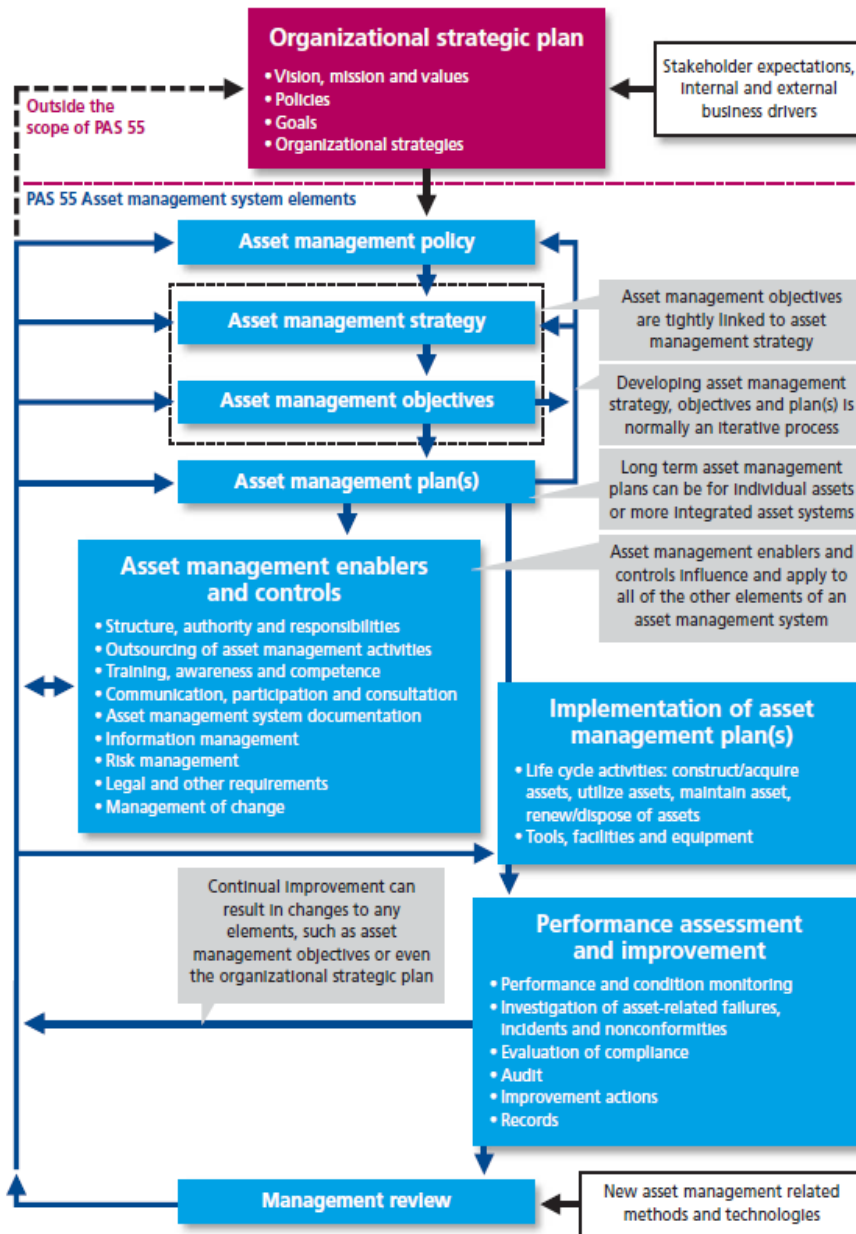


Figure 8: PASS 55's Outlined Elements of an asset management system

Source: (BSI 2008)

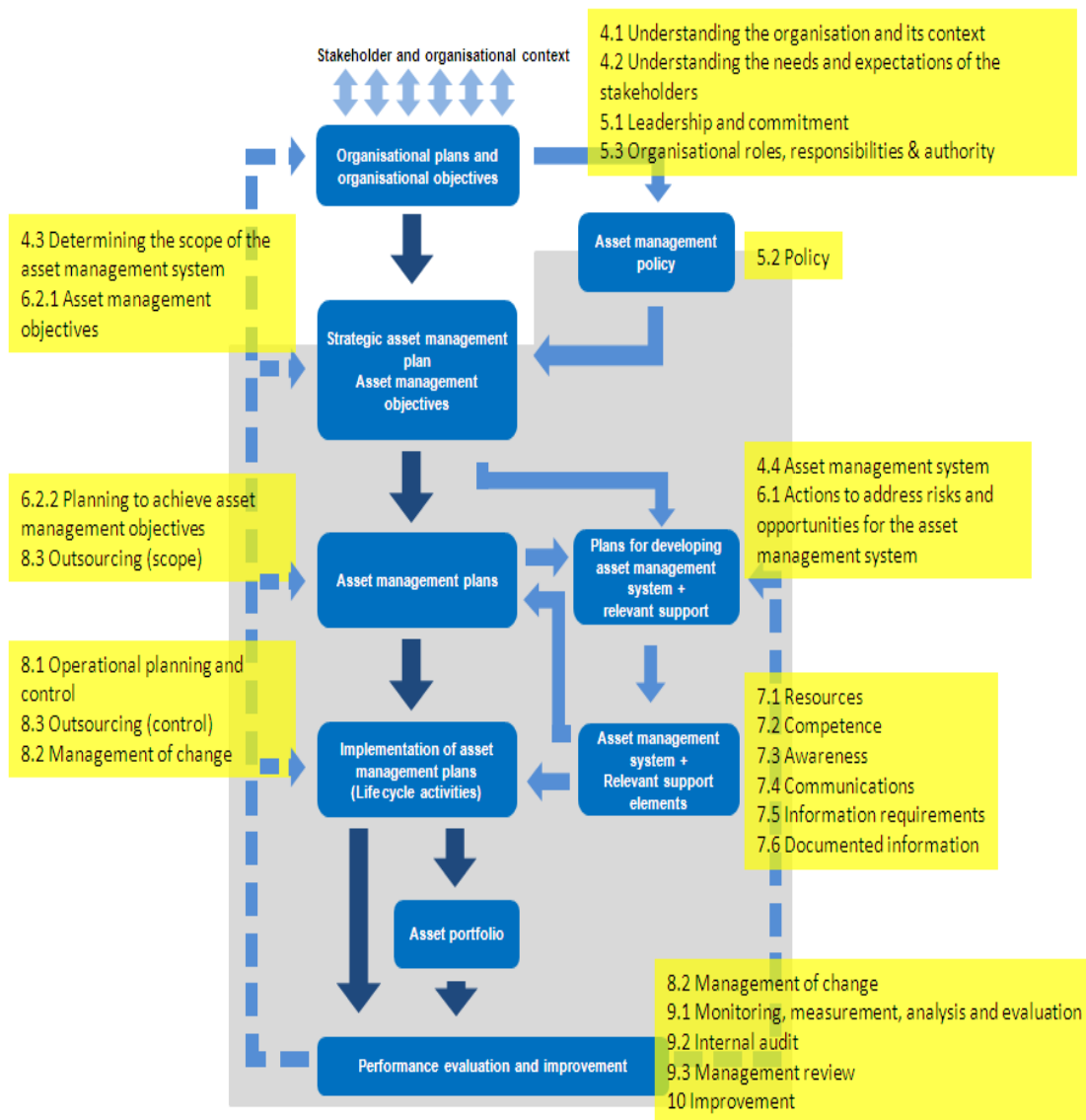


Figure 9: ISO 5500 Outlined Asset Management Strategy

Source: (BSI, 2014)

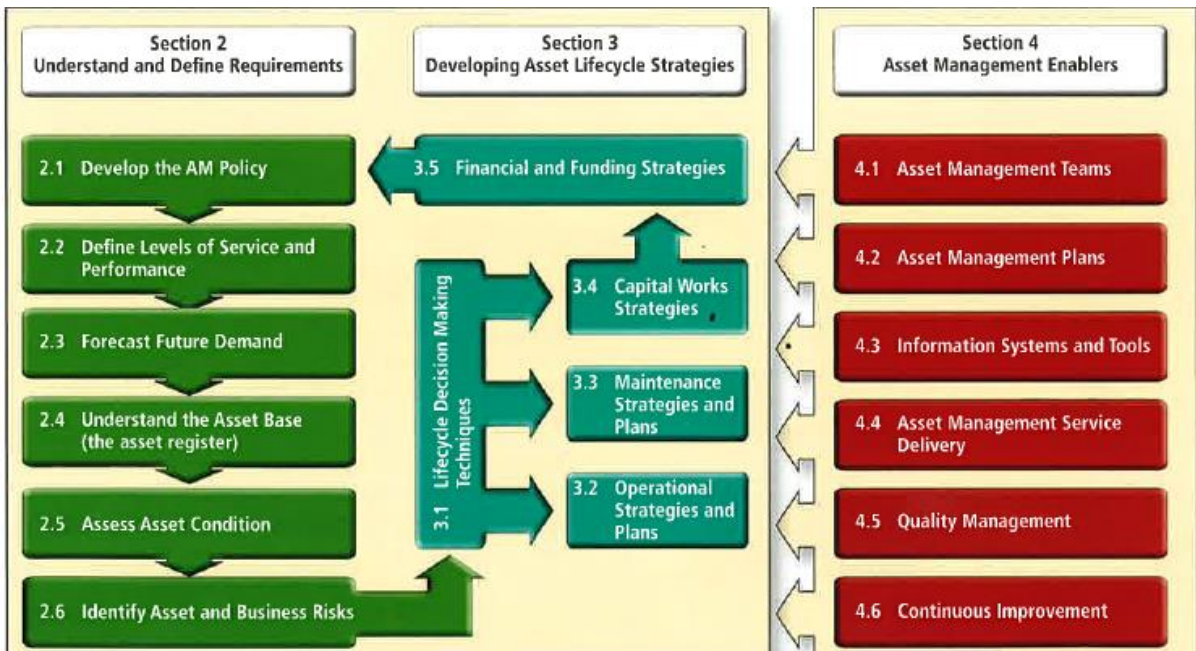


Fig 10: Elements of IIMM

Source: (IIMM, 2006, Institute of Public Works Engineering et al., 2015)



Fig 11: Alignment of 39 Asset Management Landscape Subjects with the six Subject Groups

Source: (GFMAM, 2014, Institute of Asset Management, 2015a)

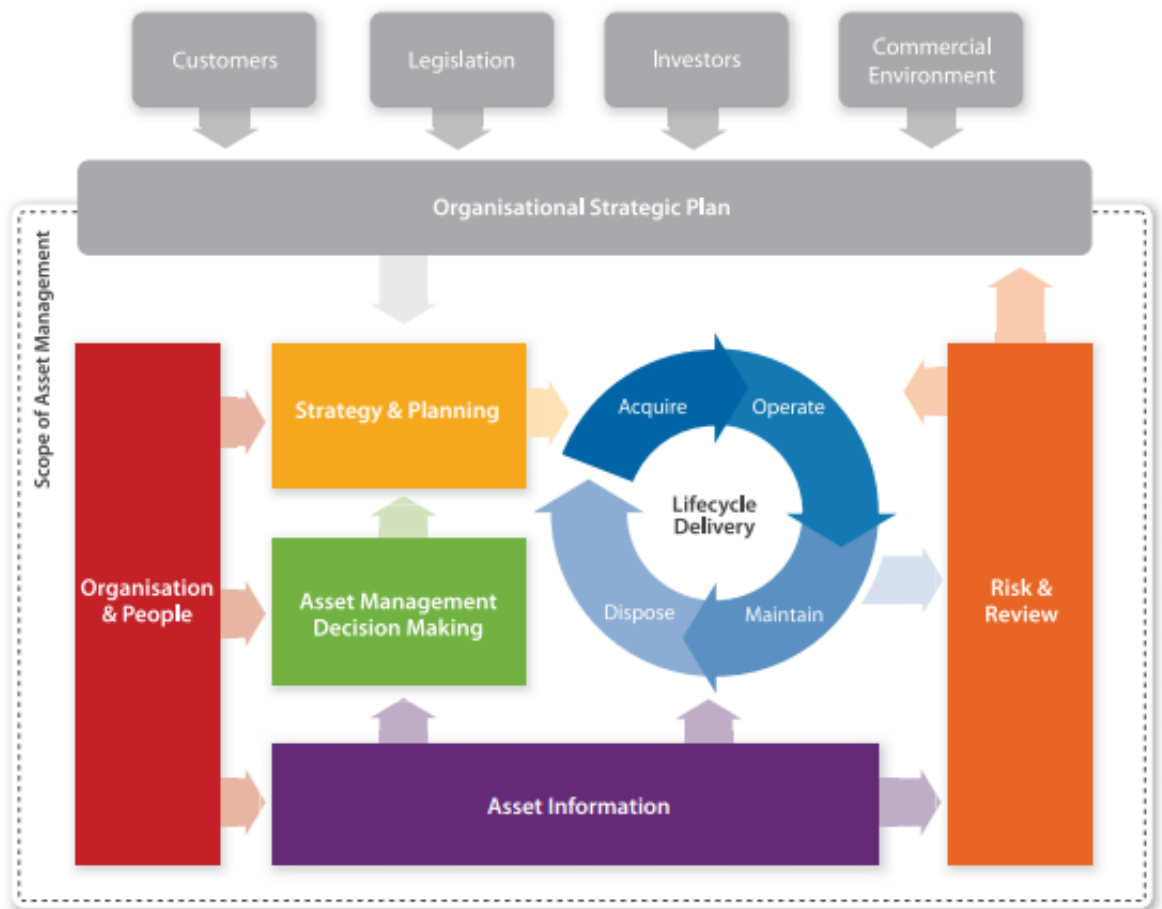


Fig 8: The IAM Conceptual Model

Source: (Institute of Asset Management, 2015a)

Appendix 3

Table 1: Performance Indicator for Senegal

| Performance Indicator | Year | |
|--|--------|--------|
| | 1997 | 2013 |
| Water Coverage | 81.05% | 97.94% |
| Sewerage Coverage | | |
| Total Water Consumption (liters/person/day) | 64.66 | 58.85 |
| Residential Consumption (liters/person/day) | - | 54.58 |
| Staff per 1,000 connections | 0.45 | 0.22 |
| Non-Revenue Water (%) | 27.79% | 19.99% |
| Non-Revenue Water (m ³ /km/day) | 12.05 | 9.34 |
| Water sold that is metered % | - | 100% |
| Average Revenue Water & Waste Water (US\$/m ³ water sold) | 0.19 | 1.08 |
| Unit Operational Cost Water and Wastewater (W&WW) (US\$/m ³ sold) | - | 0.77 |
| Collection Period (days) | - | 22.63 |
| Collection ratio (%) | 61.91% | 98.26% |
| Operating Cost Coverage (ratio) | - | 1.39 |

Table 2: Performance Indicator for Burkina Faso

| Performance Indicator | Year | |
|--|--------|-------------|
| | 1998 | 2017 |
| Water Coverage | 40.48% | 78.63% |
| Sewerage Coverage | 2.41% | 6.40% |
| Total Water Consumption (litres/person/day) | 94.78 | 30.91 |
| Residential Consumption (litres/person/day) | 46.65 | 15.0 |
| Staff Water/000 Water pop served (#/000 W pop served) | 1.12 | Unavailable |
| Non Revenue Water (%) | 60.98% | 33.54% |
| Non Revenue Water (m3/km/day) | 66.42 | 9.17 |
| Water sold that is metered % | 100% | - |
| Average Revenue Water & Waste Water (US\$/m3 water sold) | 2.06 | 1.2 |
| Unit Operational Cost Water and Wastewater (W&WW) (US\$/m3 sold) | 0.93 | 0.87 |
| Collection Period (days) | 0.0 | 33.99 |
| Collection ratio (%) | 47.83% | 97.7% |
| Operating Cost Coverage (ratio) | 2.22 | 1.38 |

Table 3: Performance indicators for NWSC

| Performance Indicator | Year | |
|--|--------|-------------|
| | 1996 | 2017 |
| Water Coverage | 40.5% | 78.00% |
| Sewerage Coverage | 2.02% | 6.40% |
| Total Water Consumption (litres/person/day) | 89.99 | 30.91 |
| Residential Consumption (litres/person/day) | 43.39 | 15% |
| Staff Water/000 Water pop served (#/000 W pop served) | 1.28 | 0.44 |
| Non-Revenue Water (%) | 68.45% | 33.54% |
| Non-Revenue Water (m3/km/day) | 66.42 | 9.17 |
| Water sold that is metered % | 100% | Unavailable |
| Average Revenue Water & Waste Water (US\$/m3 water sold) | 2.59 | 1.2 |
| Unit Operational Cost Water and Wastewater (W&WW) (US\$/m3 sold) | 1.22 | 0.87 |
| Collection Period (days) | 0.0 | 33.99 |
| Collection ratio (%) | 47.9% | 93.06% |
| Operating Cost Coverage (ratio) | 2.13 | 1.38 |

Table 4: Performance indicators for Cote d'Ivoire

| Performance Indicators | 2000 | 2014 |
|--|-------------|-------------|
| Water Coverage (%) | 80.87 % | 68.98 % |
| 11.1 - Unit Operational Cost Water and Wastewater (W&WW) (US\$/m3 sold) | 0.45 | 0.94 |
| 12.3 - Staff Water/000 Water pop served (#/000 W pop served) | 0.21 | 0.2 |
| 18.1 - Average Revenue W&WW (US\$/m3 water sold) | 0.49 | 0.99 |
| 2.1 - Sewerage Coverage (%) | 61.79 % | |
| 23.1 - Collection Period (days) | 12.34 | 0.0 |
| 23.2 - Collection ratio (%) | 92.00 % | 0.00% |
| 24.1 - Operating Cost Coverage (ratio) | 1.09 | 1.06 |
| 4.1 - Total Water Consumption (liters/person/day) | 50.39 | 37.19 |
| 4.7 - Residential Consumption (liters/person/day) | 37.78 | 31.65 |
| 6.1 - Non Revenue Water (%) | 17.48 % | 23.89 % |
| 6.2 - Non Revenue Water (m3/km/day) | 6.07 | 10.59 |
| 8.1 - Water sold that is metered % (%) | 99.83 % | 0.00% |

Appendix 4

Table 1: Overview of the First, Second and Third Urban Water Sector reforms in the Nigerian Urban Water Sector

| Project Name | Project Development Objectives | Project Components | Project Duration | Project Cost | Project Outcomes at the end date | Critical factors impacting project performance |
|--|---|--|---|---|--|---|
| <p><u>First National Urban Water Sector Reform Project</u></p> <p>This project was implemented in Kaduna, Enugu and Ogun state. Enugu state was included in 201 after Kano had dropped out from the project</p> | <ul style="list-style-type: none"> - Increase access to piped Networks in selected urban areas - Improve service reliability and financial viability of the water utilities | <ul style="list-style-type: none"> - Network Rehabilitation and Expansion - Public-Private Partnerships - Capacity building and Project Management - Policy reform and Institutional Development | <p>Start Date: 14th December 2004</p> <p>Date of Completion: 30th September 2013</p> <p>The project was approved on June 15, 2004.</p> <p>The initial completion date of September 30, 2010, was extended by three years to September 30, 2013.</p> | <ul style="list-style-type: none"> - Initial project cost at appraisal state was \$140.0 million - The actual cost of the project at completion was \$202.4 mil | <ul style="list-style-type: none"> - Project overrun by 145% - The project was delayed by 3 years - Service reliability and financial viability targets were not achieved | <ul style="list-style-type: none"> - Lack of critical assessment of the political environment - Political interference from some government s campaigning to deliver water for free - The impact of the country’s overall economic recession - High power and energy costs - NO stakeholder engagement at the federal executive council responsible for passing the national water bill - Slow implementation of reforms impacted the gains which occurred in service reliability, - Lack of incentive mechanisms attached to performance monitoring systems - Unwillingness to pay and opposition against short term tariff increases - Data collection was inadequate and focused majorly on service reliability |

Table 2: Overview of the Second Urban Water Sector reform in the Nigerian Urban Water Sector

| Project Name | Project Development Objectives | Project Components | Project Duration | Project Cost | Project Outcomes at the end date | Critical factors impacting project performance |
|---|--|---|---|---|---|---|
| <u>Second National Urban Water Sector Reform Project</u> | <ul style="list-style-type: none"> - Improve the reliability of water supply produced in participating states. - Increase access to piped water networks in Lagos state and seven cities in Cross River State. - Improve the commercial viability of the urban water utilities in participating states. | <ul style="list-style-type: none"> - Network Rehabilitation and Expansion - Public-Private Partnerships - Service Sustainability and Project Management - Policy reform and Institutional Development | <p>Start date: July 2005</p> <p>Date of completion: May 31st 2016</p> <p>The initial completion date of June 30, 2011, was extended by 5 years to May 31 2016.</p> | <ul style="list-style-type: none"> - Initial project cost at appraisal state was \$200.0 million - The actual cost of the project at completion was \$306.5 million | <ul style="list-style-type: none"> - Project overruns by 53% due to an increase in geographical coverage and adjustment of project development objectives - The project was delayed by 5 years - Service reliability targets and financial viability targets were not achieved. There was also a further decline in service reliability target and financial viability targets after the project ended | <ul style="list-style-type: none"> - no detailed pre-feasibility planning impacted the project cost - expansion of project scope - Exogenous global price increases. - Weak project implementation capacity and procurement and financial management challenges impacted the project duration - A proper monitoring system was only established after the project had ended - Weak internal control systems and lack of internal audits and manual accounting and fixed asset register - Risk of poor maintenance culture impacting production capacity of rehabilitated plants and networks which are developed with complex technologies that require regular maintenance - Political instability and economic recession - Lack of autonomy due to major dependence on state subsidies - Disruption of power supply |

Table 3: Overview of the Third Urban Water Sector reform in the Nigerian Urban Water Sector

| Project Name | Project Development Objectives | Project Components | Project Duration | Project Cost | Project Outcomes at end date | Critical factors impacting project performance |
|---|---|--|---|-------------------------------------|---|--|
| <p><u>Third National Urban Water Sector Reform Project</u></p> | <ul style="list-style-type: none"> - to increase access to improved water supply service of participating states - to improve the financial viability of existing water utilities in those States, - to increase the investment planning capacity of participating States. | <ul style="list-style-type: none"> - Sector Reforms and Water Supply Investment - Governance, Institutional Strengthening and Human Capacity Development. - Sector Wide Improvement and Project Management at the Federal Level | <p>Start date: February 12 2015</p> <p>Date of completion: June 30 2020</p> | <p>Project cost - \$250 million</p> | <p>Project is at the procurement stage as at when this research was conducted</p> | <p>Project is at the procurement stage as at when this research was conducted and full details of progress are unknown</p> |

Appendix 5

Table 1 – Characteristics of Case Utilities

| Evaluation Criteria | Utility One | Utility Two | Utility 3 | Utility 4 |
|---|--|--|---|--|
| Geographic details of utility | One of Africa's most expensive cities and the capital city of Nigeria. Home for most Federal Government agencies, parastatals and presidency. The fourth-largest city in Nigeria and is projected to be a megacity in 2050 | The main commercial hub of the country and most populous megacity | Nigeria's oil and refineries hub and is very critical to the nation's economy because oil and gas is the major source of the Nation's economy | Is situated in the north-western part of Nigeria with a population of about 1.8 million, and a major hub for trade, transportation and textile |
| Institutional arrangement | Established by the decree of minister. No law or policy in place. The national bill is still at the approval stage. | Existing water law in 2004. However, the policy is still in the draft stage. An existing mandate for the organisation. There is also a state regulatory commission | Water law and Water policy established. Existing regulatory commission. | Previous water law of 2004 being reformed and approved in 2016 after the study had been carried out. |
| Funding mechanisms | Dependence on government subsidies. Revenues generated unable to cover the cost | Dependence on government subsidies. Revenues generated unable to cover the cost | Currently working on the pilot project and aiming to start tariff collections as services were previously free | Revenue generated unable to cover the cost. Dependence of government subsidy |
| Service Coverage | 33% | 40% | 5% | 92% |
| Production capacity to provide all residents with 50lpcd, m3/ year | 61,355,245 | 388,730,519 | 18,816,754 | 2,621 |
| Hours of Operation | 24 hours | 18 hours | 8 hours | 15 hours |
| Collection rate | 38% | 48% | 112% | 66% |
| Cost-recovery ratio | 5.52 | 0.38 | 0.65 | 0.6 |
| Unaccounted losses | 18% | 58% | 2% | 27% |
| Infrastructural production Capacity | 3 major water schemes and 48 micro/ mini-water schemes with a total production capacity of 220 Million Gallons per day | Functional production capacity is only 720 million litres per day. | Only 17 functional boreholes | 12 water treatment plants with a total production capacity of 73.24 million m3 |
| Staff per 1000 customers | 0.7 | 0.1 | 1.6 | - |
| Service provision | Urban Water supply provision and rural water and sanitation provision | Urban Water supply provision | Urban Water supply provision | Water supply and sanitation provision |

Source: (Chiori, 2018, Macheve et al., 2015, World Bank, 2014b)

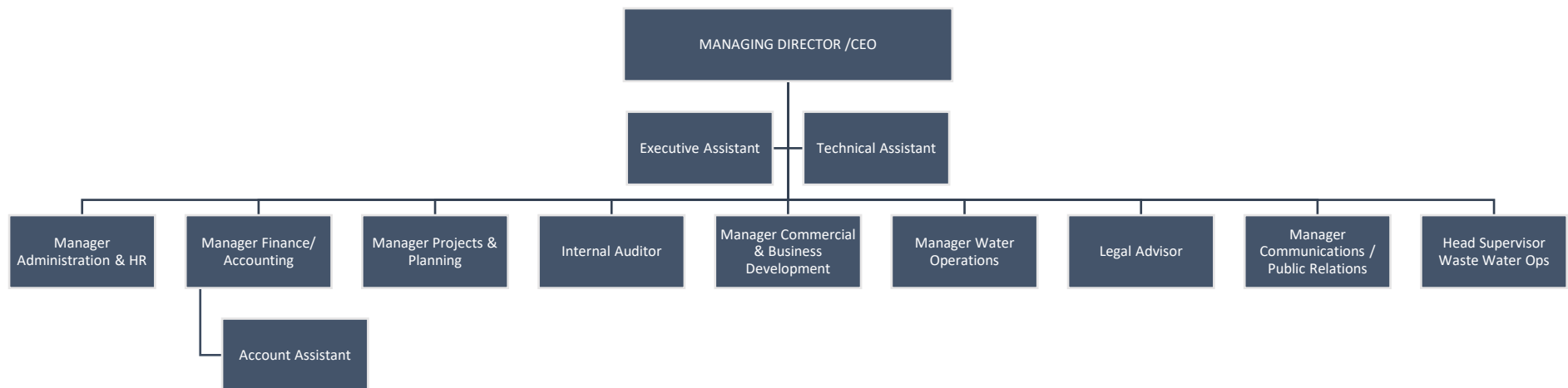


Figure 1: Organisational Structure for Port Harcourt Water Corporation

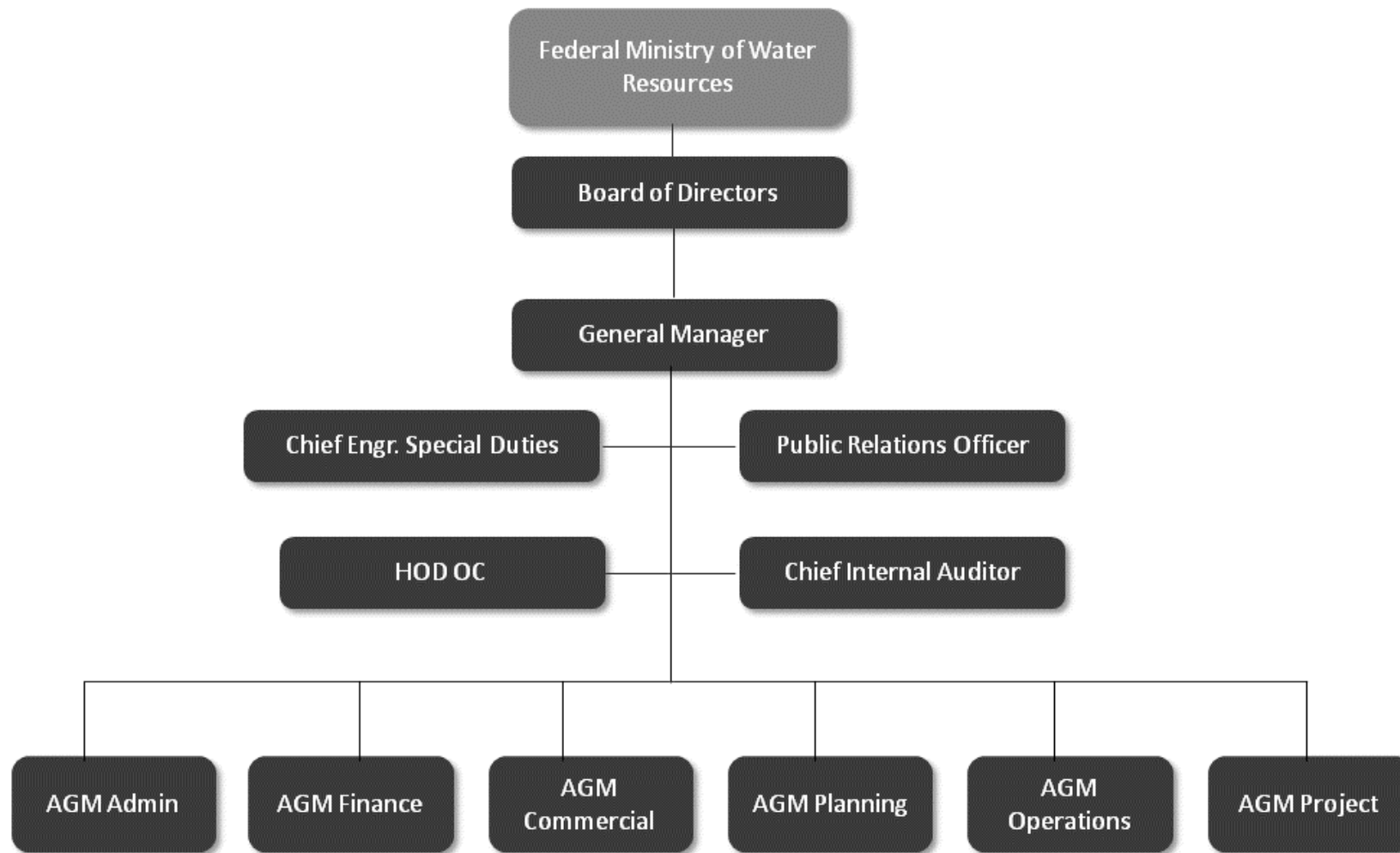


Figure 2: Organisational Structure for Kaduna

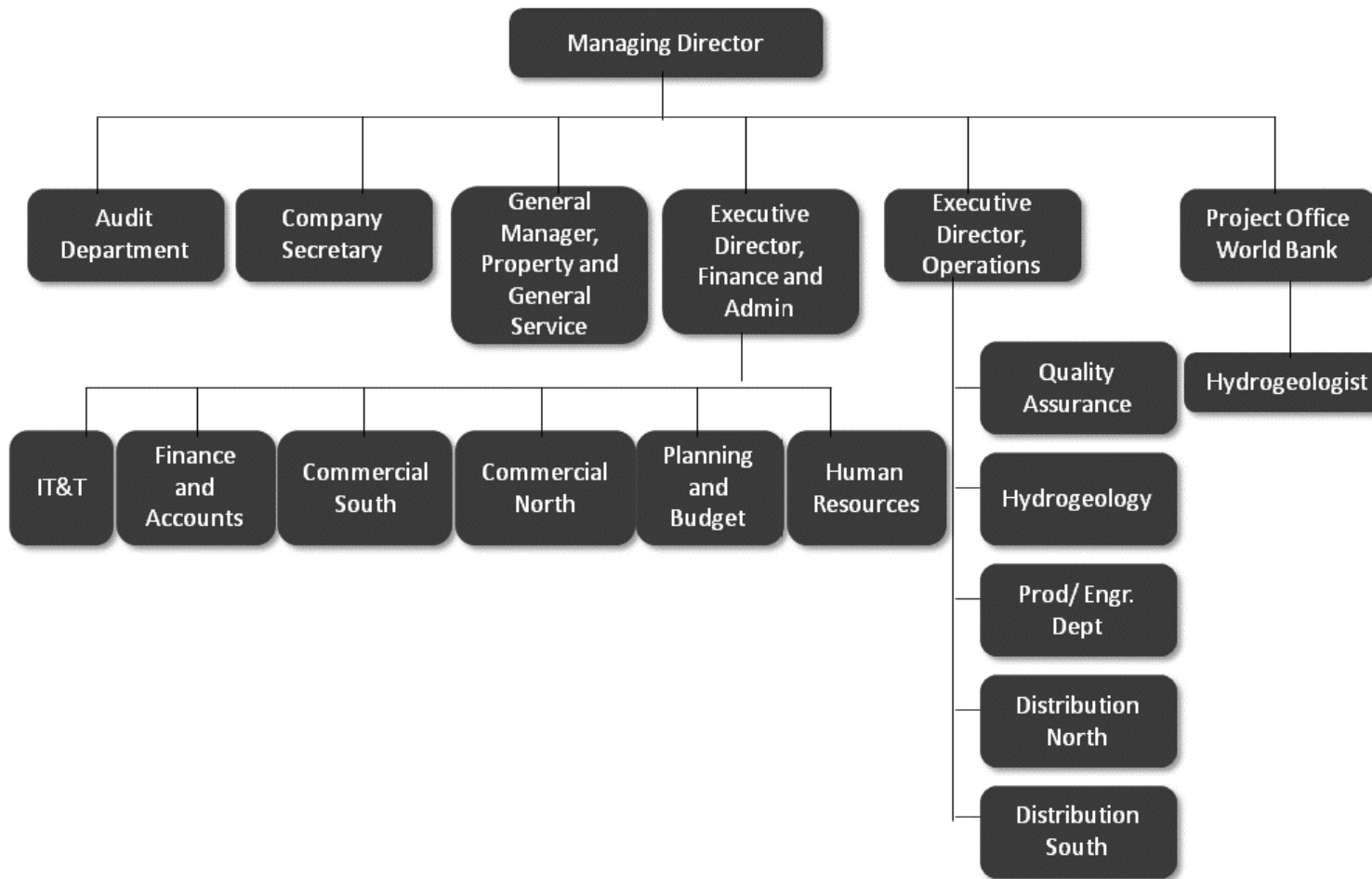


Figure 3: Organisational Structure for Lagos

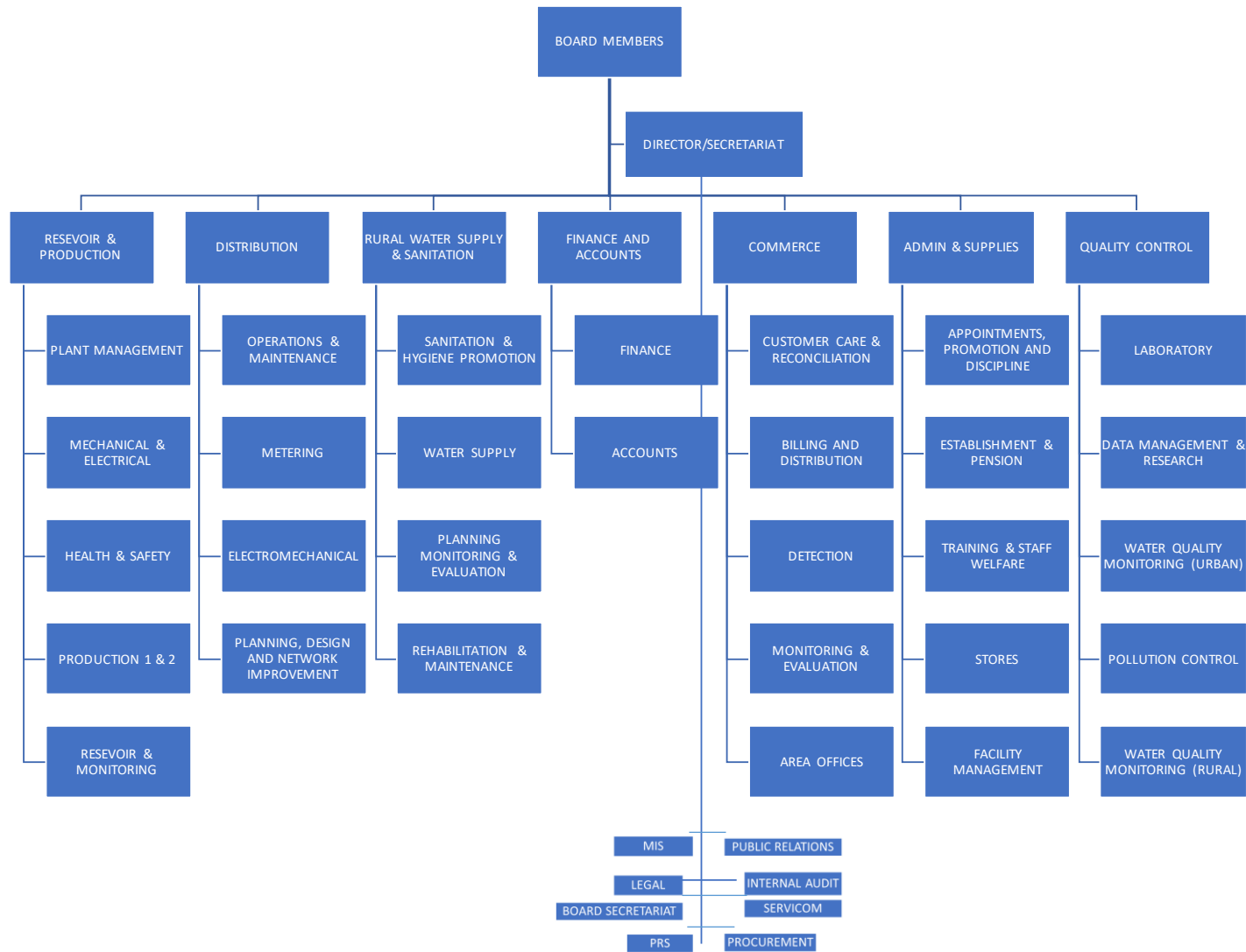


Figure 4: Organisational Structure of Abuja

Appendix 6

Interview sources = 61 respondent interviews

Table 1 – Comparative analysis of Key stakeholders for four case utilities

| Dependent nodes for Key stakeholders | Percentage of respondents by case utilities | | | | |
|--|---|-----------------|-----------------------------|-----------------|-----------------------|
| | Abuja N = 23 | Lagos N = 23 | Port - Harcourt N = 9 | Kaduna N = 6 | Average Percentage |
| Customers | 100% | 100% | 89% | 100% | 97% |
| Informal service providers | 83% | 100% | 67% | 100% | 88% |
| Funding Institutions | 100% | 96% | 33% | 100% | 82% |
| utility management and staff | 96% | 83% | 33% | 33% | 61% |
| consultants, contractor and manufacturers | 78% | 83% | - | - | 40% |
| policy makers, lawmakers and regulators | 57% | 35% | 33% | 33% | 40% |
| CSOs and community groups | 9% | 74% | 22% | 17% | 31% |
| other supporting sectors | 35% | 22% | - | 17% | 19% |

Table 2 – Comparative Analysis of key challenges for all utilities

| Dependent nodes for Key Challenges | Percentage of respondents by case utilities | | | | Average Percentage |
|---|--|-----------------|-----------------------------|-----------------|---------------------------|
| | Abuja N = 23 | Lagos N = 23 | Port - Harcourt N = 9 | Kaduna N = 6 | |
| Funding | 100% | 100% | 100% | 100% | 100% |
| Infrastructure related issues | 100% | 96% | 78% | 100% | 94% |
| Governance | 96% | 96% | 33% | 67% | 73% |
| Informal service provision | 83% | 100% | 67% | 100% | 88% |
| Poor staff management | 87% | 91% | 67% | 33% | 70% |
| Water is a social good | 22% | 78% | 67% | 100% | 67% |
| Power failure | 13% | 91% | 67% | 67% | 60% |
| Population growth and rapid urbanisation | 65% | 87% | 11% | 50% | 53% |
| Project management issues | | | | - | 31% |
| | 35% | 78% | 11% | | |
| Information management issues | 30% | - | 44% | - | 19% |
| Water quality issues | 4% | 9% | 11% | 33% | 14% |
| Climate change | 9% | - | - | - | 2% |

Table 3 – Comparative analysis of enabling factors in all utilities

| Dependent nodes for Enabling factors | Percentage of respondents by case utilities | | | | |
|---|--|-----------------|-----------------------------|-----------------|-----------------------|
| | Abuja N = 23 | Lagos N = 23 | Port - Harcourt N = 9 | Kaduna N = 6 | Average Percentage |
| staff competency and dedication | 73% | 30% | 44% | 20% | 42% |
| support from development partners and government | 65% | 83% | - | 80% | 57% |
| stake holder engagement | 9% | 4% | 78% | 60% | 38% |
| governance reforms and leadership | 61% | 13% | - | - | 19% |
| Customer paying regularly | 61% | 17% | - | - | 20% |
| credit facilities from suppliers | 4% | 4% | - | 20% | 7% |
| control systems for informal service providers and quality control | - | 4% | 11%, | - | 4% |
| continuous development and training | - | - | 11% | - | 3% |
| design modification | - | - | 11% | - | 3% |
| water rationing | - | - | 11% | - | 3% |
| Alternative power supply | 17% | 4% | - | - | 5% |
| urbanisation and population growth | 4% | - | - | - | 1% |
| knowledge management | - | 4% | - | - | 1% |
| cost effective strategies | - | - | 11% | - | 3% |
| new infrastructure | - | - | 11% | - | 3% |

Table 4 – Comparative analysis of policies in all case utilities

| Dependent nodes for policy development vs implementation process | Percentage of respondents by case utilities | | | | | Average Respondents |
|---|--|-------------------------|------------------------------------|-------------------------------|-----|----------------------------|
| | Abuja N = 23 | Lagos N = 23 | Port Harcourt N = 9 | - Kaduna N = 6 | | |
| Similar to nwp targets (quality, affordable rate, quantity) | 91% | 74% | 44% | 80% | 72% | |
| No discrepancy in implementation of master plan = | 43% | 57% | - | - | 25% | |
| Ineffective policy implementation | 61% | 22% | 44% | 100% | 57% | |
| Existing mandate and state water master plan - | 61% | 78% | 11% | 80% | 58% | |
| Following common principles before approval | - | - | 11% | - | 3% | |

Table 5 – Comparative analysis of Management Processes in all Utilities

| Dependent nodes for Management processes | Percentage of respondents by case utilities | | | | |
|---|--|-----------------|-----------------------------|-----------------|-----------------------|
| | Abuja N = 23 | Lagos N = 23 | Port - Harcourt N = 9 | Kaduna N = 6 | Average Percentage |
| water treatment, production, transportation and distribution = | 87% | 91% | 67% | 67% | 78% |
| maintenance and rehabilitation | 57% | 83% | 33% | 33% | 52% |
| stakeholder engagement workshops and public sensitisation | 43% | 87% | 89% | 50% | 67% |
| Management of revenue | 74% | 87% | 22% | 50% | 58% |
| Control systems | 65% | 96% | 56% | 67% | 71% |
| information management, | 43% | 83% | 89% | 50% | 66% |
| staff management | 70% | 91% | 11% | 33% | 51% |
| developing and executing projects | 65% | 87% | 33% | 83% | 67% |
| procurement and contract management | 13% | 74% | 11% | 17% | 29% |
| change management and reforms | - | 4% | - | 33% | 9% |
| automation and innovation | - | 9% | - | - | 2% |
| needs assessment and optioneering | 13% | - | - | - | 3% |
| research and development | - | - | 11% | - | 3% |
| organisation structure and reporting systems | 43% | - | - | - | 11% |
| water rationing | - | - | 11% | - | 3% |

Table 6 – Comparative analysis for Maturity levels for all utilities

| Key themes for Maturity | Percentage of respondents by case utilities | | | | |
|--|--|-----------------|-----------------------------|-----------------|-----------------------|
| | Abuja N = 23 | Lagos N = 23 | Port - Harcourt N = 9 | Kaduna N = 6 | Average Percentage |
| Maintenance | 61% | 87% | 44% | 50% | 61% |
| Staff management | 43% | 91% | 67% | 50% | 63% |
| Lacking adequate staff / manpower | 74% | 91% | 67% | 50% | 71% |
| Dedicated and committed staff | 74% | 91% | 67% | 50% | 71% |
| competency | 74% | 91% | 67% | 50% | 71% |
| Finance/ revenue | 57% | 100% | 100% | 100% | 89% |
| Governance | 34% | 17% | 33% | 50% | 34% |
| Infrastructure | 100% | 91% | 78% | 83% | 88% |
| Project | 26% | 74% | 11% | - | 28% |
| Information management and automation | 60% | 74% | 11% | - | 36% |
| Stakeholder Engagement | - | 74% | - | - | 19% |

Table 7 – Comparative analysis for key improvements for all case Utilities

| Dependent nodes for areas for improvement | Percentage of respondents by case utilities | | | | |
|--|--|-------------------------|--------------------------------------|-------------------------|-------------------------------|
| | Abuja N = 23 | Lagos N = 23 | Port - Harcourt N = 9 | Kaduna N = 6 | Average percentage |
| automated information systems and innovation and use of modern technology | 78% | 9% | 33% | 50% | 43% |
| governance reformation and change management | 22% | 9% | 67% | 16% | 29% |
| alternative power generation | 13% | 13% | - | 33% | 15% |
| increasing infrastructure | 61% | 13% | - | 33% | 27% |
| Innovative funding mechanisms | 35% | 83% | - | 67% | 46% |
| Preventive Maintenance | - | 78% | 33% | - | 37% |
| Management of staff (training, staff welfare, incentive-driven performance, more competent staff, staff motivation, peer review | 78% | 87% | 22% | 33% | 54% |
| setting control mechanisms | 52% | 17% | - | - | 17% |
| Stakeholder engagement | - | 9% | 22% | - | 8% |
| developing an asset management guide | 4% | 4% | - | - | 2% |
| increasing hours of supply | 4% | - | - | - | 1% |
| Increase in production | - | - | - | 44% | 11% |

Table 8 Comparative analysis of Key performance indicators

| Key themes for Key performance indicators | Percentage of respondents by case utilities | | | | |
|--|--|-----------------|-----------------------------|-----------------|-----------------------|
| | Abuja N = 23 | Lagos N = 23 | Port - Harcourt N = 9 | Kaduna N = 6 | Average Percentage |
| Non- revenue water | 50% | 70% | - | 80% | 50% |
| Billing and collection efficiency | 83% | 19% | 100% | 100% | 76% |
| Production capacity | 78% | 91% | 75% | 80% | 81% |
| Hours of supply | 24% | 4% | 75% | 20% | 31% |
| Service coverage | 78% | 91% | 75% | 80% | 81% |
| Staff productivity | 52% | 4% | 13%, | 50% | 30% |
| Response time to repairs/ customer complaints | 24% | 74% | 11% | 50% | 40% |
| Sanitation goals | 5% | - | - | - | 1% |
| Water quality | 83% | 91% | 11% | 50% | 59% |
| Customer buy in | 29% | 4% | 13% | - | 15% |

Table 10: Results Framework and monitoring Project Development Objectives – Project Development Indicators

Source: Port Harcourt Water Corporation (2016)

| Indicator Name | Unit of measure | Baseline | | | | | | | | Frequency | Data/Source methodology | Responsibility for Data Collection |
|--|----------------------------------|----------|-----|-----|--------|---------|---------|---------|---------|------------------|---------------------------------------|------------------------------------|
| | | | YR1 | YR2 | YR3 | YR4 | YR5 | YR6 | YR7 | | | |
| Number of people in urban areas provided with access to improved water sources under the project | Number | 492 | 492 | 492 | 42,000 | 168,000 | 298,000 | 420,000 | 420,000 | Every six months | FMWR | PHWC |
| Direct Project Beneficiaries | Number | 0 | 0 | 0 | 42,000 | 168,000 | 298,000 | 420,000 | 420,000 | Every six months | PHWC Database | PIU/PMT |
| Female Beneficiaries | Percentage Sub-Type supplemental | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | Every six months | FMWR | FMWR, PHWC |
| Percentage of operation and maintenance covered | Percentage | 0 | 0 | 0 | 10% | 35% | 60% | 80% | 90% | Biannually | PHWC | PHWC&FMWR |
| Medium-term sector investment plans completed for participating states | Number | 0 | 1 | 3 | 4 | 5 | 7 | 9 | 9 | Annually | FMWR | FMWR |
| National Water Sector Financing Policy Mechanism in Place | Yes/No | | | Yes | | | | | | Annually | FMWR | FMWR |
| Piped household Water Connections that are benefitting from rehabilitation works undertaken by the project | Numbers | 164 | 200 | 250 | 5,561 | 22,607 | 39,562 | 56,517 | 56,517 | Biannually | PHWC | PHWC&FMWR |
| Length of Water pipes rehabilitated and expanded | Kilometres | 15 | 23 | 93 | 185 | 278 | 370 | 463 | 463 | Biannually | PHWC/ Project Supervising consultants | PHWC&FMWR; PIU/PMT |

Table 11: Key Performance Indicators for Kaduna State Water Board

| Indicators | Unit | Sept – October 2010 | November – December 2010 | % change |
|---|----------------------|----------------------------|---------------------------------|-----------------|
| Water production in million m3 | Million m3 | 52,879.49 | 69,455.39 | 31.35% |
| Number of connections | No | 108,076 | 122,666 | 13.50% |
| Population served from the systems under rehabilitation | No x 10 ⁶ | 1.7 | 2.01 | 18% |
| Efficiency | % Billing | 41.5 | 53.21 | 4.12% |
| | % Collection | 72 | 76.32 | 6% |
| Total cost of production in million naira | Million Naira | 750.83 | 863.45 | 15% |
| Revenue from water sales in million naira | Million Naira | 456.415 | 618.516 | 31.3% |
| Cash operating ratio (how well liabilities are covered by cash flow) | Ratio | 60% | 71.6% | 11.2% |

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