



Public Procurement as a Driver of Innovation Demand in the South African Water and Sanitation Sector

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ABSTRACT

Innovation is the solution to addressing societal problems in many countries. In South Africa, a country characterised by severe water scarcity, innovative solutions have a major role to play in addressing water and sanitation challenges accruing to water constraints. This being so, innovation activities alone are not sufficient, as addressing these challenges also requires an enabling policy environment which influences innovation from the demand side. Public procurement is a demand-side policy instrument viewed as having the potential to stimulate innovation. This study sought to understand the potential of public procurement to drive innovation demand in the South African water and sanitation sector. Thus, a sectoral innovation system analysis, driven by a focus on public procurement of innovation, was conducted in two metropolitan municipalities. The research questions were addressed through semi-structured interviews of municipal officials and other sectoral actors to investigate the influence of sectoral innovation system drivers, i.e. demand, knowledge base & technologies, actors & networks, and policy & institutions on public procurement of innovation. A review of relevant public procurement documents was also undertaken as part of the literature review.

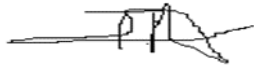
The main findings from the participants and informants report the present procurement legislative framework as a barrier to innovation procurement. Additionally, lack of adequate skills and knowledge among municipal procurement officials, the risk-aversion culture of municipalities and low revenue collection rates also constrain the adoption of innovative solutions by municipalities. As a remedy, a review and reconfiguration of present procurement regulations, among other interventions, is recommended.

KEY WORDS

Innovation, Public Procurement, Innovation Demand, Water and Sanitation Sector

DECLARATION

I, Thembela Ntlemeza, declare that this dissertation is my own unaided work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of Master of Management in the field of Innovation Studies at the Wits Business School in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other University.



Signature:

On this 31st day of March 2020

Thembela Ntlemeza (351234)

Name

DEDICATION

This dissertation is dedicated to the memory of my parents,

Lesley Sipho Ntlemeza

and

Dumazile Grace Ntlemeza

whom I don't go a day without thinking about, and to my grandmother, *Agnes Sipho Ngwenya*, who has been my anchor throughout my life.

“Laph' eng'phuma khona maw'phuma khona bathi aw'fiki la”

– Sjava, Mozzy & Reason (Seasons)

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LIST OF ABBREVIATIONS & ACRONYMS

ARC	Agricultural Research Council
CMA	Catchment Management Agencies
CSIR	Council for Science and Industrial Research
DEA	Department of Environmental Affairs
DHEA	Department of Higher Education and Training
DST	Department of Science and Technology
DTI	Department of Trade and Industry
DWA	Department of Water Affairs
DWS	Department of Water and Sanitation
EC	European Commission
GDP	Gross Domestic Product
IDC	Industrial Development Corporation
NGO	Non-Governmental Organisations
NSI	National System of Innovation
OECD	Organisation for Economic Co-operation and Development
PPI	Public Procurement of Innovation
R&D	Research and Development
RDI	Research, Development and Innovation
RIIS	Research Institute for Innovation and Sustainability
RQ	Research Question
SETI	Science, Engineering, Technology and Innovation
TIA	Technology Innovation Agency
TT	Technology Transfer
WRC	Water Research Commission

CHAPTER 1 INTRODUCTION

1.1 PURPOSE OF THE STUDY

This research investigates the role of public procurement as a driver of demand for innovation in the South African water and sanitation sector.

1.2 CONTEXT OF THE STUDY: A BRIEF OVERVIEW OF THE LITERATURE

The global water crisis is well documented in the literature. South Africa is particularly characterised as a water-scarce region owing to low annual average precipitation levels, high average temperatures as well as the uneven distribution of both surface- and groundwater resources as a result of spatial climate (Perret, 2002). Recently, the World Bank Group reported average monthly rainfall patterns in the country ranging between 12.6 to 67.3 mm for the period 1991 to 2015 (WorldBank, 2019) (Fig. 1), while many of its regions received low rainfall levels (less than 50 mm) in January 2018 (SAWS, 2019) (Fig. 2).

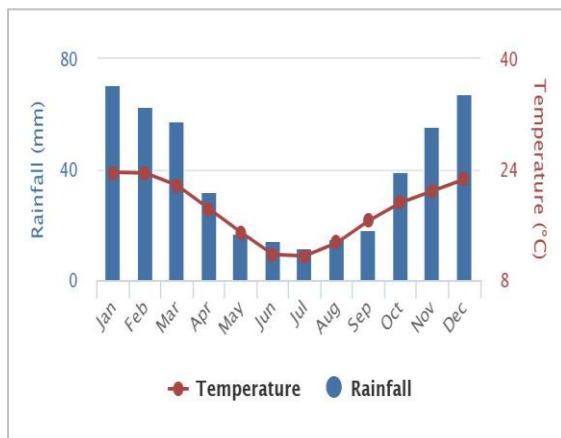


Figure 1: Average Monthly Temperature and Rainfall for South Africa from 1991-2015. Source: The World Bank Group

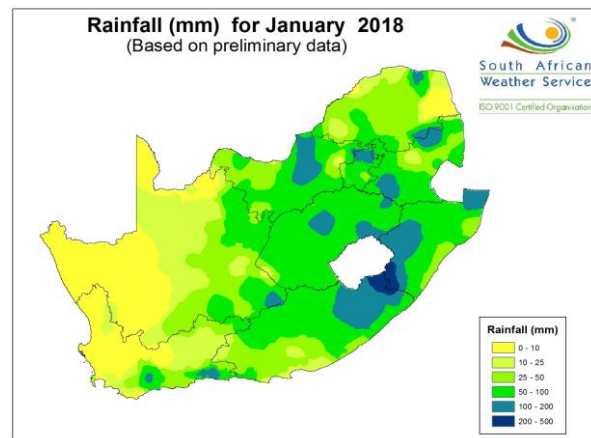


Figure 2: Rainfall for January 2018. Source: South African Weather Service

The demand for water currently outstrips existing resources (Donnenfeld, Crookes, & Hedden, 2018) and as the South African population increases and more citizens migrate to industrialised areas in pursuit of better economic prospects, the pressure exerted on water resources is exacerbated. A recent report compiled by the Federation for a Sustainable Environment (FSE) on water challenges in South Africa summarised the critical issues (FSE, 2018). Among these are the decline in water security due to

urbanisation, a decrease in precipitation due to climate change, non-revenue water, wetland degradation, and others. Furthermore, access to adequate sanitation services is not provided to all. In a report on ‘the status of sanitation services in South Africa’, the Department of Performance Monitoring and Evaluation in The Presidency (DPME & DHS) revealed that about 11% of South African households are without access to any form of government-supported sanitation and 26% of households have inadequate sanitation due to deteriorated infrastructure and/or deficient water resources (DPME & DHS, 2012). The report further described sanitation challenges as a combination of unserved households, infrastructure having declined beyond regular refurbishment, infrastructure requiring upgrading and extension to serve new communities, operation and maintenance backlogs, and others (DPME & DHS, 2012). To address these challenges in the water and sanitation sector, innovative solutions are essential.

Several policy instruments exist to promote innovation both from the demand and the supply perspective. However, innovation policies have historically focused on supply-side oriented instruments which place emphasis on strengthening the inputs by firms, i.e. human capital, physical resources, financial investments, etc. (Zelenbabic, 2015). On the contrary, policymakers have largely paid less attention to demand-side instruments which are geared to creating markets for innovation. The European Union (EU), recognising the limited success of supply-oriented approaches in improving innovation performance at the national level, began showing interest in demand-side innovation policy instruments in 2000 (Zelenbabic, 2015). Among demand-side instruments, public procurement has gained wide recognition as a tool to spur *“innovation, technology and economic development”* in the European region (Commission, 2014). As a result, the EU has enacted initiatives such as “Pre-commercial procurement: driving innovation to ensure sustainable high-quality public services in Europe”, the “Guide on Dealing with Innovative Solutions in Public Procurement” as well as national policies which articulate the important role of public procurement in promoting innovation (Society & Media, 2008). In addition, EU member states have been advised to allocate financial resources specifically for the procurement of pre-commercial as well as market-ready innovative products and services (Commission, 2014). In this respect, several EU governments are increasingly introducing initiatives to promote innovation-targeted procurement,

including Denmark's 2013 "Strategy for Intelligent Public Procurement" which aims to drive the uptake and implementation of public procurement as an instrument to aid in carrying out the government's goals of improving public services through innovation (Zelenbabic, 2015).

While the EU remains at the frontline, the past decade has seen an increase in economies employing public procurement in fostering national innovation activity (Lember, Kattel, & Kalvet, 2013). From Asian to North- and South American countries, new and explicit instruments that incorporate innovation procurement in economic development policy are being designed (Lember *et al.*, 2013). Examples of note include Australia's 'New Directions for Innovation, Competitiveness and Productivity' programme with a direct focus on public procurement (Lember *et al.*, 2013), Brazil's articulation of public procurement influence in industrial policy initiatives (Prochnik, 2011), as well as the Indigenous Innovation Policy Initiative developed by China (J. Edler & L. Georghiou, 2007). The growing implementation of public procurement as part of an innovation policy-mix is aimed at prompting innovation activity from the demand side by creating innovation-friendly markets. Scholars refer to such undertakings as *public procurement of innovation*.

Public procurement of innovation (PPI) can be defined as "*the purchase of a good that is not yet in existence or that is in existence but whose design and production will require further, if not completely new technological development, for example by means of research and development (R&D)*" (Bolton, 2016a). According to this definition, PPI essentially refers to a supplier and a procuring unit entering into a contractual agreement for the development of a new or improved product, process or service. This type of procurement is recognised as a means to introduce cost-effective products and processes which enhance public service performance in addressing socio-economic challenges (Wesseling & Edquist, 2018). In addition, PPI is a tool through which governments can increase the innovative capacity of suppliers (Wesseling & Edquist, 2018). Thus, the aim of this study was to investigate the potential of public procurement to stimulate demand for innovation in the South African water and sanitation sector.

1.3 PROBLEM STATEMENT

The vital role of innovation in the development of solutions to address societal challenges is well articulated (Fagerberg, Srholec, & Verspagen, 2010; C. Freeman, 1995; Nelson, 1987). This being so, addressing these challenges requires not only an increase in innovation activity but also a re-configuration of the policy system to create demand for innovation (Wesseling & Edquist, 2018). This implies interventions such as the implementation of demand-side oriented policy instruments to influence and stimulate the generation of innovative solutions (Edler & Georghiou, 2007; Zelenbabic, 2015). While a strong case has been made for PPI as a pathway to foster the development and deployment of innovative solutions in the EU and other regions, there is little evidence that this approach has been used in South Africa or in the water and sanitation sector. Thus, contextually understanding the role of PPI and the conditions which may or may not favour its implementation locally in the water and sanitation sector could be beneficial in raising demand, increasing the technical capability of innovators and accelerating the diffusion of water and sanitation solutions to municipalities and the broader South African society. As such, this study proposed to investigate the role of PPI as a driver of innovation demand in the South African water and sanitation sector.

1.4 SIGNIFICANCE OF THE STUDY

The findings of this study can contribute to society as water and sanitation are not only basic rights but are also central to human and economic development. The water crisis justifies the urgent need for sustainable innovative solutions to improve water security and access to adequate sanitation for both existing and future generations. Thus, an investigation into the role of public procurement in promoting demand for innovation in the water and sanitation sector could provide guidance in the design of policy aimed at accelerating the development and diffusion of water and sanitation technologies in the South African context. In addition, innovators, firms and other stakeholders in the innovation ecosystem will be guided towards a better understanding of the influence of public procurement on innovation activity, particularly through the lens of the water and sanitation sector. During the study, critical aspects to the innovation process as it pertains to water/sanitation science were explored. Thus, a new theory on innovation in the sector may be added.

1.5 DELIMITATIONS OF THE STUDY

The study was confined to analysing two municipal cases relating to the potential of public procurement to drive innovation demand in the water and sanitation sector.

1.6 ASSUMPTIONS

The research was anchored on the following assumptions:

- i. The instrument used to collect data would result in reliable responses;
- ii. The respondents would have full understanding of the questions asked;
- iii. The respondents would provide honest and objective responses as non-disclosure agreements would be signed between the researcher and each respondent in order to preserve anonymity and maximize credibility.

1.7 DEFINITIONS OF KEY TERMS

Innovation	- the creation of a new or improved product or process
Public Procurement	- the purchasing of goods and services by government or public entities to fulfil their functions or mandates
Municipality	- a town, city or district possessing its own local government
Sanitation	- public health conditions related to clean drinking water and adequate treatment and disposal of human wastes and sewage

1.8 RESEARCH QUESTIONS

The study sought to address the following research questions:

- i. What is the role of public procurement in stimulating demand for innovation in the water and sanitation sector?
- ii. Does public procurement for water technologies differ from public procurement for sanitation technologies? If so, under what conditions?
- iii. How might opportunities for innovation diffusion through public procurement be better seized and barriers overcome?

1.9 OUTLINE AND STRUCTURE OF THE REPORT

Chapter 1: Introduction

Chapter 2: Literature Review

Chapter 3: Research Strategy and Methodology

Chapter 4: Presentation of Data

Chapter 5: Discussion of Results

Chapter 6: Conclusions and Recommendations

References

Appendices: Questionnaires

CHAPTER 2 LITERATURE REVIEW

A literature review of the main aspects of investigation relevant to this study is presented. The theoretical framework comprises a brief overview of the foundations of innovation theory, innovation systems theory as well as the linkage between innovation and public procurement. Lastly, an overview of innovation in the South African water and sanitation sector is presented.

2.1 INNOVATION

Joseph A. Schumpeter was the most influential 20th century scholar and economist to formulate theories on the concept of innovation. He characterised innovation as the development of new products and processes, the establishment of new enterprises, and a shift in leadership paradigms (Robertson, 1967). Sociologist, Everett Rogers, later defined innovation as “*an idea perceived as new by the individual*”, while anthropologist H.G. Barnett viewed innovation to be “*any thought, behaviour, or thing that is new because it is qualitatively different from existing forms*” (Rogers & Adhikarya, 1979).

While innovation may be referred to in the noun form, Robertson (1967) argued that it is in fact a process and not a single event or outcome. He postulated that during this ‘process’ a new thought or idea is translated into real form and subsequently transferred from its creator to its intended users or adopters. In like manner, economist Abbott Usher (1883-1965) postulated that innovation is “*not an accidental affair*” but a slow process driven by active cumulative efforts from contributors. He further presented that the innovation process is subdivided into four steps: *perception of the problem* wherein a problem to be addressed is identified, *setting of the stage*, which entails active technical efforts to address the ‘problem’, *the act of insight* which signals arrival to the solution and lastly, *the critical revision* during which the innovation outcome is assessed for practicality. Borrego, Froyd, and Hall (2010) argue further that the adoption of innovation depends on awareness and a better understanding of its significant role in addressing problems. They also assert that innovation adoption occurs in five consecutive stages: awareness, interest, evaluation, trial and adoption.

Innovation is also characterised according to the different forms it assumes. John (1999) described three types of innovation, namely i) product, ii) process and iii)

market innovation. Product innovation comprises creating improved or radically transformed products to secure market competitiveness. Three categories of product innovation were described by Tushman and Nadler (1986) as i) incremental, ii) synthetic and iii) radical innovation. They defined incremental innovation as adding new features or extensions to an existing product, synthetic innovation as the integration of existing ideas or technologies into one assembly, and radical innovation as the design of completely new-to-market technologies. While synthetic innovation theory appears to have become sparse, recent literature has widely explored disruptive innovation in addition to incremental and radical innovation, which is defined as the creation or improvement of a product in a way that creates a new market and eventually displaces competing incumbent products from the market (Christensen, Raynor, & McDonald, 2015; Hang, Chen, & Yu, 2011). Process innovation is linked to reengineering or completely changing a business process, e.g. the manufacturing process, to arrive at products which offer maximum performance at the lowest cost. Product and process innovation combinedly make up technological innovation, and to complement technological innovation, creative methods of approaching target markets are designed by businesses in a process known as *market innovation* (Johne, 1999; Storbacka & Nenonen, 2015; White, Hoskisson, Yiu, Bruton, & Review, 2008). Other types of innovation have been defined in the literature, including organisational innovation, which refers to structures and systems incorporated into business practices to enable the innovation process within firms (Camisón & Villar-López, 2014; Damanpour & Evan, 1984; Lam, 2004). This is synonymous with the innovation culture of an organisation, which according to Elenkov and Manev (2005), is established by the leadership and influences the implementation of innovation within or by the organisation. Additionally, service innovation comprises the design of new or improved approaches to serving customers, with the aim of achieving increased value for customers and optimised profits for the business (Lusch & Nambisan, 2015; Magnusson, 2003).

Among other listed types of innovation, technological innovation stimulates economic growth and sustainable development. Wide literature has covered the contribution of technological innovation in the progress of nations and firms. As an example, technological innovation played a significant role in the early economic transformation of countries such as the US, China and the UK (Cyert & Mowery, 1987; Geroski &

Statistics, 1989; Jefferson & Rawski, 1994). Grossman and Helpman (1994) argued that technological knowledge is a determinant of a country's economic well-being in the long run. Recently, in a study on the transformative direction of innovation toward an IoT-based society, Naveed, Watanabe, and Neittaanmäki (2018) asserted that technical activity is directly associated with higher rates of increase in GDP. As the global community grapples with rapid population growth in tandem with the depletion of natural resources, resource-based economies can sustain growth by investing in innovation-driven production.

In addition, firms that strategically embrace innovation increase productivity, demand, and longevity, and contribute to economic development through national GDP growth and employment creation (Madrid-Guijarro, Garcia, & Van Auken, 2009). As such, innovation has been a major determinant in the productivity of firms in Thailand, Japan and the US (Hosono, Takizawa, & Tsuru, 2009; Mansury & Love, 2008; Wignaraja, 2008). Therefore, when firms engage in innovation activity, their economic competitiveness is both enhanced and lengthened. Further to this and arguably most importantly, societal needs are addressed through solutions generated by innovative firms. While this is so, studies have shown that the performance of innovation at the firm level does not depend solely on the activities of firms, but also on the collective efforts of other interested actors at the national level, i.e. the national system of innovation.

2.1.1 The National System of Innovation

The success of innovation diffusion in regions such as the United States, Japan and Europe in the late 19th century was influenced not only by formal research and development (R&D) but by a variety of other factors (Freeman, 1995). One dominant factor was the extent to which firms interacted with the market and with other firms within their innovation value chain. It was later also learned that in addition to inter-firm relationships, linkages with the broader science-technology community were crucial for the successful production and dissemination of innovation outputs. The 19th century political economist Friedrich List also supported this view in his recognition of the importance of interdependencies between manufacturing businesses and formal science and education institutions in the disciplines of physics, chemistry, mechanics, design and others (Freeman, 1995). In an 1841 publication cited by Freeman (1995),

List argued that industries could make no progress or new discoveries in isolation to science institutions. Over time, however, research showed that beyond science-related institutions, other participants were necessary for the innovation process. Thus, a systemic view of innovation emerged, which takes into account additional participants in the broader environment in which innovation activity occurs (Edquist, 1997; C. Freeman, 1995; Malerba, 1993). Thus, Schumpeter's advocacy for the innovative firm has given way to an expanded perspective that highlights the importance of the surrounding environment wherein innovation takes place. This accrues also to strong evidence from surveys conducted in Europe in the late 1980s which revealed the importance of linkages with various members of the environment (including users) for innovation in firms to result in economic impact. It was understood that the expansion of in-house R&D efforts were not the only ticket to successful innovation as other widely-distributed resources and skills necessary for technical change existed and had to be *identified, accessed, absorbed and used* for effective innovation. These resources and skills were present not only in other firms but also in organisations outside inter-firm relationships such as universities, research bodies, and other actors (Fagerberg, Martin, & Andersen, 2013). Freeman (1995) contended that many early improvements to products and services and associated profit gains in Europe, Japan and the United States were informed by interactions with the market. While formal R&D was instrumental in influencing radical firm and industry-level innovation, the role of the surrounding environment in the process of technical change became apparent. In addition, research increasingly revealed the significant effect of the systemic nature of innovation in shaping innovation diffusion rates and productivity gains for various diffusion processes (Freeman, 1995). This systemic approach to understanding the innovation process has been viewed from the lens of the nation, i.e. the national system of innovation, and at subsystem levels.

Currently, there is no universal approach to defining the national system of innovation in the literature. An early definition by B.-A. Lundvall (1988) referred to "*elements and relationships that interact in the production, diffusion and use of new and economically useful knowledge and...encompasses elements and relationships, either located or rooted inside the borders of a nation state*". Freeman (1987) defined the national system of innovation as "*the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies*".

The system is *social* on account of emphasising interactive relationships between stakeholders interested in the innovation process, and *dynamic* as it is characterised by constant learning and feedback (B.-A. Lundvall, 1988). Edquist (2004) argued for a more comprehensive description and stated that national systems of innovation comprise “*all important economic, social, political, organisational, institutional, and other factors that influence the development, diffusion, and use of innovation*”. These and several other existing definitions of the national system of innovation concept emphasize that innovation is determined not solely by R&D but also by constant learning and knowledge sharing between organisations.

This being so, the innovation systems approach is relatively new to developing countries (Muchie, Gammeltoft, & Lundvall, 2003; Viotti, 2002). As a result, scholars such as Viotti (2002) have contended that for developing countries that do not introduce high novelty or radical technological innovation, the use of the “innovation system” concept may be misguided. A benign *national learning system* concept is proposed, which describes learning as the process of implementing improvements on imported technologies to achieve technical change (Viotti, 2002). Thus, according to Viotti, since innovation in late industrialising economies is predominantly characterised by incremental efforts, systemic interactions should be rather framed as national learning systems. This is in agreement with the argument by Arocena and Sutz (2000) that less developed countries do not possess mature systems of innovation which can be analysed as such. However, Wu, Ma, Shi, and Rong (2009) dispute Viotti’s argument in favour of the secondary innovation concept. Contrary to original innovation, the secondary innovation process entails the acquisition and localisation of foreign technological capability, and subsequently improvement and diversification of imported technologies (Wu *et al.*, 2009). In the African context, Muchie *et al.* (2003) maintain that colonialism left most states too fragile and weak to build independent innovation systems and argue for an integrated African system of innovation characterised by an “*African-wide national political economy of production*”. Nonetheless, developing economies increasingly design development strategies on the basis of national innovation systems (B.-Å. Lundvall, Joseph, Chaminade, & Vang, 2011). Due to the high priority given to innovation in national policies and strategies, this study considers South Africa as a national system of innovation.

The national system of innovation (NSI) concept was introduced to South Africans in 1996 by the White Paper on Science and Technology (DST, 1996), which broadly defined the NSI as “*consisting of all individuals and organisations involved in creating and using a knowledge base in order to build a better South Africa*”. The White Paper recognised the NSI as a framework through which new knowledge would be “*created, acquired and diffused*” and specified six functions to be carried out by the system at government and stakeholder level, namely i) policy formulation and resource allocation at the national level, ii) regulatory policy-making, iii) performance-level financing of innovation-related activities, iv) human resource development, v) capacity building, as well as vi) the provision of infrastructure (DST, 1996). One of government’s main interests in adopting the NSI model, as stated in the White Paper, was to promote fruitful stakeholder interactions, i.e. between institutions, firms and policy frameworks. Stakeholders outlined in that policy paper included central policy departments, government line departments, funding agencies, science, engineering, technology and innovation (SETI) institutions, state corporations, business organisations (firms, industries, enterprises), the higher education sector, as well as non-government organisations (NGOs). In the White Paper the NSI is designated a responsibility to design processes which promote and fast-track the diffusion of technology and innovation to the wider South African society (DST, 1996).

While national systems of innovation dominate contemporary innovation discourse, research reveals significant differences across industries and sectors in approaches to innovation, which has led to the development of new frameworks for the evaluation of innovation systems. In this respect, systems of innovation may be delimited geographically to give rise to regional levels of analysis, or sectorally according to the breadth of technological capability considered (B. Johnson, Edquist, & Lundvall, 2004). The geographic restriction suggests that the region in question has a coherent approach to innovation activity, while the sectoral delimitation presumes a lucid technological system within a sector (B. Johnson et al., 2004). These and several other subsystems have been covered widely in the literature. For the purpose of this study, for which the interest is the South African water and sanitation sector, the sectoral system of innovation is detailed next.

2.1.2 The Sectoral System of Innovation

A major concept identified alongside the NSI in the early 1990s was the Technological Systems (TS) concept (Breschi & Malerba, 1997). Contrary to national and more localised innovation systems which focus on how the set of industries enclosed within a country or region network to accelerate productivity, the TS approach divided focus according to specific technologies and industries. It was mainly concerned about the interaction of clusters of technologies, firms or industries to create and diffuse technologies (Breschi & Malerba, 1997). These clusters can be viewed as synonymous with sectors whose distinct technological contexts influence innovation patterns (Malerba, 2004, 2005b). As a result, analysing the innovation process at the sectoral level, i.e. the sectoral innovation system (SIS), is justified as sectors are economic units which independently interact with markets. While both the TS and SIS constructs place emphasis on firms engaged in a distinct domain of technological innovation, the SIS notion also considers the role of the environment in influencing competition between firms (Malerba & Orsenigo, 1997). Malerba (2004) posits that in the SIS context, the innovation process comprises continuous and systemic interactions between actors within sectoral boundaries.

A sectoral system of innovation is therefore one which possesses a “*specific knowledge base, technologies, inputs and demand*” (Malerba, 2002), of which participants include individuals, firms and institutions who interact at various aggregate levels to accelerate the development, manufacturing and diffusion of technological knowledge and innovation produced by the sector. The systemic interactions, dictated by institutions within the sector, are through dynamic learning and knowledge spill-overs which constitute “*communication, exchange, co-operation, competition and command*” (Malerba, 2002). In addition, interactions are both market and non-market-related such that traditional economic output indicators would not be sufficient in measuring SSI outputs (Xi, Lei, & Guisheng, 2009).

Thus, typical components of a sectoral innovation system comprise firms and technology practitioners (universities, science councils, etc.), as well as supporting actors such as financial institutions, regulators, networks, demand, knowledge base and production activities which are specific to the sector (Malerba, 2002). Therefore, it is posited that the main elements which drive the innovation process at the sectoral

level include demand, knowledge and technology base specific to the sector, actors and linkages, as well as policy and institutions (Malerba, 2002, 2004). In analogy with the national systems of innovation, an effective sectoral innovation system is characterised by constant interaction and collaboration between actors (Malerba, 2005a). As the innovation systems framework tends to be based on stylised facts, that is, generalised empirical findings, the decision on the extent to which a particular SIS is successful is left to the evaluating researcher to determine in relation to selected criteria.

In assessing the progression of the pharmaceutical industry from a SIS approach, McKelvey and Orsenigo (2001) concluded that actors involved in the SIS are dynamic and constantly develop new agents and ways of networking. They argued that sectors across several European countries vary in respect of innovation strategies, level of innovation (e.g. radical, incremental) and market orientation. This being so, the significant role of country-level innovation systems is clear, with factors such as university-industry interaction, the quality of the science base, venture capital, regulation, the availability of skilled human capital, etc. determining innovation progress in sectors (McKelvey & Orsenigo, 2001). Furthermore, sectoral innovation systems are not static as capabilities, regulation, and markets are under a constant state of co-evolution. In response, agents are constantly modifying their position by changing the '*rules of the game*' to retain or increase profitability (McKelvey & Orsenigo, 2001).

Xi *et al.* (2009) analysed the evolution of the Chinese automobile industry from the perspective of the sectoral system of innovation. Among other findings, policy from the demand and supply direction appeared to significantly influence innovation and learning in Chinese automobile firms (Xi *et al.*, 2009). This is supported by research conducted by Malerba, Nelson, Orsenigo, and Winter (2001) which showed the significant impact of policy on industry structures. Further to this, unmet market demand was found to incentivize innovation in the sector while driving competition between local firms and, innovation performance rested on the willingness of firms to formulate and effect new strategies to meet consumer needs faster and competitively (Xi *et al.*, 2009).

This study considered the South African water and sanitation sector as a sectoral innovation system whose actors interact to develop, mature and diffuse innovation created within sectoral boundaries, and sought to investigate the potential of public procurement to promote innovation in the sector. The investigation was thus approached from the SIS framework, whose drivers are listed above, namely i) demand, ii) knowledge and technology base, iii) actors and networks and iv) policy and institutions. The next segment of the literature review details the theory of public procurement of innovation.

2.2 PUBLIC PROCUREMENT AND INNOVATION

The phrase ‘public procurement’ translates to *the purchase of goods and services by government or public entities to fulfil their various functions* (Bolton, 2016a). There is, however, consensus among scholars that public procurement has been an area of academic neglect (Thai, 2001). Studies indicate that public procurement practice has historically superseded theoretical research, hence global academic interest in public procurement is relatively low (Flynn & Davis, 2014). To address this disparity, public procurement has been expanding as a field of research in disciplines such as public administration, finance, management, mathematics, law, supply chain and logistics, and information and communication technology (Flynn & Davis, 2014). This progression has led to wide debate on how the purchasing power of governments can be leveraged to achieve national objectives. In policy spheres, the role of public procurement in realising socioeconomic growth and environmental sustainability has become a major subject of enquiry (Arrowsmith, 2010; McCrudden, 2007), and more recently, the role of public procurement in preserving the environment has been attracting interest (Bolton, 2008; Thai, 2001). Similarly, the influence of public procurement in promoting innovation is increasingly drawing the attention of scholars and policymakers in both developing and developed countries.

Edquist and Zabala-Iturriagagoitia (2012) define public procurement of innovation (PPI) as *“the process by which public organisations place an order for the fulfilment of certain functions by a new product (good, service and system) that does not yet exist, and whose development and diffusion will influence the direction and rate of technological change and other innovation processes”*. In Horizon 2020, a framework for research and innovation in the EU, PPI is defined as *“procurement where*

contracting authorities act as a launch customer for innovative goods or services which are not yet available on a largescale commercial basis..” (Commission, 2014). This study apprehended PPI as defined in Horizon 2020.

It is important to distinguish between “general procurement” and PPI, wherein the former implies the purchasing of already-existing or off-the-shelf products that do not require any development and therefore do not entail innovation (Bolton, 2016a). In addition, it must be stated that there is a difference between PPI and *innovation in procurement*, where the latter refers to the implementation of new technology or procedures or methods to improve the process of procurement (Bolton, 2016a), e.g. migration from manual to electronic means of submitting supplier proposals.

Edler and Georghiou (2007) distinguish between different types of PPI as follows: *direct PPI* takes place when the procurer is the end-user of the technology procured, while *catalytic PPI* implies that the procuring organisation plays a mediating role by purchasing the technology on behalf of the end-user(s). Furthermore, PPI can also be characterised according to the scale of the innovation embedded in the procured product, i.e. *adaptive PPI* means only incremental adaptation of the technology must take place before implementation and *developmental PPI* requires a completely novel product which may necessitate intensive research and development prior to implementation (Edler & Georghiou, 2007).

It is additionally posited that for PPI to contribute to challenge-driven transformation, multiple actors of the socio-technical system, i.e. state/procuring agencies, knowledge institutions, users, firms, and other stakeholders, must engage in four basic stages in carrying out same (Wesseling & Edquist, 2018). The first phase is *articulating and facilitating societal demands* which requires persistent active collaboration between stakeholders so that consensus is achieved on the perceived need. Secondly, functional specifications for *new technologies that enable meeting these societal demands must be developed and produced* given that existing technologies are often insufficient or unsuccessful in addressing emerging societal needs. The third stage comprises a competitive tendering process wherein potential suppliers submit formal proposals to design the required innovation, followed by the fourth stage which entails *selection of technologies that best enable meeting the articulated demands* during which experts within the procuring authority guide the evaluation of competing

technologies for alignment with functional requirements to validate the selection of the best technology. Thereafter, the *selected technologies are delivered to the procuring entity and diffused* with the goal of meeting the articulated societal demand (Bolton, 2016a; Wesseling & Edquist, 2018).

As the responsibility of addressing societal needs rests primarily on governments, public procurement can be employed by organs of state to generate innovative solutions which enhance the provision of basic services. Also, as (arguably) the largest procurers of goods and services in nations, governments have the capacity to create launch markets for suppliers of new technology through public procurement (Lember *et al.*, 2013). In particular, innovative suppliers in the South African water and sanitation sector can benefit from public procurement, and in turn provide solutions to address challenges in the sector and the broader society.

The drive for using public procurement to stimulate innovation builds mostly on post-WWII defence-related purchasing (Lember *et al.*, 2013). Other examples include the historic involvement of US government procurement programs in the development of new technologies such as the Internet and semiconductors (Lember *et al.*, 2013; Ruttan, 2005), Sweden's initiative to pair up the state and technology firms for specific technology-based procurement projects such as the procurement of the Nordic Mobile Telephony from Ericsson by the Swedish Agency for Telecommunications (Edquist & Hommen, 2000), and Japan's employment of public procurement as a direct policy tool for economic development in the 1960s (Rothwell & Zegveld, 1981).

In recent times, national economies have been increasingly employing public procurement to stimulate innovative solutions aimed at addressing societal challenges in various sectors and regions. The Netherlands introduced an innovative electronic identification system which provides electronic certificates and signatures for every citizen. The €760,000 procurement project comprised and upscaled adaptation of an existing system to European and international standards. The specification of requirements was developed in collaboration with external experts over a lengthy period to ensure full compatibility with appropriate standards and an informed analysis of demand by the procuring authority (Vinnova, 2007).

The City State of Hamburg (Germany) contracted a supplier for the development of a new lighting system for all its public offices. The specification was in line with the

German government's national objective to reduce energy consumption in its activities. In this regard, the tender specification compelled the supplier to undertake a certain degree of product development in designing the required "*largely existent yet relatively new*" technology (Vinnova, 2007). To ensure that the procurement process was distinguished from *regular* procurement, the procuring authority conducted informal meetings with potential suppliers to clearly articulate the innovation aspect in the City's need. The public authority thus acted as a launch customer for the innovative lighting system, which prompted private companies to acquire similar energy-saving improvements from the supplier (Vinnova, 2007).

Similarly, the Austrian government procured an innovative file management system, ELAK, for all its public ministries and employees in 2001. The procurement process began as a response to a government-declared priority need for internal efficiency and easy accessibility of information by citizens. The web-based electronic system is innovative both in regard to functionality and software and can be integrated into several platforms (Vinnova, 2007). A new market has been created in file management systems as a result of the success of ELAK and demand has been widely articulated to suppliers.

In the UK, the Highways Agency (HA) articulated a broad specification of requirements for a novel generation of traffic signs along motorways by means of a competition. Of the two enterprises that contested, the winning candidate designed graphics-based message signs as opposed to historically used text-based signs. When the design was completed, HA took ownership of the intellectual property rights in accordance with the initial contractual agreement which provided for the agency to accrue the ownership as it had financed the full scope of the development work. As a result, the supplier must license the intellectual property from HA for mass production and exportation of the technology (Vinnova, 2007).

In 2006, the Swedish government commissioned the Swedish Governmental Agency for Innovation Systems (Vinnova) and the Swedish Agency for Economic and Regional Growth (NUTEK), in collaboration with the Swedish National Board for Public Procurement, to examine the potential of public procurement in contributing to the development of innovative and creative solutions to drive technological change and business opportunities in Sweden (Vinnova, 2007). The resultant report states that it

is essential for PPI to form an integral part of the long-term development strategies of public organs, including municipalities. Furthermore, procurement of innovation must be encouraged through the creation of methods and structures to coordinate procurement processes such that consensus regarding demand is attained and the potential of small firms to satisfy articulated needs through innovation is considered and leveraged. It is thus important that demand and innovation expertise are coordinated to ensure quality in both the 'request for proposals' and the submitted applications. The study further revealed that government's intent for continual policy development in regard to meeting demand is a strong influence in efficient public procurement of innovation (Vinnova, 2007).

The Dutch water construction sector also employed public procurement to address a societal challenge through innovation (Wesseling & Edquist, 2018). To mitigate against a recurrent flooding problem, the sector sought to migrate from historically used dyke-based technologies toward innovative flood barriers with higher efficiency and longevity. The procurement process followed a shift in the policy system – from concentrating only on protection against storm surges toward articulating additional demands including *maritime transportation, ecology and land use* (Wesseling & Edquist, 2018). To obtain the desired solution, a competitive tender process was carried out, which led to the selection of a new-to-the-world design built over a ten-year period (1987-97), consisting of advanced sector gates built with steel-based material (Wesseling & Edquist, 2018).

However, while national policy programmes increasingly build innovation criteria into procurement objectives, public procurement as innovation policy is also a subject of growing debate. The widening interest in spurring innovation using public funds is met by conflict from opposing scholars who argue that the public purse should not deal with innovation and must be foremost handled with efficiency (Lember *et al.*, 2013). This end of the debate considers innovation as a potential by-product of procurement and not a priority.

In addition, several studies have documented various hindrances to public procurement of innovation. Inadequate skills of public procurement practitioners, limited management capacities, the risk-avoidance tendency of government entities, constrained financial resources, limited innovation champions in procurement

departments, lack of strategic intent at senior management level, etc. are listed as barriers to innovation procurement in the public sector (Zelenbabic, 2015). From a supplier perspective, the main constraints to PPI comprise limited or poor interaction between procuring agents and solutions providers, rigid tender specifications with less focus on outcome, risk aversion and limited skills of procurement specialists (Uyarra, Edler, Garcia-Estevez, Georghiou, & Yeow, 2014). These barriers are reported to be compounded when suppliers are small firms and non-profit organisations.

While this study focused on the potential of public procurement to promote innovation in the water and sanitation sector, focus was also placed on barriers and how they could be overcome in the South African context.

2.2.1 Public Procurement in the South African Environment

In 1995, the post-1994 government instituted a reformed procurement system with a dual focus: the promotion of effective governance and the advancement of certain socio-economic goals (Ambe & Badenhorst-Weiss, 2012). Due to its strong economic and political significance, public procurement is a subject of strict regulation in South Africa. The legislative regime, established by the National Treasury, is guided by Section 217 of the RSA Constitution, which provides the overriding guide on the approach organs of state must follow when undertaking procurement practice. Other frameworks developed to complement the provisions of Section 2017 include the Preferential Procurement Policy Framework Act (PPPFA), the Public Finance Management Act (PFMA), and other guidelines and policies.

2.2.1.1 Section 217 of the Constitution

Section 217 mandates government entities at all levels, i.e. national, provincial, local and all other institutions listed as “organs of state” in Section 239 to contract for goods or services in a manner that is “fair, equitable, transparent, competitive and cost-effective” (Sudáfrica, 1996). In subsection (2), the implementation of public procurement policy in *categories of preference* is permitted, including preference for suppliers disadvantaged by unjust apartheid laws (Sudáfrica, 1996). As such, subsection (3) prescribes a national framework for the implementation of the *preferential* policy provided for in section 217 (2), hence the Preferential Procurement Policy Framework Act was effected in 2000 (Parliament, 2000).

2.2.1.2 Preferential Procurement Policy Framework Act (PPPFA)

The Act mandates organs of state to define and implement preferential procurement policies for specific goals within a framework which stipulates a point system to be adhered to in the allocation of contracts. Section 2(d) states that the specific goals may include awarding contracts to previously disadvantaged suppliers and implementing policies aligned to the Reconstruction and Development Programme (RDP) (Parliament, 2000).

2.2.1.3 Public Finance Management Act (1999)

The object of the Public Finance Management Act (PFMA) is stated as *“to regulate financial management in the national government and provincial governments; to ensure that all revenue, expenditure, assets and liabilities of those governments are managed efficiently and effectively; to provide for the responsibilities of persons entrusted with financial management in those governments; and to provide for matters connected therewith* (SA, 1999). Therefore, all government-related procurement activities are subject to the provisions of the PFMA.

In addition, the PFMA also regulates public private partnerships (PPPs) at national and provincial levels (Treasury, 2019). National Treasury Regulation 16 defines a PPP as:

“A contract between a public-sector institution and a private party, where the private party performs a function that is usually provided by the public sector and/or uses state property in terms of the PPP agreement”

In a PPP, the project risk, i.e. financial, technical and operational, is carried by the private partner who incurs the capital and operational costs of the project. All government entities entering into PPPs must obtain approval from National Treasury in four stages: feasibility study, procurement, value for money and final PPP agreement (Treasury, 2019). Through the PPP vehicle, government has partnered with the private sector to meet several infrastructure demands.

As this study investigated the potential of public procurement to spur innovative (water and sanitation) solutions from the perspective of municipalities as custodians of service delivery at the local level, it was important to also understand public procurement at local government level.

2.2.2 Public Procurement at the Local Government Level

This study investigated the potential of public procurement to spur innovative (water and sanitation) solutions from the perspective of municipalities as custodians of service delivery at the local level. At local government level, public procurement is guided by the Municipal Finance Management Act (MFMA) in conjunction with the Municipal Supply Chain Management Regulations.

2.2.2.1 Municipal Finance Management Act (MFMA)

The mandate of the MFMA is *“to secure sound and sustainable management of the financial affairs of municipalities and other institutions in the local sphere of government; to establish treasury norms and standards for the local sphere of government; and to provide for matters connected therewith* (Parliament, 2003). The Act regulates the procurement of goods and services at municipal level and, in accordance, provides for the development and implementation of a supply chain management policy by all municipalities and municipal entities to give effect to the requirements of the Act (Parliament, 2003). The MFMA also regulates local government PPPs in a process similar to national and provincial levels.

2.2.2.2 Municipal Supply Chain Management Regulations

The Municipal Supply Chain Management (SCM) Regulations were introduced by National Treasury in 2005 (Treasury, 2005). The regulations were published under the MFMA to specifically address local government procurement. Thus, an SCM function was instituted as part of financial management across local governments to promote coherence in the interpretation of procurement legislation by government units and to guide accounting officers/authorities in the implementation of compliant public procurement (Treasury, 2005). SCM regulations are also subject to Section 217 of the Constitution which necessitate that, among other requirements, procurement activity must be competitive at all levels of government. An exception to the principle of competitive procurement is made for cases where only a single supplier of a good or service is known, i.e. a *sole supplier*. Therefore, a municipality can circumvent standard procurement procedure to enter into a contract with a supplier proven as the only one able to provide a specific product or service. This provides an opportunity for suppliers of innovation to be considered for contract awards. Further to this, National

Treasury Practice Note 11 of 2008/2009 makes provision for suppliers to approach local governments with unsolicited bids which fall outside the scope of normal procurement processes (Treasury, 2008). The Practice Note expresses explicit support for innovation procurement as it defines an unsolicited bid as a “submission that must be innovative, unique and provided by a sole supplier”. Government organs may reject or accept unsolicited offers as they deem necessary, however acceptance must be based on the following criteria:

- (a) a comprehensive and relevant project feasibility study has established a clear business case; and
- (b) the product or service involves an innovative design; or
- (c) the product or service involves an innovative approach to project development and management; or
- (d) the product or service presents a new and cost-effective method of service delivery.

2.2.2.3 Contract Award Procedure

The standard obligation for awarding contracts is to procure products and services in a manner compliant to the principles of fairness, equitability, transparency, competitiveness, and cost-effectiveness as prescribed by Section 217 of the Constitution. To meet the requirements of transparency and competitiveness, a Request for Proposals (RFP) process (also known as the public tender process) is advertised in the Government Tender Bulletin and other public platforms for a specified period (Treasury, 2010). The RFP outlines a specification under which suppliers are requested to bid, as well as other relevant information such as the contact details of the institution calling for bids, the place to deliver bids, etc. For purchasing in the range R2 000 to R200 000, a municipality can contract upon receipt of three or more price quotes from interested suppliers and procurement above the value of R200 000 is advertised for tender. Alternatively, a municipality can issue an Expression of Interest (EOI) in the early stages of the procurement process when potential solutions to meet a specific need are not known (Treasury, 2010). Through the EOI approach, the municipality scans the market for available potential suppliers or seeks industry input into technical specification requirements to be advertised for competitive bidding in the

future. Procurers are exempted from the prescribed competitive process in two circumstances already listed above, namely i) the sole supplier and ii) unsolicited bid conditions.

All specifications must adhere to the demand management requirements listed under Regulation 10 of the Municipal SCM Regulations, which mandates an SCM policy to provide for an effective demand management system to ensure that the needs of the municipality are adequately satisfied through a procurement process (Treasury, 2005).

Evaluation of proposals occurs under a three-stage criteria where submissions are assessed for formal compliance with tender requirements, followed by evaluation on the basis of functionality or technical specifications, and concluded by evaluation on the basis of cost. At the end of the evaluation process, a bid is awarded to the supplier that scores the highest on the criteria (Treasury, 2010).

2.2.3 Challenges to Public Procurement in South Africa

While the legislative framework may be extensive and appear arguably progressive in theory, procurement practice faces many challenges in South Africa. Ambe and Badenhorst-Weiss (2012) describe the single greatest of these challenges as lack of skills and capacity of public procurement personnel, which has remained a persistent barrier since the introduction of the reformed legislation. In agreement, Migiro and Ambe (2008) postulate that while many SCM officials in the South African public sector have participated in several training initiatives, there is still a wide gap in proper implementation of SCM guidelines across government spheres. The second challenge is listed as non-compliance with policies and regulations which includes a tendency to bypass the requirement for competitive bidding without sound motivation, lack of appropriate committees to evaluate bids, poor controls for the handling of proposals, and others (Ambe & Badenhorst-Weiss, 2012).

Further restraints to successful public procurement include inadequate planning and failing to link demand to available resources wherein specialists fail to draw up accurate strategic plans to meet needs, which results in ineffective use of limited resources. In addition, corruption, lack of accountability of procurement officials, inadequate audit measures and too much decentralisation of the procurement system

are listed also among challenges to successful public procurement in the South African environment (Ambe & Badenhorst-Weiss, 2012; Migiroy & Ambe, 2008). It is submitted that due to the nature of innovation, these challenges may amplify for innovation procurement.

2.2.4 Rationale for Public Procurement of Innovation in South Africa

Government policy interest in innovation-friendly public procurement was first articulated in the Ten-Year Innovation Plan in which public procurement was acknowledged as a tool to spur innovation activity:

“The government recognizes the potential to make use of procurement to stimulate technological innovation. The challenge is to develop a public procurement regulatory framework that supports local innovations, including SMMEs and technology start-ups” (DST, 2007).

In corroboration, the 2014 Industrial Policy Action Plan (IPAP) states that *supporting and strengthening small and emerging enterprises; encouraging the commercialisation of new products and services; and fostering a sustainable green economy* must be integrated into public procurement policy and procedures (DTI, 2014). In the updated IPAP (2017/18-2019/20), public procurement is listed as one of six transversal focus areas for industrial growth and development, along with developmental trade policy, industrial financing, innovation and technology, and others (DTI, 2017). The newly articulated industrial plan recognizes government expenditure as a tool which can be leveraged to enhance local manufacturing and capability and to develop diversified suppliers along value chains (DTI, 2017).

However, very limited latitude is provided for procurement to drive innovation in the present regime (Bolton, 2016b). The unsolicited bid approach is currently the only portion of the legislative framework that explicitly articulates support for the use of procurement to stimulate innovation. However, albeit passively, other parts of the legislation also provide scope for innovation procurement. While correcting past injustices may be interpreted as the underlying objective of Section 217(2)(a) of the Constitution, the broader interpretation of ‘*categories of preference*’ can include also the procurement of new-to-market goods and services as ‘*specific goals*’ pursued by

government organs (Bolton, 2016a). Further to this, section 5 of the PPPFA makes provision for the Minister of Finance to “make regulations regarding any matter that maybe necessary or expedient to prescribe in order to achieve the objects of this Act”. Thus, authority also rests on the Minister of Finance to influence innovation-friendly procurement practice. The Constitution therefore arguably provides scope for procurers to target innovation as a desired output in tender specifications. Innovation generated by the South African water and sanitation sector, detailed next, has the potential to contribute significantly to the country’s socioeconomic progress, and can be enabled by a favourable procurement system.

2.3 INNOVATION IN THE SOUTH AFRICAN WATER AND SANITATION SECTOR

South Africa’s contribution to published water research is ranked 19th in the world (Pouris, 2013). This is corroborated by growth in the number of water and sanitation publications – from below 60 in 1981 to above 200 in 2014 (Pouris, 2015). This wealth of research is constantly being translated into innovative solutions to address water and sanitation challenges. The sanitation and water patent landscape, which indicates inventive activity by the sector, shows not only that 46 patents were granted to applicants by the United States Patent Office (USPTO) between 2000 and 2014, but also that South Africa had a relatively high water patents to total patents ratio (3.39%) when compared to BRICS countries such as Russia (2.55%), India (1.21%) and China (1.28%), surpassed only by Brazil with a ratio of 4.13% (Pouris, 2015).

To increase the rate of development and dissemination of inventions to the broader South African society, funding for water-related research has risen significantly in recent years, with contributions from both government and the private sector having increased from about R50-million in 2000 to R240-million in 2014 (Pouris, 2015). The principal funder of water research and development in the country is the Water Research Commission (WRC), which funded over 65% of research projects in the sector in 2014, followed by the Council for Scientific and Industrial Research (CSIR), Mintek, and the National Research Foundation (NRF), with contributions of 16%, 9% and 8% respectively (Pouris, 2015). The WRC is therefore one of the key actors driving the water and sanitation sectoral innovation system in South Africa. Other participants involved in the sectoral innovation system include institutions of higher learning,

science councils, firms, innovation support programmes, funding agencies, regulatory bodies such as the Department of Water and Sanitation (DWS), Department of Science and Technology (DST), and others represented in Figure 3 below.

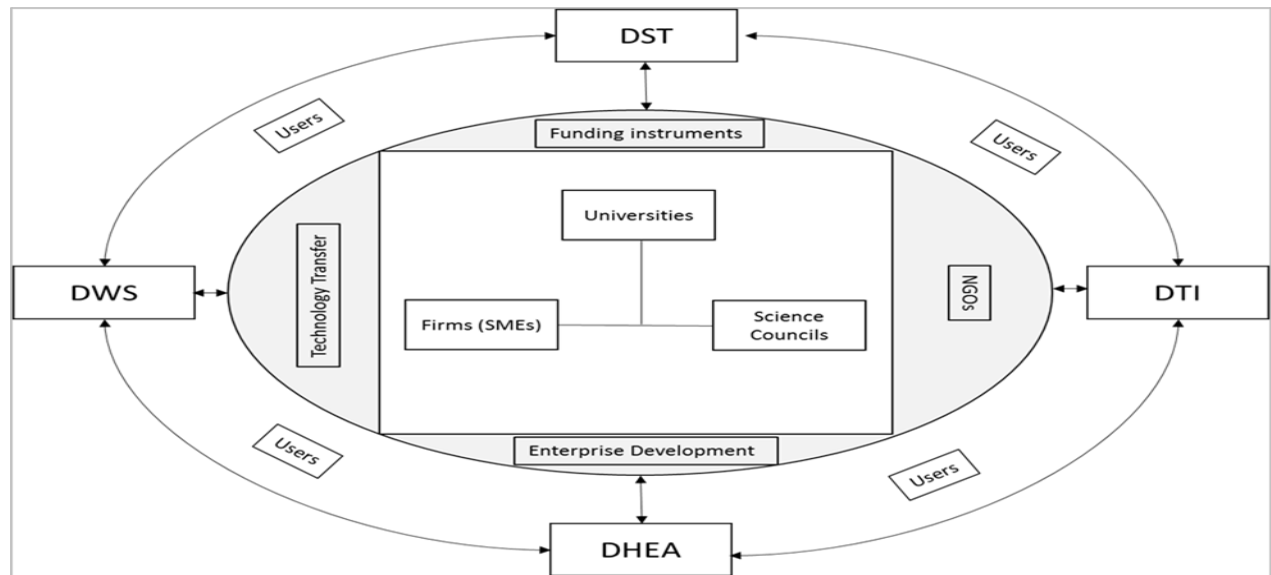


Figure 3: The Sectoral Innovation System of the South African Water and Sanitation Sector. *Adapted from Tallin University of Technology*

The WRC was established under an Act of Parliament to mitigate against mismanagement and threats on water resources through research and development (WRC, 2018b). The mandate of the Commission includes establishing and communicating the country's water research priorities, dispensing funding for water research aimed at addressing priority needs, stimulating effective technology and information transfer, as well as promoting collaboration in water research and development (WRC, 2018b). Additionally, the DST, which frames science and innovation policy in the country, has partnered with the DWS and the WRC in establishing and implementing the National Water Research, Development and Innovation (RDI) Roadmap (WRC, 2018a) which *"facilitates and guides refocusing of research, reprioritisation of funds, synergising of existing initiatives and ring-fencing of new resources to facilitate a more optimal water innovation system"* (WRC, DST, & DWS, 2015). Other innovation support programmes in the sector include the Water Technologies Demonstration Programme and the South African Sanitation Technology Evaluation Programme. The three programmes are described in detail below.

2.3.1 The National Water RDI Roadmap 2015-2025

The National Water RDI Roadmap aims to align water RDI activity with national policy objectives while positioning South Africa, among developing countries, as a vanguard in the development and diffusion of water RDI outputs (WRC *et al.*, 2015). The roadmap seeks to provide sustainable water and sanitation solutions through strategic direction, a set of operational plans, as well as an implementation guideline for planning, streamlining and management of the country's investment portfolio for the ten-year period in seven key identified clusters of water RDI activity, namely i) unlocking alternative sources of water, ii) governance, planning and management of supply, iii) governance, planning and management of demand, iv) improving adequacy and performance of built and ecological infrastructure, v) reducing losses and increasing efficiency of productive use, vi) financially sustainable business approaches for improving operational performance and vii) monitoring and metering (WRC *et al.*, 2015). Each of the seven clusters entails itemized, actionable tasks to guide the roadmap in contributing to the development and strengthening of local water RDI competency within and between actors in the water and sanitation innovation system, and thus expedite effective deployment of local technologies while growing the export capacity of local innovators (WRC *et al.*, 2015). Essentially, *the Roadmap is a high level planning tool that facilitates and guides refocusing of research, reprioritisation of funds, synergising of existing initiatives and ring-fencing of new resources in order to facilitate a more optimal water innovation system* (WRC *et al.*, 2015). Not only does the RDI Roadmap present the opportunity for collaborative interaction between sectoral actors to address water and sanitation challenges, it also supports increasing the technological capacity of (small) firms in the sector.

Figure 4 presents the returns anticipated to result from RDI investment (WRC *et al.*, 2015):

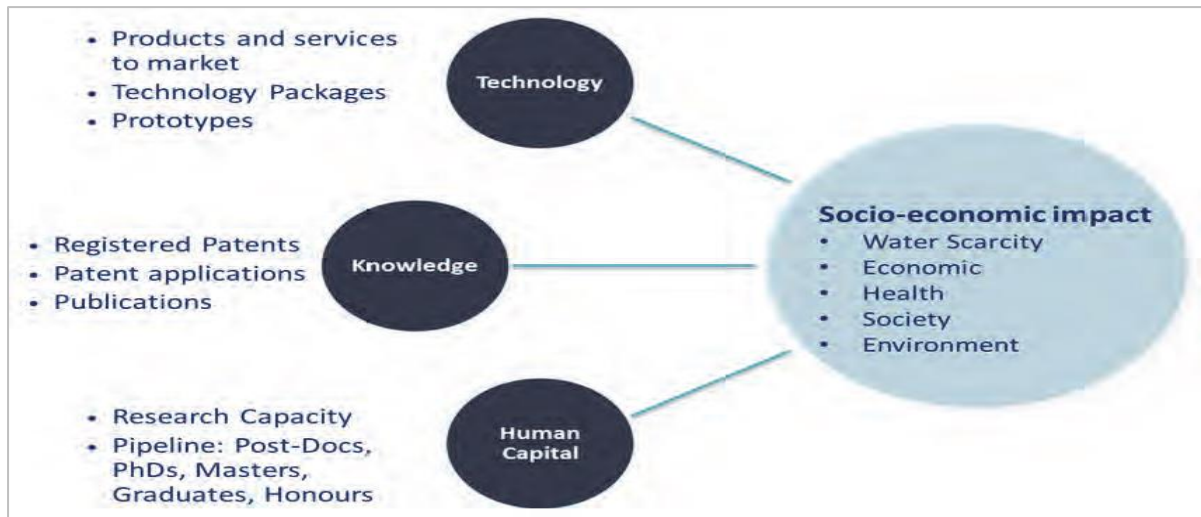


Figure 4: Projected RDI investment returns

2.3.2 The Water Technologies Demonstration Programme

The Water Technologies Demonstration Programme (WADER) was established by the Department of Science and Technology in partnership with the WRC to bridge the gap between the R&D and pre-commercialisation phases of the water innovation process (WADER, 2017). This is executed through the facilitation of technology demonstrations in collaboration with public and private partners. The programme thus promotes the adoption of prospective technologies by municipalities and industries through marketing technologies that have been assessed and validated in commercial environments. Water and sanitation technologies are selected, evaluated and showcased to target markets through a competitive open call process (WADER, 2017). Technologies supported by WADER include the DEWdrop, a decentralised wastewater treatment system with a modular design that enables harvesting and re-use of greywater, the Passive Sampler which selectively targets and recovers semi-precious and precious metals from mine waste waters and the WEROP (Wave Energy Reverse Osmosis Pump) which uses wave energy to pump seawater for desalination, and others (WADER, 2017).

2.3.3 The South African Sanitation Technology Enterprise Programme

The South African Sanitation Technology Evaluation Programme (SASTEP) is a collaborative initiative funded by the Bill and Melinda Gates Foundation (BMGF) and the Department of Science and Technology, with the WRC as a programme implementation and support services partner (WRC, 2019). The objective of the

programme is to *“foster a local sanitation industry (manufacturing and services) that would increase access to proper sanitation, reduce pollution, improve water security, create jobs and entrepreneurial opportunities and contribute to the country’s GDP”* (WRC, 2019). The SASTEP intends to achieve this by supporting and accelerating the uptake of new, alternative sanitation solutions through field testing, demonstration, technology assessments and validation towards localisation and industrialisation (WRC, 2019). Sanitation solutions supported under the programme include innovative off-grid sanitation front-end solutions that require little or no water for flushing, urine diversion technologies, off-grid faecal sludge treatment technologies, off-grid blackwater treatment technologies, innovative sanitary pad disposal systems, innovative off-grids sanitation solutions that produce beneficial product from sanitation waste, and others.

2.3.4 Innovative Water and Sanitation Technologies Developed in South Africa

In 2018, the African Centre for a Green Economy documented innovative water and sanitation technologies which have been developed in South Africa. The research, which revealed over 100 technologies developed locally over the past 20 years, mapped water technologies through an extensive literature review, case studies and face-to-face interviews with sectoral innovation system actors including innovators, researchers, entrepreneurs, funding agencies, etc. (ACGE, 2018). In addition, the study focused on solutions related to sanitation, water efficiency, water resource management, water quality and other priorities of the RDI Roadmap (ACGE, 2018).

Some technologies which have emerged to address sanitation related challenges include the Arumloo – a micro-flush toilet designed to flush with less water compared to conventional toilets, i.e. 1-2.5 litre per flush, the Pour-Flush toilet structure which is built without a cistern to allow the user to pour the flushing water while the pit is assembled at a distance to block harmful odour and prevent harmful hazards (ACGE, 2018). To improve access to potable drinking water in rural areas, the VulAmanz Microfiltration system was developed as a point-of-use water treatment solution for rural households dependent on water collected directly from rivers, dams, etc. (ACGE, 2018). Furthermore, the Aquatrip leak detection system improves water efficiency by tracking the flow of water in domestic and industrial properties and shutting off water supply in the event of a leak or pipe burst (ACGE, 2018). Several other technologies

have been developed in South Africa to increase access to adequate water and sanitation services. However, despite investment in these technologies to alleviate water and sanitation challenges, most have failed to reach implementation and deliver anticipated benefits (Roma, Buckley, Jefferson, & Jeffrey, 2010), hence this study sought to uncover the potential of public procurement to influence the adoption of water and sanitation technologies by municipalities .

2.4 LOCAL GOVERNMENT AS A MARKET FOR WATER AND SANITATION INNOVATION

Local governments have a constitutional obligation to ensure that adequate services are provided to their communities. Appropriately addressing community needs has however proven difficult for most South African municipalities (Buthelezi & Dollery, 2004). Due to rising populations and recent droughts, municipalities are grappling also with the challenge of providing water and sanitation services (Masindi & Duncker, 2016). Thus, to improve service delivery and achieve Goal 6 of the United Nations' Sustainable Development Goals: *increasing access to adequate water and sanitation by 2030*, a shift in technical performance has to be adopted by South African municipalities. A shift from traditional solutions toward new alternative solutions proven to be efficient in preserving water must be explored through partnerships with the private sector. This was corroborated by former Minister of Water and Sanitation, Ms Nomvula Mokonyane, in her address to attendees of the 2015 National Sanitation Indaba that “*we must introduce new technologies that appreciate that water is a scarce resource...*”. As such, municipalities have a significant role to play in creating markets for innovation.

2.5 THE LEGISLATIVE FRAMEWORK GOVERNING THE WATER AND SANITATION SECTOR

The water and sanitation sector is governed by the National Water Act (No. 36 of 1998), the Water Services Act (No. 108 of 1997) and the Water Research Act (No. 34 of 1971). The objective of the National Water Act is to ensure the protection, use, distribution, conservation and management of South Africa's water resources in a manner that takes into account factors such as; meeting the basic human needs of present and future generations, promoting equitable access to water, facilitating social and economic development, providing for growing demand for water use, and others

(DWS, 1998). The Water Services Act is to provide for *the rights of access to basic water supply and basic sanitation, the setting of national standards and of norms and standards for tariffs, water services development plans, a regulatory framework for water services institutions and water services intermediaries*, and others (DWS, 1997). The mandate of the Water Research Act is to provide for the promotion of research related to water and sanitation, to set up a Water Research Commission, and to address other matters in relation to water and sanitation research (DWS, 1971).

2.6 SUMMARY

South Africa has experienced aggravated water-scarcity challenges in recent years, with rising populations seeing the demand for water exceed supply. In addition, a significant proportion of the population is without access to adequate sanitation. Addressing these challenges requires a paradigm shift from traditional efforts towards innovation-driven solutions wherein the water and sanitation sectoral innovation system can participate by providing solutions and, by extension, contribute to developing the South African economy. As such, favourable environments for innovation activity must be created not only from a supply perspective but also from the demand side. This includes enacting and implementing policy instruments designed to create markets for innovation, one such instrument being public procurement. Hence, the role of public procurement as a stimulant for innovation has to be understood. In this respect, a qualitative approach was employed to investigate the role of public procurement as a driver of innovation demand in the South African water and sanitation sector.

2.7 CONCEPTUAL FRAMEWORK

The conceptual framework is developed from the work of Malerba and Orsenigo (1997), Edquist and Zabala-Iturriagagoitia (2012), Bolton (2016b), Wesseling and Edquist (2018) and others, and presents that the sectoral innovation system can enable public procurement to drive demand for innovative technologies in the sector. This can further result in increased supply of innovative solutions to municipalities, and, as a consequence, improved service delivery.

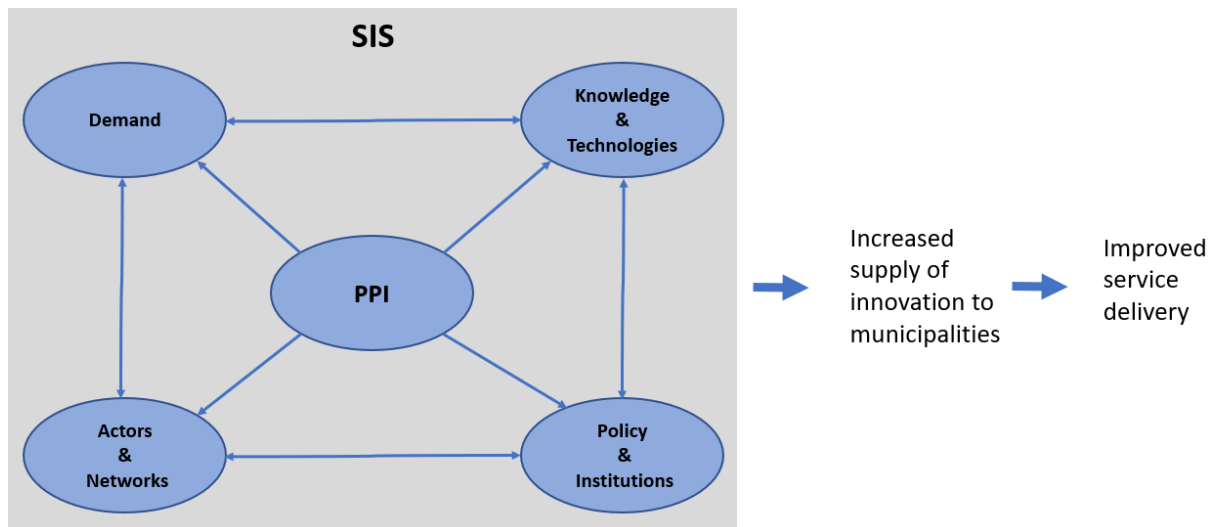


Figure 5: A conceptual framework for analysing the potential of PPI to drive innovation demand in the water and sanitation sector.

The framework is a synthesis of the literature to understand how the water and sanitation sectoral innovation system can influence innovation-friendly public procurement to increase innovation levels by creating launch markets for innovative suppliers in the sector and, as a consequence, improve services provided by municipalities. It presents the key elements of *sectoral innovation systems* theory to be studied according to the manner in which each informs PPI. Thus, the study investigates the behaviour of demand as a driver of PPI, the implementation of the knowledge and technology base developed by the sectoral innovation system through PPI, how the actors and networks of the sectoral innovation system enable PPI through various interactions, the influence of policy and institutions in the transfer of innovation to intended markets through PPI, and other relationships.

2.8 PROPOSITIONS

The following propositions were formulated in consonance with the research questions and accepted or rejected in accordance with the findings of the study:

RQ1: What is the role of public procurement in stimulating demand for innovation in the water and sanitation sector?

P1: Public procurement oriented toward innovation results in increased innovation activity in the water and sanitation sector as well as improved delivery of services by local municipalities.

According to the literature, public procurement is a demand-side instrument that can be utilized to prompt innovation activity to meet the needs of national and local governments by improving the provision of basic services, while creating launch markets for entrepreneurs (Lember et al., 2013). In countries such as Japan, the Netherlands, Germany and others, governments are employing innovation through public procurement to respond to societal needs (Vinnova, 2007).

RQ2: Does public procurement for new water solutions differ from public procurement for new sanitation solutions? If so, under what conditions?

P2: Public expenditure is oriented more toward new water-supply solutions compared to sanitation solutions therefore the public procurement process differs between the two services.

The General Household Survey (GHS) released by Statistics South Africa in 2018 revealed that access to water vs sanitation services was uneven in the country, with 89% of households reported to have access to drinking water while only 83% had access to improved sanitation (StatsSA, 2018). Therefore, due to disparate progress in the provision of water and sanitation services, it is expected that public procurement of water/sanitation innovation will be influenced by these factors.

RQ3: How might opportunities for innovation diffusion through public procurement be better seized and barriers overcome?

P3: Opportunities for innovation diffusion through public procurement can be enhanced through a redesign of public procurement legislative frameworks to support the procurement of new solutions.

Currently, legislation governing public procurement does not make explicit provision for innovation, neither are organs of state encouraged to purchase innovative goods and services (Bolton, 2016a). Thus, in order to fully support innovation, South Africa's public procurement regulatory regime requires reconfiguration.

CHAPTER 3 RESEARCH STRATEGY AND METHODOLOGY

3.1 INTRODUCTION

This chapter articulates the research strategy and methodology employed in carrying out the study in order to provide certainty that a fitting approach was followed in addressing the research questions. The key aspects outlined in the chapter include the research approach, the selection of participants, the data collection and analysis method, the limitations of the study, the ethical considerations as well as the approach followed to ascertain the reliability and validity of the research instrument.

3.2 RESEARCH STRATEGY AND DESIGN

3.2.1 The Research Strategy

Three common approaches to conducting research are identified in the literature, namely i) quantitative, ii) qualitative and iii) mixed-methods (Williams, 2007). The quantitative method follows a numeric and statistical approach in the collection and analysis of data and can be applied to investigate the relationships between variables within a study (Choy, 2014; Zawawi, 2007). The qualitative approach, which was selected to undertake this study, is defined by Astalin (2013) as “*a systematic scientific inquiry which seeks to build a holistic, largely narrative, description to inform the researcher’s understanding of a social or cultural phenomenon*” and is interpretivist and constructivist in nature. As the qualitative method is most suitable for collecting data which allows for understanding of concepts in broad detail (Atieno, 2009), it was most suitable for this study, given that the interaction of innovation with other phenomena is complex and requires detailed understanding (Inigo & Albareda, 2016; Noronha & Cesário, 2008). The mixed-methods paradigm involves an integration of both the quantitative and qualitative approach in the collection and analysis of data within a single study (R. B. Johnson, Onwuegbuzie, & Turner, 2007; Terrell, 2012).

3.2.2 The Research Design

The four main designs of qualitative research include ethnography, grounded theory, phenomenology, and the case study, which is employed by this study (Astalin, 2013). According to Baxter and Jack (2008), the qualitative case study design enables the researcher to examine the relationship between various phenomena and

individuals/organisations in-depth, as well as the development of theory, evaluation of existing programs and the structuring of interventions where necessary. As such, the case study approach was appropriate for this investigation to allow the researcher to examine the relationships between the water and sanitation sectoral innovation system and the South African public procurement system in depth. The design may concentrate on a single case or on comparing two or more cases within and across contexts, i.e. the comparative case study. Comparative case studies are suitable when seeking to comprehend the influence of programmes and/or policies on specific contexts and may contribute to developing interventions to support the accomplishment of targeted outcomes (Goodrick, 2014). While this research did not explicitly undertake a comparative case study analysis, contrasts were nevertheless drawn from the findings in the two cases of two metropolitan municipalities studied to understand the role of public procurement as a stimulant for water and sanitation innovation from the perspective of each municipality. Also, the research sought to explore similarities and differences between water-supply and sanitation services, particularly in the context of public procurement.

3.3 SELECTION OF PARTICIPANTS

3.3.1 The Purposive Technique

The selection of participants was undertaken by the purposive sampling technique, a non-probability form of sampling in which the participants are selected strategically such that they are appropriate for the research questions being posed (Bryman & Alan, 2012). Thus, all potential participants and informants were selected according to their high degree of knowledge and expertise in the fields of innovation and public procurement (Etikan, Musa, & Alkassim, 2016; Tongco, 2007). This was fitting due to the exploratory nature of the research as well as the short time frame allocated for a master's research project.

3.3.2 The Selection Criteria

According to Robinson (2014), the selection of cases and participants who are suitable to provide reliable information is a crucial step to a qualitative study. In due manner, two municipalities were selected for the study – eThekweni and City of Tshwane. The two municipalities were selected due to their role as Water Services Authorities as

prescribed by the Water Services Act 108 of 1997, i.e. these municipalities are the authorities responsible for the provision of water supply and sanitation services to citizens within their boundaries. As such, the municipalities are allocated financial resources to make decisions on suitable approaches for providing water and sanitation services. Metropolitan municipalities were targeted over district/local municipalities as they are better capacitated compared to the latter (Magagula, Mukonza, Manyaka, & Moeti, 2019), and would enable the researcher to sufficiently address the research questions. Six (6) and four (4) relevant officials from eThekweni and City of Tshwane respectively were interviewed as primary sources of data (participants). While an invitation was sent out to an equal number of potential participants from both municipalities, responses were only received from six and four respondents from eThekweni and City of Tshwane, respectively, a disparity which was beyond the control of the researcher. The participants were perceived to possess useful insights due to their experience and involvement in public procurement and water/sanitation innovation activities in their respective municipalities. The majority of the participants arguably had a high level of experience in their roles (described in Chapter 4), while others were relatively new in their employment positions. The same was true for the informants.

Three sets of key informants were interviewed as follows: four managers of innovation support programmes in the water and sanitation sector, two managers of firms which have developed novel water/sanitation solutions for municipalities and one public procurement policy specialist. Similarly, the informants were respectively selected in their described roles due to their involvement in the development of new water and sanitation solutions for the municipal market, among others, as well as their experience and expertise in public procurement policy.

3.4 DATA COLLECTION

The study employed interviews as a qualitative data collection method as they allow the researcher to collect in-depth information and better explore and understand the views and experiences of the participants through open-ended questions (Stuckey, 2013). In particular, the data was collected using semi-structured interviews, which can be described as a qualitative data collection method that combines a list of prepared questions, i.e. an interview guide, with flexibility in how the interviewee

responds and opportunity for some aspects to be explored in more detail by both the interviewer and the interviewee (Longhurst, 2003). Other commonly used types of interviews include the *structured interview* during which the researcher asks respondents a specific set of pre-planned questions in the same order, as well as the *narrative interview* in which the researcher uses open-ended questions to probe the participant's story rather than answers to specific questions (Stuckey, 2013). While they may be time consuming and resource intensive, semi-structured interviews are useful in examining an uncharted territory where the researcher may prefer to ask probing open-ended questions to afford respondents the latitude to gauge their independent thoughts (Newcomer, Hatry, & Wholey, 2015). In addition, the researcher can ask follow-up questions and is provided with the opportunity to clarify questions in the interview guide (Low, 2013). In this respect, the semi-structured interview approach was followed due to the researcher's interest in asking a specific set of prepared questions while also allowing the respondents the flexibility to express their own views in their own words. Interview guides with questions relevant to the research questions were developed for conducting face-to-face interviews with municipal officials as participants, as well as innovation programme managers, innovators and procurement policy specialists as key informants.

All interviews were conducted by the researcher based on three research questions:

- What is the role of public procurement in stimulating demand for innovation in the water and sanitation sector?
- Does public procurement for water technologies differ from public procurement for sanitation technologies? If so, under what conditions?
- How might opportunities for innovation diffusion through public procurement be better seized and barriers overcome?

Four guides were used for the interviews, each for municipal officials, managers of innovation support programmes, firms and the procurement legislation specialist respectively, as indicated in Appendices A, B, C and D. For each of the four guides, the first few questions were to understand the interviewee's expertise and their level of experience, while the rest of the questions focussed on detailed aspects of the interview protocol relating to public procurement and innovation in the water and sanitation sector.

3.4.1 Data Collection Procedure

The data collection process began with conducting interviews with municipal officials as primary sources of data, followed by managers of innovation support programmes, managers of firms, as well as procurement specialists as key informants. Secondary sources of data were used for further information where required. The process was as follows:

3.4.1.1 Pre-interview preparation

Preparation for interviews commenced with requesting formal permission to conduct the research from participants and informants. Upon issue of permission, the relevant officials were contacted telephonically to confirm consent and availability for face-to-face meetings. Subsequently, interviews were scheduled to take place in the offices of officials. For each interview, necessary resources were carefully calculated and set aside.

3.4.1.2 The interview process

The interviews were conducted according to the six guidelines set out by Rabionet (2011): i) selecting the type of interview, ii) establishing ethical guidelines, iii) crafting the interview protocol, iv) conducting and recording the interview, v) crafting the interview protocol, and vi) reporting the findings. All interview guides were tested in the preliminary stages of data collection to ascertain the efficacy of the questions and changes were made where necessary. During each interview, the researcher explained the objectives of the study to the participant and requested that a confidentiality agreement be signed in order to provide assurance that the identities of respondents would not be disclosed to the public. The interviews were audio recorded with the permission of participants, and concluded with the researcher extending appreciation to the participants and promising to share the complete research findings.

3.4.2 Population / Sample:

Participants: eThekweni and City of Tshwane municipalities

Informants (SIS Actors): Innovation support programmes, firms, procurement legislation institution

3.5 DATA ANALYSIS

Interpretivism, which focuses on how participants in a given context make sense of a social phenomenon (Roth & Mehta, 2002), was used to analyse data collected from the study. The analysis and interpretation process was very intensive and required constant update as new insights emerged to contribute to existing literature. A technique described by Ritchie and Spencer (1994), cited by Arksey and O'Malley (2005), for synthesizing qualitative data was used to categorize data according to key themes. The five-step framework which comprises familiarisation, identifying a thematic framework, indexing, charting and mapping and interpretation was applied as outlined below:

3.5.1 Familiarisation

Interview transcripts were read repetitively and thoroughly for immersion in the comprehensive data. This allowed for sorting of the data according to recurrent themes and matching ideas.

3.5.2 Identifying a Thematic Framework

Themes and ideas were guided by the conceptual framework developed from the literature review, therefore arising themes were categorised according to the pre-defined elements of the conceptual framework.

3.5.3 Indexing

The conceptual framework was used to assign codes to the data (words, phrases, sentences, paragraphs). The coded and categorized data were then displayed using charts and tables.

3.5.4 Charting

The charting process involved reorganising data in line with the themes developed from the literature review and summarised in the conceptual framework. Data was orderly presented using charts or tables according to the sequence of the participants and informants as laid out in 4.2 (demographic profiles of participants).

3.5.5 Mapping and Interpretation

The mapping process involved analysing the data for patterns and linkages to the literature review. The interpretation was carried out in the form of a discussion of the research findings in respect to the literature review. This process, according to (Miles & Huberman, 1994) “provides the link between data and conceptualisation”.

3.6 ETHICAL CONSIDERATIONS

As advised by (Bryman, 2007), the following ethical standards were considered:

- i. Research participants were not put in harmful situations in any ways
- ii. Research participants were handled with utmost dignity
- iii. Consent was sought from the participants (and informants) before the questionnaires were rolled-out
- iv. The identities of the participants were kept confidential in the report
- v. Information shared by respondents was adequately held in confidentiality
- vi. The objectives of the research were articulated without deception or exaggeration
- vii. The research was carried out in honesty and transparency
- viii. Data findings were represented honestly and objectively

3.7 RELIABILITY AND VALIDITY

The reliability and validity of the research instrument were assessed through respondent validation, i.e. the account of findings were fed back to each respondent to confirm that the deductions were in corroboration with the views of the respondents (Bryman & Alan, 2012). During this process, areas of incongruence were sought out and addressed accordingly.

CHAPTER 4 PRESENTATION OF DATA

4.1 INTRODUCTION

The previous chapter described the methods used to collect and analyse data in exploring the main research question: *What is the role of public procurement in stimulating demand for innovation in the water and sanitation sector?* This chapter presents the data collected from interviewing officials from two municipalities, managers of innovation support programmes, managers of firms, and a procurement legislation specialist. The presentation is split into the demographic profile of participants and the detailed data.

4.2 DEMOGRAPHIC PROFILE OF PARTICIPANTS

In total, seventeen interviews were conducted with the following respondents: ten (10) municipal officials as participants (six from eThekweni, four from City of Tshwane), and four (4) managers of innovation support programmes, two (2) managers of firms and one (1) procurement legislation specialist as informants.

4.2.1 Participants: eThekweni Officials

A short description of the profiles of participants from eThekweni, indicated as “eTh1 to eTh6” is presented in Table 1 below. The respondents differed in expertise and level of experience, and were drawn from the units: procurement, service delivery support, research & innovation, commercial and business, strategic executive and capital projects. The diverse profile of business activities was selected to establish the trustworthiness of the data.

Table 1: Profiles of six officials from eThekweni

No.	Code	Business Activity	Level of Experience in Current Role
1	eTh1	Procurement / Supply Chain Management	11 years
2	eTh2	Service Delivery Support	20 years
3	eTh3	Research & Innovation	5.5 years
4	eTh4	Commercial and Business	22 years
5	eTh5	Strategic Executive	10 years

6	eTh6	Capital Projects	2.5 years
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4.2.2 Participants: City of Tshwane Officials

The profiles of participants from the City of Tshwane, labelled as “CoT1 to CoT4” are summarised in Table 2. The interviewees’ experience spanned across project management, supply chain management, as well as innovation services. The diversity in expertise was selected for broader insight and to ensure the credibility of the information collected.

Table 2: Profiles of four officials from City of Tshwane

No.	Code	Business Activity	Level of Experience in Current Role
1	CoT1	Bulk Water & Sanitation Project Management	7 years
2	CoT2	Supply Chain Management	8 years
3	CoT3	Supply Chain Management	2 years
4	CoT4	Innovation Services	5 years

4.2.3 Key Informants A: Managers of Innovation Support Programmes

Four managers of innovation support programmes in the water and sanitation sector were interviewed as the first set of key informants, labelled KIA1 to KIA4. The various areas of innovation support these managers are involved in include business development, sanitation technology development, water research and innovation, and partnership development. All four managers engage with innovators in developing new solutions for various markets, including municipalities, and thus have insights on innovation in the sector. A summary of the managers’ demographic profiles is presented in Table 3 below.

Table 3: Profiles of four innovation-support programme managers in the water and sanitation sector

No.	Code	Business Activity	Management Level	Level of Experience in Current Role
1	KIA1	Business Development & Innovation	Executive manager	4 years
2	KIA2	Sanitation Innovation Support	Senior Manager	9 months

3	KIA3	Water Research, Development and Innovation Support	Senior Manager	3.5 years
4	KIA4	Partnership Development	Senior Manager	3.5 years

4.2.4 Key Informants B: Managers of Firms in the Water and Sanitation Sector

The managers of two firms in the water and sanitation sector were interviewed as the second set of key informants, indicated as KIB1 and KIB2. The firms have developed novel sanitation-supply and water treatment solutions respectively and have approached both eThekweni and City of Tshwane municipalities as target markets for their innovative solutions. Their profiles are provided in the summary below:

Table 4: Profiles of two managers of firms in the water and sanitation sector

No.	Code	Focus Area	Management Level	Firm age
1	KIB1	Sanitation technology	Chief Executive	6 years
2	KIB2	Water treatment technology	Chief Executive	19 years

4.2.5 Key Informant C: Public Procurement Legislation Specialist

A legislation specialist from a public procurement regulatory authority was interviewed as the third set of informants, labelled as KIC1. The regulatory authority guides the roll-out and implementation of procurement activities by municipalities.

Table 5: Profile of a public procurement legislation specialist

No.	Code	Business Activity	Management Level	Level of Experience in Current Role
1	KIC1	Supply Chain Management	Senior Management	6 years

4.3 PRESENTATION OF RESULTS

This chapter presents data collected from seventeen semi-structured interviews. The data is categorised according to four main elements which, according to the literature review, drive the water and sanitation system of innovation, namely i) demand, ii) knowledge & technologies, iii) actors & networks, as well as iv) policy & institutions.

Findings from the interviews of the primary sources of data (municipal officials) are presented first, followed by results from interviews with the three sets of key informants.

4.3.1 Demand

The participants were requested to comment on what they perceive as the main water and/or sanitation needs of their local municipalities. In addition, the perceptions of informants on the needs of municipalities were gaged. According to the literature, demand drives the activities of innovating agents as well as the orientation of public procurement. The responses of municipal officials, innovation support programme managers, firm managers and public procurement specialists are presented respectively.

4.3.1.1 eThekwini needs

Participants from eThekwini indicated that the needs of the municipality include providing unserved households with basic water and sanitation services in light of water resource constraints, renewed infrastructure to service growing populations, low cost sludge treatment methods for safe disposal of faecal waste, and others. The verbatim statements of some of the participants are articulated below:

eTh1: “The main need is addressing sanitation backlogs using innovative technologies which use less water”

eTh2: “The municipality must work out how to manage the growing demand for services due to a high influx of people from other regions”

eTh3: “From a water perspective, the need is to ensure that the municipality provides safe drinking water to citizens. When it comes to sanitation, the need is addressing backlogs, especially for rural and informal citizens”

eTh4: “Low-water sanitation currently being considered promises to provide some sort of relief on water resources but in the interim while the tech is still in the development pipeline, the municipality needs to provide sanitation services. Also, communities are generally not happy about

this low-water sanitation. The real challenge is getting the buy-in of communities for new solutions"

eTh5: "Through increased migration there's a lot of stress and demand for more supply and the municipality is constrained by water resource availability. We also have to look at how to prepare for future water demand and security given recent droughts so alternative water and sanitation technologies become very important because solutions have to factor in the water constraints that the country is facing"

eTh6: "The municipality inherited old water and sanitation infrastructure which was designed to service only a few citizens in the previous political dispensation. The old infrastructure has to be maintained and in some cases renewed in order to ensure quality service delivery. Also, the municipality needs an asset management plan since it's been growing rapidly in recent years"

The responses of eThekwini participants are summarised below:

Table 6: *The responses of eThekwini participants on the water and sanitation needs of the municipality*

Demand					
eThekwini participant	Addressing sanitation backlogs using innovative technologies	Safe drinking water for current and future demand	Management of growing demand for services	New water and sanitation infrastructure	Asset management plan
eTh1	X				
eTh2			X		
eTh3	X	X			
eTh4	X				
eTh5	X	X			
eTh6				X	X

When asked if they perceived demand to be higher for water-supply compared to sanitation supply or vice-versa, eThekwini officials responded as follows:

eTh1: *“Demand is the same because often the two are viewed as a bundle”*

eTh2: *“I would say demand is higher for sanitation because over 95% of residents have access to potable water in the form of either individual household supply or shared community supply, while about 16% of the municipality’s population lack access to basic sanitation”*

eTh3: *“Demand is the same for both because water and sanitation services are provided as a package, especially in rural and informal settlements”*

eTh4: *“There is more demand for water due to recent droughts”*

eTh5: *“There is a greater demand for water services because people tend to gravitate toward ensuring that they have water. If water is provided, sanitation becomes the next important requirement for households. Water generally leads the way in terms of demand”*

eTh6: *“They are both of equal weighting because the two services are complementary, when rolling out water infrastructure, sanitation must be facilitated and vice versa”*

Table 7 provides a summary of the responses:

Table 7: Perceptions of eThekweni on relative demand for water vs sanitation

eThekwini participant	Demand is higher for water-supply	Demand is higher for sanitation-supply	Demand is the same for both water and sanitation-supply
eTh1			X
eTh2		X	
eTh3			X
eTh4	X		
eTh5	X		
eTh6			X

4.3.1.2 City of Tshwane needs

Participants from City of Tshwane indicated that the main needs of the municipality are the provision of sanitation and running water using new infrastructure and 'transformative solutions' to ensure adequate supply. Some of the statements are captured below:

CoT1: "The municipality needs bulk water and sanitation supply as well as working infrastructure"

CoT2: "Since the end of the apartheid dispensation people are no longer managed by the Group Areas Act and are free to move anywhere for greener pastures. Because of this, the municipality experiences an increase in labour migrants which leads to high volumes of informal settlements for which running water and toilet structures must be built"

CoT3: "The infrastructure is old and ailing and must be renewed. Some can be maintained but the bulk of it has to be completely renewed, otherwise service delivery will not improve"

CoT4: "We need transformative solutions to tackle service delivery in the wake of water scarcity. We cannot continue to use the same toilet that flushes with eight litres of water when we can flush with four litres instead"

Table 8 summarises the responses of City of Tshwane participants:

Table 8: *The responses of City of Tshwane participants on the water and sanitation needs of the municipality*

City of Tshwane	Demand		
	Bulk water and sanitation supply	New water and sanitation infrastructure	Transformative sanitation solutions
CoT1	X	X	
CoT2	X	X	
CoT3		X	
CoT4		X	X

When asked if they perceived demand to be higher for water supply compared to sanitation supply or vice-versa, City of Tshwane officials responded as follows:

CoT1: “The demand is the same. Normally when you have community protests, the community members will say “we want water and sanitation”, so the demand is equal in my opinion”

CoT2: “I think the two are inseparable. So when there is a need for water, there will end up being a need for sanitation”

CoT3: “The need is for water mostly because usually people can make a plan for sanitation, especially in informal settlements, but water can’t be replaced by anything so the need is mostly water”

CoT4: “You can’t look at the one separate from the other. They are both needed equally”

The responses are summarized below:

Table 9: Perceptions of Tshwane on relative demand of water vs sanitation

City of Tshwane participant	Demand is higher for water-supply	Demand is higher for sanitation-supply	Demand is the same for both water and sanitation-supply
CoT1			X
CoT2			X
CoT3	X		
CoT4			X

4.3.1.3 *The needs of municipalities as perceived by innovation support programme managers*

Managers of innovation support programmes (key informants A) articulated the needs of municipalities as new alternative water and sanitation supply solutions, skills and capacity development, proper revenue collection models and policy review to guide the implementation of new solutions. Captured below are some of the verbatim statements of the informants:

KIA1: "Municipality needs to include new and alternative water supply options at bulk and decentralised levels, as well as new innovative sanitation technologies for all levels of scale (centralised, decentralised, on-site (off-grid) systems. But this must be coupled with policy review and advice on barriers to implementation. Also, guidance on emerging water quality issues that affect health and the environment and the types of technologies that can treat different contaminants of emerging concern are a major requirement"

KIA2: "There is limited awareness on the role that new innovation can play in building solutions to municipalities. Tried and tested solutions are being used on repeat rather than introducing new innovations. So I would say creating that kind of awareness is definitely a big need"

KIA3: "Municipalities need more options in the technology toolbox, i.e. innovative technologies and solutions to meet new needs and demands especially given the issue of droughts, climate change and sustainability. Also, skills and capacity development in technical, commercial, strategic and leadership areas, as well as an alignment of policy, vision and the workforce to deliver water and sanitation services fit for the 21st century"

KIA4: "An innovative revenue collection model is a major need for municipalities. As it stands, revenue collection is a major hindrance to the supply of water, provision of sanitation and operation and maintenance due to low collection and unwillingness to pay by communities"

The responses of Key Informants A are summarized in Table 10 below.

Table 10: Responses of key informants A on water and sanitation needs of municipalities

Key Informants A	Demand						
	New water and sanitation solutions	Awareness on the potential of innovation to provide solutions	Skills and capacity development	Policy alignment for the delivery of new solutions	Innovative revenue collection models	Infrastructure maintenance	Climate-resilient long term planning
KIA1	X		X	X	X		
KIA2	X		X	X			
KIA3	X	X		X	X	X	X
KIA4	X		X	X	X	X	

The managers of innovation support programmes viewed the relative water vs sanitation demand of municipalities as follows:

KIA1: “In the urban centre, informal settlements provide a major problem for both water supply and sanitation as both needs to be provided off-grid but sanitation is probably the bigger problem in informal settlements of cities. In municipalities that have limited engineering capability, supply of water to their communities is from smaller water treatment plants so they have major challenges on water quality and supply to communities water to their communities is from smaller water treatment plants so they have major challenges on water quality and supply to communities”

KIA2: “Water and sanitation are interlinked, hence the need for one cannot supersede the other. Proper and adequate sanitation results in better water quality and adequate water supply is necessary to manage our current waterborne sanitation paradigm”

KIA3: “It depends on the specific municipality you are focusing on, challenges will differ”

KIA4: “Sanitation in itself is a water user so because of that I would say water is of higher demand”

The responses are summarised below:

Table 11: *Perceptions of key informants A on relative demand for water vs sanitation*

City of Tshwane participant	Demand is higher for water supply	Demand is higher for sanitation-supply	Demand is the same for both water and sanitation-supply	It depends on the municipality
KIA1	X	X		
KIA2			X	
KIA3				X
KIA4	X			

4.3.1.4 *The needs of municipalities as perceived by firms*

According to managers of firms in the water and sanitation sector (key informants B), the main needs of municipalities include new water treatment and waste disposal solutions. This is reflected in the verbatim statements of the two respondents:

KIB1: “From my view, the current waste disposal methods are an issue and are not sustainable. I believe that municipalities need solutions that can conduct on-site sanitation treatment, packaged plants and on-site water treatment”

KIB2: “The main need is clean water for rural areas. If municipalities can start providing decentralised water treatment solutions to single households, that would have a very high impact on the health and general well-being of rural citizens”

KIB1 perceived demand to be higher for sanitation than water supply, while KIB2 viewed water as of higher need when compared to sanitation.

4.3.1.5 *The needs of municipalities as perceived by a public procurement legislation specialist*

According to the procurement legislation specialist interviewed, the main needs of municipalities are skills and capacity development, and both water and sanitation are of equal need.

KIC1: “In my opinion, skills and capacity development are the number one needs of municipalities”

KIC1: “I think about water and sanitation together, they’re both needed equally. There is no one without the other”

4.3.2 Knowledge & Technology Base

The participants and informants were requested to comment on the role and application of new knowledge and technologies in addressing water and sanitation needs. This was fitting as the literature states that for public procurement to contribute to innovation-driven solutions in a sector, the sectoral innovation system must possess a knowledge base and technologies which are key to driving innovative solutions. Due to fields of practice and expertise, only the responses of municipal officials, innovation support programme managers and firm managers are presented below.

4.3.2.1 eThekwini

Participants from eThekwini alluded to having formal partnerships with local higher learning institutions from which knowledge is sourced. In addition, the municipality engages knowledge from research institutions as well as conferences. The verbatim statements of the participants are articulated below:

eTh2: “We have signed MoUs with the various tertiary institutions locally as a pledge to work with the science community, which has allowed different units within the municipality to sign individual Memorandums of Agreement with specific departments within the universities. This helps the municipality to get relevant scientific knowledge which helps in service delivery. The management of the municipality values science-based evidence in provision of services – scientific evidence even drives some of our internal policies”

eTh3: *“Our research is done through universities around. Nothing is implemented without scientific opinion or approach to guide our thinking”*

eTh5: *“The municipality keeps up with new knowledge coming through in the sector to understand how best it can be applied in improving services. We have linkages with research institutions and we attend conferences”*

eTh6: *“From a national perspective, the municipality has alliances with research agencies with a mandate to ensure that global water/sanitation challenges are looked at and their impact at national level is researched and relevant scientific information is generated to ensure that the nation is able to prepare and deal with these challenges. At the local level, the municipality has research agreements with local universities, which also have linkages with the national research institutions. So the municipality, according to its research requirements, collaborates with universities by looking at studies done by research institutions in the area of interest.*

When asked if the municipality applies novel solutions in addressing water and sanitation challenges, the participants responded as follows:

eTh2: *“Yes, we recently developed a first-of-its-kind sludge treatment technology through a joint venture with a private company. The company came in with their technology, a local university joined in to conduct research on the feasibility of the technology, and the technology was then refined based on the research findings. However, the process got stuck when the technology had to be procured. It’s the only machine of its kind so the normal public tender or three quote process couldn’t work”*

eTh3: *“Yes. We worked with a university to develop a urine diversion technology for rural areas, we are now engaging further to improve the technology to a version that will become more acceptable by the community”*

eTh4: “Yes, the municipality constantly engages with the private sector to try and filter what new solutions are being developed. All the projects we have implemented through public-private partnership model were innovative and first of their kind in Africa”

eTh5: “The municipality has been a forerunner in shifting from historical conventional systems to innovative solutions. The new political dispensation mandated water services authorities to scale up service delivery as provision moved from catering to a few citizens to including previously unserved people. This is where research and innovation became important to support the municipality in exploring new ways of doing things. We had to re-invent ourselves – urine-diversion toilets, black soldier fly waste-processing and others are examples of innovative ways of doing things we have implemented. The body of knowledge has come through from research to help municipalities improve service delivery. We are also exploring new service delivery models to improve municipal service provision”

The process of deploying new water and sanitation solutions is briefly detailed:

eTh3: “Once a solution is developed, it is not immediately rolled out. Multiple consultations are done with relevant stakeholders including councillors, chiefs, etc. to get their buy-in, after which the solution is then piloted at a small scale. Then the pilot is upscaled to verify technical feasibility. It is important to get buy-in and support from the community leadership because during mass implementation, they are the ones who assist in convincing community members that the technology works”

eTh5: “The municipality has a responsibility to ensure the health and safety of communities when rolling out solutions because the risk is often very high to be managed at the household level, especially for sanitation facilities”

4.3.2.2 City of Tshwane

Participants from City of Tshwane indicated that scientific knowledge is sourced from local higher learning institutions and through the appointment of consultants with high acumen for scientific knowledge.

CoT1: "Project managers appoint consultants who refer to knowledge produced by research bodies across the country and globally"

CoT3: "We make use of the surrounding universities and science councils like the CSIR to gather the information they produce in the space of water and sanitation to see how we can best use it in delivering services to our people"

CoT4: "We value scientific knowledge and technology. We are always trying to find a scientific way to come up with better services"

When asked if the municipality applies novel solutions in addressing water and sanitation challenges, the participants responded as follows:

CoT1: "We do, for example we are implementing new green solutions which use less electricity. In all our projects we try by all means to look into saving water and electricity. In areas where we don't have bulk services, we are looking into putting urine-diversion toilets as an alternative sanitation solution"

CoT2: "Yes. We have implemented some advanced technologies to make sure that we keep improving service delivery and saving water and energy in the process"

The interviewees alluded to the appointment of consultants to conduct studies and provide advice before the implementation of new solutions at a large scale:

CoT1: "Our consultants draw up reports after a rigorous process of evaluating a technology. That report gives direction in terms of whether we can upscale and implement in communities or whether we must refine the technology"

CoT2: *“We rely on the findings of consultants who are trained in that specific field – for example if we are constructing a reservoir we will appoint consulting engineers to advise us accordingly”*

4.3.2.3 Innovation support program managers

When asked to comment on the role of their institution in the development of new water and sanitation solutions, the managers of innovation support programmes pointed to factors which constrain the development and adoption of new solutions such as the low willingness of municipalities to partner with research entities in the development phase, limited internal capability to operate and maintain new solutions within municipalities, gaps in procurement policy and regulation, and others. The verbatim responses are captured below:

KIA1: *“We support the development of innovative solutions but a few municipalities are willing to play a role as a partner. Almost 95% will test new solutions but not use the opportunity to build internal capability, improve new solutions or provide funds for demonstration. Most want immediate proven solutions that they can procure and for certain instances technologies need to be adapted and improved in demonstration. Those that are unwilling cite procurement restrictions and while different municipal supply chain personnel interpret procurement clauses differently, some municipalities are able to test new solutions. But it is a tedious process and risk aversion is common”*

KIA2: *Through funding received from water levies and leveraged funds from grants and other donors, we fund and support the development, testing and demonstration of novel solutions that address water and sanitation needs. Further focus is being placed on other factors that deter the adoption of these technologies such as policy, regulation, market issues including procurement and other factors. Through one of our support programmes, we are piloting an innovative approach that is involving commercial partners in the innovation development process and brings a holistic approach that involves the unlocking of policy, regulatory and other aspects that stifle the adoption of novel solutions.*

KIA3: Generally speaking, it has been the largest and highest performing metros that have partnered with us in developing new solutions. It is less common for small local municipalities and district municipalities to develop or test innovations on a consistent basis.

KIA4: “We are in the business of innovation. That is what we are constantly driving in the sector – doing things smarter and more efficiently”

4.3.2.4 Firm managers

When requested to reflect on the availability of new solutions to address water and sanitation challenges, the firm managers referred to the innovative solutions their companies have developed and attempted to have procured by municipalities, including eThekweni and City of Tshwane. Their statements are recorded below:

KB1: “We have designed three types of solutions, i) a 4 to 6-litre flushing toilet unit fitted with a hand wash basin which allows the user to flush using grey water, ii) a urinal unit fitted with a hand wash basin which allows the user to flush, wash and save between 500 ml to 1 litre of fresh water compared to current urinal systems found in the market, and iii) a 3-litre flushing toilet system which saves up to 3 litres of water compared to the conventional toilet. Our solutions are prone to change the narrative and mindset of water utilization in the bathroom, by incorporating greywater usage in everyday living and equally improving hygiene”

KB2: “Our company manufactures novel non-electric point-of-use water filtration systems for rural dwellers who collect water directly from untreated sources such as rivers and dams. These devices are an affordable sustainable solution particularly for areas where installation of piped water has proven difficult due to complexity in the topography and spatial distribution of the houses. Solutions are there but adoption by municipalities is very slow or non-existent”

4.3.3 Actors & Networks

According to the literature, the development and implementation of new solutions within a sector requires interaction among a network of actors within the sector. As such, the participants (and informants) were requested to comment on the actors with whom they interact in the development and implementation of new water and sanitation solutions. In the interest of area of practice, only the verbatim responses of municipal officials, innovation support programme managers and firm managers are outlined below.

4.3.3.1 eThekwini

eThekwini officials alluded to collaborating with academic institutions, research councils, local and international technology providers, funding agencies and regulators in the process of purchasing and implementing new solutions. The verbatim statements of the interviewees are captured below.

eTh2: “We work with research councils, academia, regulators (for example the SABS), the private sector, international companies, etc. Academics are paired with commercial partners where necessary”

eTh2: “Local and international private partners who provide funding, technology, expertise, etc.”

eTh4: “We collaborate with the private sector, the Development Bank and other potential funders, as well as technology developers for new ideas. External funders are encouraged to engage technology providers directly instead of channelling funds to the municipality. This helps facilitate the early development stages by short-circuiting procurement challenges – instead of money coming to the municipality, it is transferred to the specialist instead”

eTh5: “Municipalities are generally very risk-averse. We are different because of the culture of innovation driven by our leadership to allow staff to be creative and innovative. So innovation will tend to come from the private sector to a large extent. But the private sector is starting to become averse to innovating in the municipality space because of the procurement processes. Previously, private companies would invest in the development of water/sanitation technologies while targeting

municipalities as the biggest customer but the constraints introduced by procurement legislation have created a lot of difficulty. So there is an observed stagnation in the innovation rate of companies since the legislation”

4.3.3.2 City of Tshwane

City of Tshwane officials made mention of collaborating with academia, the private sector and research associations when introducing new solutions, as indicated by the verbatim statement below:

CoT1: “We engage with the private sector, local universities and researchers, depending on the project at hand. For example, for sanitation projects, the source of knowledge can be research reports on sanitation technology options. It depends on the requirements of the project. For example, for a number of our projects we’ve worked with a local university”

4.3.3.3 Innovation support program managers

Managers of innovation support programmes articulated partnerships with academic institutions, municipalities and other actors. Their comments follow below:

KIA1: “Innovation support councils tend to think all solutions that emanate from innovative suppliers are completely new when, in fact, it is not always the case. This lack of knowledge leads to poor tenders being rolled out with an inability to service the solutions. We have decided to engage more with leadership for water sector institutions to ensure better knowledge of innovations. We are also developing strong relations with technical heads and innovation managers to strengthen collaboration but SA has a long way to go”

KIA2: “We work with many stakeholders in developing novel water/sanitation solutions and they include academic and research institutions. This is usually where the ideation process begins and they are involved in managing and driving the innovation process. We work with many

innovators who are academics or researchers but there are individuals, entrepreneurs and consultants as well. We also partner with municipalities and waterboards in testing, validating and demonstrating many of the developed solutions. As the main end-users of innovative water/sanitation solutions, the municipalities and waterboards work closely with us in the development process and are a valuable resource in the innovation value-chain.

KIA3: “As a general rule for a project there would be two or three partners, i) the municipality which provides site and technical expertise, ii) a university or science partner who brings the technology which in some cases may be a small local or international business ‘selling’ the technology, and iii) a commercial partner who assists with project implementation”

4.3.3.4 Firms

The two firms referred to collaborations with innovation support programmes mainly. The statements of the managers are captured as follows:

KIB1: “We are an alumnus of programmes established to support innovation in the sector. Such entities are the main contributors to our product research, design, development and piloting. With the support from the entities we were able to show case and exhibit our solutions on multiple platforms, aimed to align with municipal buy-in”

KIB2: “We have worked mainly with government incubation programmes to move from proof-of-concept to where we are currently”

4.3.4 Policy & Institutions

The participants and informants were requested to comment on the influence of policy and institutions on the development and adoption of new solutions by municipalities. The literature highlights institutions and policy frameworks as determinants of innovation performance within sectoral boundaries. The views of municipal officials,

innovation support programme managers, firm managers and procurement legislation specialists follow in detail.

4.3.4.1 eThekwini

When probed on the policy processes followed to purchase and implement new water and sanitation solutions, eThekwini participants referred to the public tender process, expression of interest issuance and public-private partnerships. Their verbatim statements are captured below:

eTh1: “We adhere to the public tender process where an unbiased specification is drawn up in which the municipality describes the solution required. This approach doesn’t allow for much flexibility. Alternatively, we put out an expression of interest where we go out to tender in the competitive market and say ‘this is the problem, what is the solution?’, from that, suppliers will respond back and the municipality will get a sense of what possible solutions have been developed out there in the market to solve the problem being experienced. A third option is a public-private partnership process which we follow when the municipality has identified a supplier who has developed the desired solution but needs to be tested in the relevant environment, for example, a solution implemented in one municipality may require testing and re-configuration before implementation in another because of differences in environmental factors. In the public private partnership process, the municipality will request proof from the supplier that the solution works to ascertain mutual understanding and mutual benefit.

eTh4: “Where there is opportunity, the public-private partnership process is followed. The other aspect is that although the system allows for sole provider procurement, an expression of interest must still be requested, for which certain issues may arise, including BEE compliance, information sharing, etc. But the PPP works for innovation because we can specify that we do not want conventional technologies. We have the longest running PPP in the country. Back in the 90s, a paper manufacturing company that located in close

proximity to a wastewater treatment facility approached the municipality for a project to generate recycled water for industrial use. The only procurement model that could work was a PPP. The municipality and the private company created a first-of-its-kind recycling plant next to the wastewater treatment plant. We supply recycled water to these companies through agreements that we signed. The benefits are that the municipality gets a revenue stream through this project and the companies have guaranteed water security. There has been growth in expertise and skills and on the social side – bursaries have been rolled out and local companies were involved in equity shares. Also, potable water is diverted to communities instead of industry. PPP works for innovation in the municipality space because the significant risk is transferred to the private party and after a period of time, the asset is transferred back to the municipality, who then can capacitate staff to operate it.

eTh5: “There is no blueprint in the water and sanitation sector for procurement of new solutions or innovation per se. There is a lot of talk about innovation across the sector but no commitment into that process in the form of complementary procurement legislation and that is frustrating innovation and holding the sector back because for water and sanitation innovation, the primary market is always the municipality and if there will be efforts to address the huge challenges faced by the sector, people are only going to innovate if there is commitment from the municipality’s side to procure technologies but the legislation is not geared towards this”

eTh6: “We have to adhere to the prescripts of section 217 of the Constitution ...we must be fair, equitable, cost-effective, etc. because that is the foundation of the procurement system. From an innovation perspective this system is a hindrance because for new-to-market solutions the legislation doesn’t make provision for engaging with service providers. There is no specific clause in our supply chain policy to tackle the procurement of innovation”

There was consensus among the interviewees that there is no difference in approach between procuring new water-supply and procuring new sanitation-supply solutions:

eTh1: “There is no difference really because the legislation strictly regulates procurement across the board. There isn’t much room in the legislation for one to come up with one’s own different way of procuring, the legislation is too dictative. For example, the municipality is currently looking for an alternative sanitation solution to the current VIP toilets in some areas and must follow the same procurement process as for water supply solutions”

eTh2: “The process is guided by the same legislation, so there is no difference”

eTh5: “The approach is the same because it is the same policies that guide procurement even for a pencil”

eTh6: “The approach is the same for all services”

When probed for their understanding of procurement regulation, eThekwini officials alluded to the Constitution, MFMA, SCM guidelines and others.

eTh1: “The MFMA, supply chain management regulations, Public Private Partnerships”

eTh4: “The Public Private Partnership process is supported by the Government Technical Advisory Committee within National Treasury. The committee is there to provide advisory and recommendations to municipalities on Public Private Partnerships”

eTh5: “The Supply Chain Management system always applies during procurement activities”

eTh6: “Section 217 of the Constitution, MFMA, SCM regulations, etc. regulate procurement in municipalities”

The participants listed the following challenges as constraints to procuring and implementing new solutions in the municipality:

eTh1: *“The legislation itself is a barrier. It has removed the flexibility with which procurement was previously done, for example there used to be many walk-ins by technology suppliers with their portfolios in the olden days, but face-to-face supplier-customer contact has diminished because the legislation requires that the procurer must deal as little as possible with the supplier because of the whole transparency, competitive approach. Relationships between the municipality and suppliers have weakened. The three quotations system can take a long time, the tender processes on average take between 14 and 18 months, so it takes a long time to get to the part where the ordinary resident receives the service”*

eTh2: *“Novel solutions get piloted and are proven to work, but always get stuck at the adoption stage because procurement does not enable adoption. Also, institutional structures are too rigid, for example if something new is implemented, issues such as ‘which branch will manage it?, who’s gonna look after it?’ emerge because staff members have set job descriptions and are sometimes not willing to be flexible outside of that. Budget is also an issue. If a newly implemented technology is too specialised, there must be sufficient budget for maintenance, etc.”*

eTh4: *“SCM is stifling municipalities. It has shifted the focus from service delivery to compliance. It has centralised procurement such that a basic procurement process can average between 12 and 18 months”*

eTh5: *“The procurement legislation is the main barrier to technology adoption by municipalities. The innovation capacity is there, the capability is there in this country, but there are limited returns especially when suppliers are looking at us as a market. We have to follow process even when we can see that a solution fits what we are looking for”*

eTh6: *“Having to comply with the procurement policy, which is not geared up for innovative suppliers, is a constraint. There isn’t space in the legislation for procuring innovation, unless a technology is offered to the municipality at no cost through pilot processes. Even after piloting*

a technology and proving that it works, it cannot get adopted without going through a competitive procurement process”

When requested to comment on possible interventions to address barriers to procurement of new solutions, the interviewees responded in this way:

eTh1: “It’s simple: review the rigidity of the legislation and create flexibility”

eTh4: “I would say find a way to procure via the Public-Private Partnership route. Also, you will need strong municipal leadership and vision which supports the provision of solutions through innovation. Municipalities must play a more active role in advocating for innovation”

eTh5: “Create flexibility in the procurement system to allow local manufacturers to develop themselves. It has to start at the national level where the legislation comes from. Innovation procurement is not addressed adequately at national government level.

eTh6: “A review of the procurement frameworks needs to occur to create a chance for innovation”

The officials reflected on benefits which were realised from cases where new solutions were piloted or implemented:

eTh1: “A few years ago, before the constitution dictated that water is a right, the municipality needed to find a way of restricting non-paying people from accessing water supply. A solution was needed which could be installed on a household water meter to allow the switching off and on of water supply. A contract was entered into with an engineering company for the development of a device which could be connected to water meters so that when the water account was not paid, municipal officials could switch off the valve to stop water supply coming from municipal pipeline to household meter. The benefit was that payment for water increased”

eTh2: “A machine that processes pit waste was co-developed by the municipality and a private company and eventually purchased. This tech could be purchased because it was built together by the municipality and the developer. Implementation led to better management of sludge and the end product is a fertilizer which can be used in farming”

eTh3: “A water management device which limits supply of water to a prescribed free amount per day was procured. If a water account is in arrears, the device switches off supply as soon as maximum allowed water is used. The device helps in assisting customers to manage their water bills and to use water sparingly”

eTh4: “Two companies approached the municipality for a project to generate recycled water for industrial use. The only procurement model that could work was a PPP. The municipality gets revenue through this project, the two companies have guaranteed water security and the social aspect is that the municipality is able to then divert potable water to communities and the companies roll out bursaries in the area of water recycling”

4.3.4.2 City of Tshwane

In regard to policy processes for procurement of new water and sanitation solutions, officials from the City of Tshwane pointed mainly to the public tender process. Their insights are presented below.

CoT1: “We draw up a specification and go out for procurement through the public tender process”

CoT2: “We use the normal tender process whereby the department, based on a specified need, prepares a report explaining the item needed, which is approved by an internal chain of authority to say there is money for that item, then that report becomes the scope of the service that needs to be delivered. Then, based on that scope, supply chain processes would unfold whereby an internal committee considers the report

against the annual plans of the municipality, to check whether what is being considered is indeed in the plan that was approved at the beginning of the year. After that, a criteria of selecting suppliers is crafted and agreed upon to list the elements required in the suitable supplier candidate. Thereafter, the scope is advertised in the media where possible bidders could access it to enable them to submit offers. We arrange site meetings if the tender is complex. The bidders who submit proposals are recorded and the documents are assessed by an evaluation committee. The committee then decides which service provider must be awarded the tender.

The officials agreed that the procurement process is the same for both water and sanitation solutions.

CoT2: "The process is the same. Whether it's a reservoir or a piece of paper we are buying, the process is the same"

CoT3: "The procurement approach would be the same. Only the criteria differ because we cannot apply the same criteria that we use to buy everyday products when we buy innovation. In the criteria we can articulate that a product must be new and more advanced, but the procurement process itself would be the same for either water or sanitation"

Section 217 of the Constitution and guidelines were cited as regulation for purchasing new water and sanitation solutions.

CoT1: "Our specification is signed off by the executive, then it goes to SCM to ensure that it adheres to procurement policy, then we go out on tender"

CoT2: "Normally the regulations are the principles of Section 217 of the Constitution and the others which are subject to that"

When asked to comment on barriers associated with procurement of new water and sanitation solutions, the participants responded as follows:

CoT1: *“Usually for a new solution there would be only one or very few service providers in the market, or you have to source the solution internationally which means the process is long and expensive. Also, the actual operation and maintenance may become a challenge because the solution is new”*

CoT2: *“The challenges differ depending on the type of solution. But new solutions have to adapt to our environment and often these new systems can’t adapt to our structures, so we don’t buy them”*

CoT3: *“The SCM system of three quotes means you can’t go and procure anything directly, you must get three quotes and choose the cheapest even if it doesn’t work as well as the one you actually want to buy”*

These are some of the ways these barriers could be addressed, according to the interviewees:

CoT1: *“I think the only way is to make room for procurement of innovation specifically (and to have the SCM support in the processes that we have to go through with procurement), is submission of proof that the required procurement item is the first of its kind”*

CoT2: *“People who bring new technology into the market should make sure that their technology is a proper fit for where they intend to implement it because if we get a system that doesn’t gel with our environment we will not consider buying it”*

CoT3: *“Change SCM policy, do away with the three quotes system”*

Through the implementation of new solutions, the following benefits accrued to City of Tshwane:

CoT1: *With our reservoir we’ve achieved energy-saving and improved water access. With urine diversion toilets we are providing improved sanitation to communities”*

CoT3: *“Currently, I would use the water meter as an example. That solution was attempted but because of political involvement, the meters could*

not be rolled out at the same rate as was anticipated. The water meter was going to be a very good solution to our customers because currently, the problem people have with the municipality is that they are billed based on estimations, which is a serious problem. Newly innovated meters was going to solve that problem but unfortunately, due to political interference it was not rolled out to scale”

4.3.4.3 Innovation support programme managers

When asked to comment on the adoption of new solutions developed/supported through their programmes by municipalities, the managers reflected as follows:

KIA1: “Very few technologies for wastewater or sanitation have been taken up by municipalities. Emerging point-of-use technologies to improve water quality have been rolled out in test communities and after a few years have gained significant user acceptance. This was done with municipalities, ourselves as the trusted partner, a university and a private company. Some of our research outputs have been taken up by the national department and rolled out to municipalities as innovative regulatory programmes”

KIA2: “I know of two sanitation technologies adopted by municipalities. Despite this, the number of innovative solutions being purchased by municipalities or the number of municipalities actively seeking to purchase innovative solutions is quite low”

KIA3: “There are some cases, although they are very limited”

KIA4: “I wouldn’t say many have been procured, but a sizable few technologies have been piloted and demonstrated with municipalities as testbed partners”

The barriers preventing the adoption of new water and sanitation solutions by municipalities were conveyed in the following manner:

KIA1: *“Municipalities have many challenges especially around migration, informal settlements and inadequate budgets due to poor revenue collection”*

KIA2: *“There is anecdotal evidence that procurement and supply management governance rules are not flexible enough to encourage the procurement of innovative and novel solutions. The tender specifications are written in a manner that only allows for the procurement of tried and tested products and solutions and do not cater for instances where the solution is novel or has not been tested. Thirdly, in some instances novel solutions do not fit into existing regulatory frameworks and hence the municipal official is unable to apply current procurement processes. Lastly, in these cases, the municipal official is required to make the judgement call, and this can come at a personal cost as the official would have to stake personal reputation or responsibility for the success or failure of implementing the solution. As such, a risk averse official is unlikely to pursue a novel solution unless a framework exists”*

KIA3: *“There are issues in the interpretation of the PFMA and MFMA around single source procurement, the culture of the municipality in terms of how risk averse are both in terms of taking risks on new tech and in terms of pushing boundaries of how MFMA can be interpreted, limited incentives in the bulk infrastructure grants to adopt innovative solutions. Also, most businesses brokering new tech are not necessarily experienced in dealing with the public sector, generally being very young businesses”*

KIA4: *“Municipalities don’t want anything that is not tried and tested. But also, understanding the procurement process by our municipal partners is quite important, especially understanding how it can assist them in their endeavours to take up new tech. There’s definitely some work to be done there”*

According to the managers, tackling these barriers should entail skills development within municipalities, a culture of innovation, an enabling regulation system for supplying municipalities with innovative solutions, and others as expressed below:

KIA1: “Improve skills with municipalities, increase innovation culture, increase number of solutions available for water and sanitation for informal areas, rural and peri-urban areas, depoliticise water and sanitation and make it a call to action where everyone contributes from government to NGOs to businesses to foundations to communities themselves. And create enabling regulation that allows SMMEs to provide services to rural, peri-urban and informal communities.

KIA2: “Deal with prohibitive policies and regulations by reviewing existing policies and regulations, and realign them with existing realities to ensure that these policies and regulations promote and not inhibit the supply of solutions. Improve willingness to pay by end-users; the willingness of end users to pay for services has a direct impact on the bottom line of the municipality. When a municipality cannot cover its costs, it is difficult to sustain service delivery. Due to the culture of non-payment of certain services, it has been challenging for municipalities to maintain and/or continue to provide such services”

KIA3: “MFMA training, particularly from the perspective of procurement. Also chief procurement officers reviewing limitations to innovation deployment and in some cases relaxing certain criteria for innovation projects, and building an innovative solution requirement into government grants”

The managers of innovation support programmes understood the supply of new water and sanitation solutions to municipalities to comprise the PFMA, MFMA, internal municipal processes, etc.

KIA2: “I don’t think there is a regulation in place apart from the procurement and supply management rules such as the PFMA and the internal procedure of the municipality”

KIA3: *“The MFMA, the municipal mandate in the Constitution and organisational business plans. The regulations of grant systems or lenders also come into play because external finance comes with specific rules and expectations, and PPPs which come with their own heavily legislated set of rules”*

4.3.4.4 Firms

The two firms' experiences in supplying new water and sanitation solutions to municipalities was probed. The managers of both firms reported limited success in getting their solutions adopted by municipalities so far, in particular reference to eThekweni and City of Tshwane. Their verbatim articulations follow.

KIB1: *“Unfortunately, our solutions are yet to be purchased by the municipalities. However, we have piloted our solution in five sites in City of Tshwane, respectively in five schools. The pilot project was supported by our partners with a pilot partnership from a provincial education department. However we are still not getting business from municipalities”*

KIB2: *“We successfully piloted our technology in two district municipalities. We have been marketing it to eThekweni with no success thus far. It's a serious problem, too much red tape”*

When asked what they perceived as barriers to supplying their solutions to municipalities, the two firms commented:

KIB1: *“Our barrier to entry to conduct business with municipalities is that innovative solutions are not technically specified and thus may not form part of a tender specification list. The PFMA doesn't cater for the municipality to purchase an innovative solution, whether on a pilot basis or test-site basis. We have engaged with two specific metropolitan municipalities at this stage. One told us that they are still working on incorporating their policy in alignment with the PFMA, so as to open a development wing for innovative technologies and solutions. The second told us they would need to involve a technical*

team to properly specify and document the solution in order to align it to a procurement need and due to the increased workload, it would create more work for the team at hand as they did not have enough capacity. To date, we are yet to conduct any business with either municipality”

KIB2: “We have been told that our solution can’t be considered because it is new in the market and we are the only company manufacturing such a technology, which gives us a special competitor advantage as no one will be able to bid against us, and the specification would only be aligned to our project and such could cause a lot of legal and non-compliance issues”

The two managers of firms proposed the following interventions as remedies to these constraints:

KIB1: “Draw up a new MFMA that incorporates innovation. Other countries are doing it. You can’t preach innovation in summits and papers but fail to create legislation that complements your vision to be more innovative as a country. Or better yet, add a framework that builds into the MFMA that focuses on innovation especially. These things can be done if the leadership of this country becomes intentional”

KIB2: “It’s no use to say innovation, innovation, but when we bring innovation we are sent back because there’s no policy support. To solve these issues I would say make the procurement process more flexible because if we are talking innovation, it is unlikely that you will get many people with the same product to compete for the tender, so how do you deal with that?”

4.3.4.5 Procurement legislation specialist

The procurement legislation specialist alluded to Section 217 of the Constitution as primary regulation for the procurement of water and sanitation solutions. The verbatim commentary is expressed below:

KIC1: “All public procurement is regulated through section 217 of the Constitution which lays out five principles to be adhered to when procuring with public funds: fairness, equity, transparency, competitiveness and cost-effectiveness”

When asked if a specific portion of regulation that addresses the procurement of novel solutions exists, the specialist stated that while there is no explicit provision for novel solutions, there are processes within the confines of the legislation which can be followed to procure new solutions.

KIC1: “The regulation does make provision for things like an unsolicited bid for when somebody has developed something completely new, which some municipalities are not aware of. Entities always argue that government supply chain processes do not allow them to be innovative and we sensitise them about the unsolicited bid option. There is also what we call a ‘sole provider process’ whereby deviation from normal procurement processes can be allowed for testing of new solutions. So basically what I’m saying is while the procurement process is not tailor-made specifically for new things, there are still processes that can be used for innovation”

According to the specialist, the main challenge associated with purchasing new water and sanitation solutions by municipalities is lack of personnel with adequate understanding of procurement legislation.

KIC1: “The barriers include skill, not having people with enough knowledge of the procurement system. Project managers are technical people and often they’re not skilled in procurement. They may want something from a specific service provider but the Constitution does not allow that because state-owned entities have an obligation to grow the economy by allowing everyone who can to partake in doing business with government”

The specialist argued that these barriers can be eliminated through the formation of teams containing adequately skilled procurement personnel for procurement projects.

KIC1: “If municipalities put together multifunctional teams for procurement projects by partnering technical people with procurement personnel who fully understand and can implement the legislation that would solve the issue. My opinion is that legislation will not change and does not need to, perhaps more work must be put in training people on interpreting the legislation so that it is not seen as a barrier to innovation”

4.3.5 Summary

The needs of both eThekweni and City of Tshwane include providing water and sanitation services to unserved residents as well as renewed infrastructure to aid in the delivery of these services. While some participants viewed demand for water as higher than demand for sanitation and vice versa, the majority of respondents in both municipalities alluded to the two services as bearing equal need due to their complimentary nature. Both municipalities indicated a need for innovative solutions that take into account constrained water resource availability in the supply of water and sanitation services. This was consistent with the responses of innovation support programme managers and firm managers, who considered innovative solutions as the primary need of municipalities, among others. The managers of innovation support programmes also indicated that innovative solutions must be coupled with a policy environment that enables their adoption by municipalities. The results show that the existing procurement policy framework is viewed by the municipalities, innovation support programme managers and firms as an impediment to the implementation of innovative solutions by municipalities. However, the procurement specialist perceived the barrier as the interpretation of present procurement legislation, and not the legislation itself. Other barriers to innovation procurement were indicated as the lack of adequate skills of municipal procurement personnel, the risk aversion culture of municipalities, the low revenue collection rates of municipalities, and others. A review and reframing of the current procurement legislation, improving the skills of procurement personnel, improving revenue collection and establishing an innovation culture within municipalities are among the suggested interventions to create an

enabling environment for the procurement of new water and sanitation solutions by municipalities.

The results from eThekweni and City of Tshwane are generally similar, however a few differences are presented. While both municipalities indicated collaborations with research entities and higher learning institutions as sources of scientific knowledge, City of Tshwane alluded to obtaining scientific knowledge also from independent consultants in the water and sanitation sector. Moreover, eThekweni officials cited that the management of the municipality values science-based evidence as a guide in the provision of services and, as a result, scientific evidence drives some of the municipality's internal policies. In addition, eThekweni alluded to having successfully employed the Public-Private Partnership model to implement certain innovative projects, one being a recycling plant from which many benefits have accrued to the municipality; including revenue generation, skills development, and other social benefits detailed above. Also, the municipality reports consulting with community leaders before rolling out a new solution in order to obtain the approval of end-users prior to large scale implementation. To mitigate against procurement challenges and facilitate early technology development, eThekweni indicated that external funders are encouraged to fund technology providers directly instead of directing funds to the municipality. Among barriers to innovation procurement in the municipal environment, eThekweni respondents indicated institutional structures which dictate rigid job descriptions for employees such that there may be limited willingness and flexibility to accommodate the operation and maintenance of new solutions. In addition, the availability of sufficient budgets to operate and maintain new 'specialized' solutions is a barrier to innovation procurement. City of Tshwane results indicate that the municipality may in certain cases avoid procuring new solutions due to a poor track record of adaptability of innovative solutions previously implemented by the municipality.

CHAPTER 5 DISCUSSION OF RESULTS

This section provides a discussion of the data presented in Chapter 4. The discussion is based on data collected from the interviews which were conducted based on three research questions:

- What is the role of public procurement in stimulating demand for innovation in the water and sanitation sector?
- Does public procurement for water technologies differ from public procurement for sanitation technologies? If so, under what conditions?
- How might opportunities for innovation diffusion through public procurement be better seized and barriers overcome?

The discussion is narrated according to the four main elements which drive the water and sanitation sectoral innovation system according to the literature: i) demand, ii) knowledge base & technology, iii) actors & networks, and iv) policy & institutions.

5.1 DEMAND

The literature argues that demand influences the direction of public procurement (Bolton, 2016b; Wesseling & Edquist, 2018) and so may drive the procurement of innovative water and sanitation solutions by municipalities and, as a consequence, create or expand launch markets for innovative firms.

The results indicate that the municipalities have similar water and sanitation needs which include addressing service backlogs, managing growing demand for services as a result of growing populations, as well as improved infrastructure. This is corroborated by the literature in which the Department of Performance Monitoring and Evaluation in The Presidency described sanitation challenges as comprising unserved households, infrastructure either dilapidated beyond regular refurbishment or requiring upgrading and extension to serve new communities, operation and maintenance backlogs, and others (DPME & DHS, 2012). While data from a few interviews imply that demand for water supply is higher than demand for sanitation supply due to recent droughts, there is a majority consensus that the two services are of equal need due to their complementary nature and their facilitation as a bundle. This contrasts with the

literature in which StatsSA (2018) claimed that progress in providing water services exceeded progress in sanitation supply in 2018.

Furthermore, the data reveals that due to water resource constraints and other influencing factors, the municipalities perceive innovation as necessary to meet current needs. Innovation support programme managers and firms are in agreement with this view and consider innovative solutions as a primary need for municipalities. This confirms the literature that new solutions are key to addressing societal needs and, by extension, partly provides a response to the first research question in validating that demand for innovative water and sanitation solutions exists in municipalities and, despite this not being the case currently, public procurement should be employed as an instrument to stimulate innovation activity by supporting procurement contracts between municipalities and suppliers of new solutions (Wesseling & Edquist, 2018). This also provides empirical evidence to support the first proposition (P1) that public procurement oriented toward innovation is expected to yield both increased innovation activity and improved service delivery by municipalities in the water and sanitation sector.

The data also reveals that in parallel to demand for innovative solutions to improve service delivery, a need exists to create awareness among municipalities on the potential of innovation to bring about effective solutions. This view by managers of innovation support programmes is consistent with Borrego et al. (2010) who argue in the literature that institutional adoption of innovation depends on awareness and better understanding of its significant role in establishing new solutions. They further contend that innovation adoption is a five-stage process which begins with awareness, followed by interest, evaluation, trial, and lastly, adoption.

Furthermore, the results reveal that a policy framework which supports the delivery of services using novel solutions is a requirement for municipalities. As argued by Wesseling and Edquist (2018) in the literature, a policy shift which stimulates innovation from the demand side must accompany the innovation process. This once more responds to Research Question 1.

In addition, developing skills and capacity in the disciplines of innovation and public procurement to strengthen capacity support for innovation procurement is viewed by innovation support programme managers and procurement specialists as a need for

municipalities. This is corroborated in the literature by Zelenbabic (2015) and (Ambe & Badenhorst-Weiss, 2012) in the argument that among the main hindrances to public procurement of innovation is inadequate skills and capacity. In articulating skills development as a way to improve opportunities for innovation diffusion through public procurement, this part of the data contributes to addressing Research Question 3.

5.2 KNOWLEDGE BASE & TECHNOLOGIES

The literature states that a sectoral innovation system must be in possession of a specific knowledge base and technologies which firms and institutions interact to diffuse (Malerba, 2002). In corroboration, it is postulated that for public procurement to promote innovation for meeting sectoral needs, a pool of knowledge and new technologies must exist from which solutions can be drawn (Wesseling and Edquist (2018). The findings show that the municipalities have established collaborations with knowledge institutions engaged in producing knowledge in the sector. These include higher learning institutions and research entities from which informed knowledge is obtained to guide the municipalities in the delivery of water and sanitation services.

Further to this, the data alludes to the presence of firms that have developed novel water and sanitation technologies for the municipal market. These findings are supported in the literature by the postulations of Malerba (2002) and Edquist (2004) that the innovation process within the sectoral innovation system is characterised by knowledge sharing and the development of new technologies specific to the sector. Public procurement is therefore a tool through which these new technologies can be deployed to municipalities and end-users (Bolton, 2016b; Lember et al., 2013), however this is not the case as the public procurement system is not enabling the adoption of these technologies by municipalities. This finding also responds to the main research question (RQ1) and disagrees with P1 in outlining the existence of new solutions for which the public procurement system has not created markets.

The results also reveal that both municipalities have partnered with higher learning institutions and the private sector in implementing innovative water and sanitation solutions to improve service delivery and preserve resources such as water and energy. eThekweni municipality attributes its innovation affinity to the innovation culture driven by the leadership within the municipality. This is supported by Elenkov and

Manev (2005) where they posit that an organisation's leadership sets the innovation culture and influences the implementation of innovation. However, according to the data, the implementation of new technologies in the two municipalities appears to have been mainly through pilot and demonstration projects and less through adoption.

The data also suggests that municipalities respond with risk averseness when new solutions are marketed for adoption. The risk aversion culture is observed not only in relation to purchasing new solutions but also in “pushing boundaries” in the interpretation of the present procurement legislation. This observation agrees with the assertion of Lember *et al.* (2013) in the literature that many countries and institutions view innovation as too risky to procure with public funds and hence may be reluctant to commit financial resources to such solutions known to carry uncertainty. Moreover, procurement policy is viewed as an impediment to innovation adoption due to its restrictive nature which supports mainly conventional solutions. The submission by Zelenbabic (2015) that PPI requires that procurement objectives be accompanied by innovation supporting policies is confirmed. As such, Research Question 3 is addressed by the data in pointing out risk aversion and restrictive regulations as barriers to innovation diffusion through public procurement. In consequence, Proposition 3 is supported by the data.

5.3 ACTORS AND NETWORKS

According to the literature, constant interaction and dynamic networks between relevant actors influence the development and diffusion of technologies by the sectoral innovation system (Malerba, 2004; Xi *et al.*, 2009). In consequence, these interactions also have an effect on the degree to which public procurement aligns to innovation. In corroboration, the results indicate that both municipalities partner with private companies and research institutions in exploring innovative solutions.

Results from eThekweni, however, reveal that the municipality has observed a decline in the willingness of private technology developers to collaborate with them due to constraints in procurement processes. This challenge is confirmed in the literature where Uyarra *et al.* (2014) contend that suppliers report experiencing many barriers when collaborating with public authorities – including rigid procurement processes, limited or poor interaction between procuring agents and solutions providers, risk

aversion and limited skills of procurement specialists. To counteract the challenge of rigid regulations, the municipality reports encouraging external funders to channel resources to technology developers instead of the municipality in order to evade procurement challenges.

The results from the interviews show also that innovation support programmes interact directly with municipalities in testing water and sanitation technologies, creating awareness on existing innovative solutions and contributing to strategic decision-making pertaining to improved service delivery.

5.4 POLICY AND INSTITUTIONS

The literature refers to policy and institutions among the building blocks of a sectoral system of innovation wherein institutions influence policy outcomes (Malerba, 2002). Furthermore, the literature posits the integration of public procurement into the innovation policy-mix as essential for stimulating the creation and implementation of innovative solutions in a nation or sector (J. Edler & L. J. R. p. Georghiou, 2007).

The results indicate that both municipalities undertake procurement activities subject to the MFMA and SCM regulations, which prescribe the principles of Section 217 of the Constitution for all expenditure in the local government arena. The results also make visible that the approach for purchasing water-related products and services is the same as that for purchasing sanitation products and services since the legislation regulates all procurement activity the same way, irrespective of the type of service or product. This thus provides a response to Research Question 2 and does not support the proposition that public procurement varies between water and sanitation services (P2).

The two municipalities refer to the public tender and expression-of-interest processes as means to undertake procurement activities. However, the dominant approach for procuring solutions appears to be the public tender process, which both municipalities express is too rigid, dictative and not enabling for the procurement of innovation specifically. This is in agreement with the postulation in the literature that procurement legislation offers limited scope for innovation (Bolton, 2016b). eThekweni, however, listed the public private partnership process as a permitting approach for innovation procurement as the process is designed such that the private party incurs the financial

risk of development yet still transfers the asset to the municipality at a later stage. This is confirmed in the literature by the PFMA regulations which stipulate that in PPPs, project risk is carried by the private party in the form of capital and operational expenditure. This also contributes to addressing the main research question on the grounds of articulating a potential procurement approach which can be used to stimulate innovation. The general consensus from both municipalities is, however, that procurement legislation is silent about promoting innovation, and the standard public tender process deters innovation procurement due to the requirement of competition for consideration of an offering. Also, the data suggest that verbal innovation advocacy by politicians is not met with commitment in the form of supportive procurement legislation.

Further data from the interviews specifies procurement legislation as a barrier to innovation procurement as municipalities perceive it as more compliance-driven than service-delivery oriented. The legislation appears to restrict innovation procurement from different facets, one being the discouragement of sufficient face-to-face contact between suppliers and procuring entities. This confirms the claim presented by Uyarra *et al.* (2014) in the literature that one of the barriers to procurement of innovation is limited person to person interaction between procurers and solution providers. Once more, the data addresses Research Question 3 in articulating further constraints to PPI.

Also, the results from eThekweni reveal that the requirement for competitive bidding excludes innovation suppliers from consideration as innovative solutions providers are often the only ones in the market due to the novelty of their offerings. This is a hindrance even when a technology has been piloted with the municipality and proven to address a problem as it still cannot be adopted without following a competitive procurement process. This is corroborated also by the two interviewed firms that, after successfully testing their solutions at sites in both eThekweni and City of Tshwane, there hasn't been progress in attempts to get the municipalities to adopt either solution due to procurement policy issues. These circumstances are in agreement moreover with Bolton (2016b) that procurement policy requirements are generally not geared toward driving innovation.

As a further response to Research Question 3, both eThekweni and City of Tshwane cited the risk of cumbersome operation and maintenance as a restraint to procurement of innovative solutions since new solutions may require novel methods of operation and maintenance. This observation confirms the claim in the literature by Zelenbabic (2015) and Uyarra *et al.* (2014) that the risk-aversion tendency of governments is among barriers to public procurement of innovation.

The findings indicate also that other actors of the sectoral innovation system – in this case firms and innovation support programme managers – agree that the present public procurement legislation is a barrier to innovation procurement by municipalities. Both the legislation and SCM regulations are seen as lacking the flexibility required to encourage the purchasing of novel solutions. Furthermore, the lack of a risk management framework for innovation procurement in the legislation is cited as a compounding factor in the risk-aversion culture of government entities.

However, the results also indicate that some actors within the innovation system view the challenge as not being the legislation itself but the manner in which it is understood and interpreted by municipal officials. The results also show that the procurement legislation representative agrees with this observation and asserts that while the procurement system is not designed for novel products in particular, the unsolicited bid option is the channel through which municipalities can procure innovative products and services. In addition to this, the procurement specialist argues that to purchase new-to-market solutions, municipalities can follow the “sole provider” process stated in Chapter 2, which allows deviation from normal procurement requirements when only a single provider of a good or service is known. The results in this manner contribute to answering Research Question 3 in enunciation of ways in which the present legislation can enable innovation procurement.

The data further details the lack of appropriate knowledge, skills and capacity by personnel in the public procurement system as a constraint to innovation procurement. This is noted in Chapter 2 by Ambe and Badenhorst-Weiss (2012) and Migiro and Ambe (2008) as a persistent barrier following the introduction of the current legislation.

To address these barriers and in further addressing Research Question 3, the results indicate a consensus among respondents that a review of procurement legislation frameworks must be conducted to address regulations that are prohibitive to

innovation. Such a review would begin at the national level and cascade down to the local government level to not only introduce flexibility in the procurement system but also to explicitly and adequately support the supply of innovative solutions. This is supported in the literature by the assertion of the Swedish Governmental Agency for Innovation Systems that government's intent for continual policy development is a strong influence in efficient public procurement of innovation (Vinnova, 2007).

Further data suggests that barriers could be addressed through improving skills among procurement officials to create a better and more coherent understanding and interpretation of procurement policy with respect to innovation across organs of state. This is essential given the already stated challenges of lack of adequate skills and capacity of procurement personnel. Additionally, another way to contribute to eliminating barriers is by assembling multi-functional teams through partnering technical personnel with procurement officials with in-depth understanding of the legislation sections that can be applied for innovation. Moreover, exploring Public Private Partnerships as an option to drive innovation is listed in the results as potential means to circumvent procurement challenges. As stated in the literature, PPPs transfer the risk inherent in innovation projects to private parties while guaranteeing transfer of the innovative asset to the public entity after an agreed-upon period of time. The challenge, however, is that small businesses and start-up companies still require support and therefore cannot bear the risk necessitated by the PPP approach. The data also indicates that establishing a culture wherein the leadership within municipalities advocates for innovation is another way to enable public procurement of innovation, as observed also by Elenkov and Manev (2005) that the leadership of an organisation is a dominant factor in the degree to which the organisation supports and implements innovative products and services.

However, an unexpected finding emerged from the data: the willingness of users to pay for services may impact on public procurement of innovation. According to Manyaka (2014) and Lubbe and Rossouw (2005), revenue collection is the biggest financial challenge for many South African municipalities due to non-payment by residents and poor debt collection strategies. The data therefore refers to this challenge as a hindrance to innovation procurement as municipalities depend on revenue from service recipients to implement new and improved services. This finding therefore contributes to responding to Research Question 3. While this is so, this

finding also presents an opportunity for an innovative solution which can improve revenue collection in municipalities.

Another result which emerged from the data gathering was that the buy-in of community leadership (traditional chiefs, councillors, etc.) may influence innovation procurement more in certain municipalities compared to others. The results from eThekweni indicate that lack of support and approval from community leaders may deter the implementation of innovative solutions. Hence, it is important to secure their approval before implementing a solution as failure to do so may lead to rejection of the solution by residents. This is confirmed by Khan and Lootvoet (2002) in their contention that in 1994, community leaders in KwaZulu-Natal began asserting their authority in governance and service delivery matters, particularly in the Durban region. Once more, this piece of data provides Research Question 3 with a partial response.

A few differences were observed between eThekweni and City of Tshwane in respect of the study. eThekweni's consulting of scientific knowledge not only to aid in the provision of services but also as a guide in the drafting of internal policies showed the municipality's high commitment to innovation. This innovation-friendly culture is credited to a leadership that recognizes the important value of science and innovation, which confirms the literature cited above that an organisation's leadership influences its innovation culture or lack thereof. Furthermore, eThekweni has previously successfully explored the Public-Private Partnership approach to implement innovative projects which satisfied PPP scope and requirements. In addition, the municipality promotes the transfer of external funding directly to innovators (instead of the municipality) in order to circumvent procurement challenges and facilitate early technology development. This again reveals the municipality's commitment to enabling innovation and addressing barriers thereto. This may however limit resources availability and reinforce the indicated barrier linked to insufficient budgets to operate and maintain new solutions.

City of Tshwane specified sourcing scientific knowledge from a wide variety of sources, including independent water and sanitation consultants. This shows that the municipality's science and innovation related interactions are not limited to only higher learning institutions and research entities. However, a poor track record of adaptability

of innovative technologies was alluded to, which has rendered the municipality pessimistic concerning the procurement of new solutions.

5.5 SUMMARY

The summary is presented by addressing each research question in succession.

Research Question 1: What is the role of public procurement in stimulating demand for innovation in the water and sanitation sector?

South African municipalities are faced with the challenge of providing adequate water and sanitation services to communities (among others) in the wake of severely depleted water resources. This necessitates migration from conventional approaches to alternative innovative solutions capable of addressing water and sanitation needs in light of limited water availability. Such solutions have been developed by different suppliers and are available for adoption by municipalities. However, the findings show that in broad terms, present public procurement legislation does not support the purchasing of innovative water and sanitation solutions by municipalities. While procurement legislation specialists argue that the obstacle lies in its interpretation, the legislation is viewed by municipalities, firms and innovation support programmes as too restrictive and unfavourable for innovation procurement. This being so, municipalities view innovation as a means to address water and sanitation needs and as such interact with knowledge producers and technology developers including research entities, higher learning institutions and firms to engage new solutions developed by the sector. However, the degree to which innovative solutions are procured remains very low.

Research Question 2: Does public procurement for water technologies differ from public procurement for sanitation technologies? If so, under what conditions?

The results make visible that the approach for purchasing water-related products and services is the same as that for purchasing sanitation products and services since the legislation regulates all procurement activity the same way, irrespective of the type of service or product.

Research Question 3: How might opportunities for innovation diffusion through public procurement be better seized and barriers overcome?

In addition to procurement legislation being unfavourable for innovation procurement, the findings reveal that other constraints also hinder the adoption of innovation by municipalities. These include lack of adequate skills and knowledge among procurement officials in municipalities, the risk-aversion culture of municipalities, and low revenue collection rates. To remedy these issues, a review and amendment of present procurement regulations is suggested such that a reformed, flexible framework which explicitly articulates support for the procurement of innovation is established. In addition, exploring PPPs and other deviation options, enhancing skills and capacity among procurement personnel, improving revenue collection rates, promoting a culture of innovation, and attaining support from community leaders are factors which can contribute to addressing barriers to innovation procurement in municipalities.

The key overall results are summarized in Table 12 below.

Table 12: Barriers to PPI and proposed interventions

	Barrier to PPI in the water and sanitation sector	Proposed intervention to enable PPI in the water and sanitation sector
#1	Unsupportive, restrictive procurement legislative framework	Review and reconfiguration of present procurement regulations
#2	Lack of adequate skills and knowledge of procurement officials	Enhancing skills, knowledge and capacity of procurement personnel
#3	Risk-aversion culture of municipalities	Promoting a culture of innovation in municipalities
#4	Low revenue collection rates of municipalities	Improvement in revenue collection rates of municipalities

The study proceeds to provide conclusions, recommendations, limitations and suggestions for future research in the next chapter.

CHAPTER 6 CONCLUSIONS AND RECOMMENDATIONS

6.1 INTRODUCTION

This study explored the potential of public procurement to drive innovation demand in the South African water and sanitation sector. A sectoral analysis was conducted in two municipalities and insights on the interaction of public procurement with innovation were provided. This chapter seeks to summarise the findings and make conclusions based on the literature and interview results on four major themes, namely i) demand, ii) knowledge base & technologies, iii) actors & networks, and iv) policy & institutions.

6.1.1 Research Questions

On the basis of the research problem articulated in Chapter 1, the following research questions were explored by this study:

- i. What is the role of public procurement in stimulating demand for innovation in the water and sanitation sector?
- ii. Does public procurement for water technologies differ from public procurement for sanitation technologies? If so, under what conditions?
- iii. How might opportunities for innovation diffusion through public procurement be better seized and barriers overcome?

6.1.2 Propositions

In exploring the literature, the following propositions were made:

- P1: Public procurement oriented toward innovation results in increased innovation activity in the water and sanitation sector as well as improved delivery of services by local municipalities.
- P2: Public expenditure is oriented more toward new water-supply solutions compared to sanitation solutions therefore the public procurement process differs between the two services.
- P3: Opportunities for innovation diffusion through public procurement can be enhanced through a redesign of public procurement legislative frameworks to support the procurement of new solutions.

As discussed previously, the results were collected through semi-structured interviews of ten municipal officials (six in eThekweni and four in City of Tshwane) as primary participants, and four managers of innovation support programmes, two managers of firms and one procurement legislation expert as key informants respectively. The major findings of the study are presented in the next subsection, followed by the recommendations, limitations and areas for future study.

6.2 Major Findings

The major findings from the study confirm that public procurement can drive demand for innovation in the water and sanitation sector. This is owing to municipalities and other actors of the sectoral innovation system recognizing innovation as integral to meeting current municipal needs which comprise service backlogs, managing demand, infrastructure, and others. Established partnerships with knowledge and technology suppliers by the studied municipalities demonstrate interest in new water and sanitation solutions. Therefore, by providing latitude for suppliers to enter into contracts with municipalities for the procurement of new products and services, public service delivery can be improved and innovation activity enhanced in the water and sanitation sector.

However, the findings confirm that in general terms, the current public procurement legislative regime does not promote innovation. The restrictive and compliance driven nature of the legislation impedes the supply of innovative solutions to municipalities and hence delays the provision of improved water and sanitation services. The regulations of the legislation dictate a competitive process for offerings including new-to-market solutions, which disadvantages innovation. Also, mandated limited interaction between procuring agents and suppliers prohibits the constant communication necessary for innovation projects. This being the case, public private partnerships, the *unsolicited* bid and *sole provider* processes, as well as other deviation processes are potential channels through which new solutions could become adopted by local governments.

While it bears the most weight in deterring innovation procurement, the legislation is not the only constraint in this respect. The study reveals and confirms other prohibitive factors to public procurement of innovation. Capacity and skills shortage of municipal

procurement officials is listed among major constraints – particularly as it relates to interpretation of the legislation. Another stated barrier is the tendency of government organs to avoid taking risks with novel solutions in the intention of “safeguarding” the public purse. In addition, limited awareness of the capability of innovation to provide working solutions is among the barriers which hinder the procurement of new water and sanitation solutions. Some municipalities prefer conventional ‘tried and tested’ solutions even when they fail to address problems, rather than introducing new solutions. Furthermore, low revenue collection rates affect the budgets of municipalities, which directly impacts their capacity to purchase innovative (and other) solutions.

The results indicate that these barriers can be addressed mainly through a reconfiguration of the current legislative regime. By reviewing procurement regulations to address and reform aspects that restrict innovation procurement, innovation activity in the water and sanitation sector is likely to rise and, by consequence, municipal service delivery improve. Further to this, capacitating procurement personnel in municipalities with knowledge and skills to adequately interpret the present legislation could result in better prospects for suppliers of innovative solutions. Also, public private partnerships as well as the unsolicited bid and sole provider processes must be explored as vehicles to enable innovation procurement in municipalities. In like manner, a culture of innovation among municipalities, improved revenue collection and support from community leaders can contribute to eliminating barriers to the procurement of water and sanitation solutions.

6.3 Recommendations

The findings of this study have implications for municipalities, innovation support programmes and the water and sanitation sector, public procurement legislators and other stakeholders involved in the development, diffusion and application of innovation respectively. In this respect, the following recommendations are made:

6.3.1 Recommendations to Municipalities

Municipalities wishing to procure innovative solutions should consider:

a) **Investing in skills and capacity building among procurement personnel.**

This will strengthen understanding and interpretation of public procurement legislation such that opportunities for innovation within the legislation are better identified.

b) **Implementing strategic tools towards building a culture of innovation.**

This will strengthen advocacy for innovation within municipalities and, by consequence, support for innovation procurement.

c) **Advocating for a review and redesign of present public procurement legislation.**

This will influence the decision making process of procurement policymakers in the direction of innovation-friendly regulations.

6.3.2 Recommendations to Innovation Support Programmes and the Broader Water and Sanitation Sector

The water and sanitation sector, in its endeavour to promote innovation deployment to municipalities and other markets, should consider:

a) **Constructing sector-specific demand-driven interventions**

to address the needs of technology developers wishing to disseminate innovative solutions to municipalities. It must be kept in mind that 'innovative solutions' do not only refer to technological solutions but also non-technological solutions in areas such as marketing and organisation (as listed in the literature review), which are important as they can provide insights into how to effectively diffuse technological innovation emerging from the sectoral innovation system.

b) **Devising appropriate municipality-oriented strategies**

to enhance linkages between technology developers and municipalities. This is supported by the finding that there is not yet a clear approach for technology developers and municipalities to interact with one another.

c) **Championing advocacy for a review and redesign of present public procurement legislation.**

This will influence the decision-making process of procurement policymakers in the direction of innovation-friendly regulations.

6.3.3 Recommendations for Public Procurement Legislators

Public procurement legislators should discourse on the following:

- a) **Consultative multi-stakeholder engagement** on the design of the present legislation and its effect on innovation.
- b) **A review and reconfiguration of the present legislation** to incorporate innovation-affirming regulations.
- c) **Continual interaction with stakeholders** on the efficiency of the legislation in promoting innovation procurement.

6.3.4 Recommendations to Other Interested Stakeholders

Stakeholders, including firms, government and other entities should consider the following:

- a) **Advocating for a review and redesign of present public procurement legislation.** This will influence the decision-making process of procurement policymakers in the direction of innovation-friendly regulations.
- b) **Continual engagement with procurement legislation and legislators** to keep abreast with new progressions in the legislation.

6.4 LIMITATIONS AND FURTHER RESEARCH

A discussion of the limitations of this study and opportunities for further research follows respectively.

6.4.1 Limitations of the Study

The limitations of the study are noted and indicated as follows:

- The study was limited to only two municipalities and therefore, the insights are not generalisable to all municipalities in South Africa, but may very well be transferable to some.
- The study focused on metropolitan municipalities whose environments and experiences may differ from district and local municipalities.
- The respondents' roles/functions within the municipalities were not exactly similar, which made the comparison of the two cases difficult and the conclusions being contingent on further investigation.

- The study concentrated only on innovation as beneficial to municipalities, whereas innovation is complex and interdisciplinary.

6.4.2 Further Research

Further studies on innovation and public procurement of innovation in South Africa should consider:

- A cross-sectional design involving a larger sample to improve the transferability of results;
- A longitudinal exploration of one or more cases to make allowance for the examination of long-term impacts;
- An in-depth review of the existing public procurement regulatory regime as well as opportunities for reconfiguration toward an innovation-oriented framework.

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APPENDIX A: Interview guide for municipal officials (participants)

Background

1. What is your role within the institution?
2. How long have you been in this role?

Demand

3. What are your local municipality's water/sanitation needs and how are they being addressed? (RQ1)
4. Is the need higher for water vs sanitation or vice versa? (RQ1)

Knowledge & technologies

5. How is scientific knowledge used to address water/sanitation needs? (RQ1)

Actors and networks

6. What are the sources of the scientific knowledge? (RQ1)

Knowledge and technologies

7. Do you apply new solutions (new technologies and/or service delivery models) in addressing water/sanitation needs? (RQ1)
8. How are new solutions applied to address water/sanitation needs? (RQ1)

Actors and networks

9. Who are the providers of new solutions (water & sanitation technologies)? (RQ1)

Policy & institutions

10. What policy process does the municipality follow to purchase and implement new water/sanitation solutions? (RQ1)
11. Is there a difference in approach for purchasing new water vs sanitation solutions? (RQ2)
12. If so, how does the approach differ? (RQ2)
13. How is the purchasing and implementation of water/sanitation solutions regulated? (RQ1)
14. What barriers are associated with purchasing and implementing new solutions? (RQ3)
15. How could barriers be addressed or eliminated? (RQ3)

16. Please briefly describe an example of a novel solution that was purchased and implemented by the institution? (RQ1)
17. What benefit has been realised through the implementation of the solution? (RQ1)

Actors and networks

18. Who did the municipality collaborate with in purchasing and implementing the solution? (RQ1)

APPENDIX B: Interview guide for firms (informants)

Background

1. What is your role within the firm?
2. How long have you been in this role?

Demand

3. What according to you are the main water and/or sanitation needs of municipalities? (RQ1)
4. Do you perceive the need to be higher for water vs sanitation or vice versa? (RQ1)

Knowledge and technologies

5. Has the firm developed novel solution(s) to address any water/sanitation need? Describe the solution and the novel aspect.

Actors and networks

6. Which partners did the firm collaborate with in developing the solution? (RQ1)

Policy & institutions

7. Has the solution been purchased and implemented by a municipality? If so, describe the process followed. If not, describe the barriers preventing the adoption of the solution by municipalities.
8. How is supply of water/sanitation solutions to government entities regulated? (RQ1)
9. Is there a difference between supplying water vs sanitation solutions to municipalities? If so, what is the difference? (RQ2)
10. What challenges are associated with supplying new water/sanitation solutions to municipalities? (RQ3)
11. How could these challenges be addressed or eliminated? (RQ3)

APPENDIX C: Interview guide for innovation support programme managers (informants)

Background

1. What is your role within the organisation?
2. How long have you been in this role?

Demand

3. What according to you are the main water and/or sanitation needs of municipalities? (RQ1)
4. Do you perceive the needs to be higher for water vs sanitation or vice versa? (RQ1)

Knowledge and technologies

5. Has the council developed or supported the development of novel solutions to address water/sanitation needs?

Actors and networks

6. Which partners does the council collaborate with in developing novel water/sanitation solutions? (RQ1)

Policy & institutions

7. Has any of the solutions been purchased and implemented by municipalities? If so, describe the process followed.
8. If not, describe the barriers preventing the adoption of the solutions by municipalities.
9. In your understanding, how is the supply of water/sanitation solutions to municipalities regulated (RQ1)
10. According to you, is there a difference between supplying water vs sanitation solutions to municipalities? If so, what is the difference? (RQ2)
11. According to you, what challenges are associated with supplying new water/sanitation solutions to municipalities? (RQ3)
12. How could these challenges be addressed or eliminated? (RQ3)

APPENDIX D: Interview guide for procurement legislation specialist (informant)

Background

1. What is your role within the institution?
2. How long have you been in this role?

Demand

3. What according to you are the main water and/or sanitation needs of municipalities? (RQ1)
4. Do you perceive the needs to be higher for water vs sanitation or vice versa? (RQ1)

Policy & institutions

5. In which ways does the institution regulate the purchase and implementation of water/sanitation solutions by organs of state?
6. Is there a specific portion of the regulation that addresses procurement of novel goods and services?
7. According to you, what barriers are associated with purchasing new water/sanitation solutions by municipalities? (RQ3)
8. How could these barriers be addressed or eliminated? (RQ3)

APPENDIX E: CONFIDENTIALITY AGREEMENT



Sculpting global leaders

This **Confidentiality Agreement** is made by and between

..... (the Disclosing Party)

..... (signature)

AND

..... (the Receiving Party)

..... (signature)

In reference to: MMIS Research Project on Public Procurement of Innovation as a Driver of
Innovation Demand in the South African Water & Sanitation Sector (by
Thembele Ntlembeza)