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# Drivers and barriers to the adoption of the smart city paradigm in developing countries: A South African perspective

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**Abstract**

The UN predicted that there will be a significant increase in urbanisation worldwide, and estimated that South Africa's urban population will increase from 64.8 percent in 2015 to 79.8 percent in 2050. Rapid urbanisation in SA has led to various social and economic challenges such as, poor living standards, an increase in crime due to the higher cost of city living, increased pressure on transportation and infrastructure, safety and security issues and overcrowding due to a mushrooming of informal settlements.

The smart city concept is considered to be a means to manage the challenges and needs of urbanisation as outlined above, through the utilisation of information and communication technology (ICT). Although developed countries have implemented successful smart city initiatives, developing countries including SA, are delayed in the adoption of the smart city paradigm. This research sought to understand the drivers and barriers to the adoption of the smart city paradigm within the SA context. The literature review of this research revealed that there are no studies that investigated a comprehensive set of drivers and barriers holistically within SA, thereby, substantiating the need for this study.

This qualitative study provided and added key insights to the existing body of smart city knowledge with respect to the rationale and barriers for smart city developments in SA. This research was conducted via semi-structured interviews which included 13 public and private entity participants. This study further developed recommendations to overcome the smart city barriers identified by this research, and recommended the sectors and areas in SA that need to prioritise the implementation of smart city projects to derive its benefits.

This study also proposed a framework (DBRB framework) by taking cognisance of all key insights obtained. The framework, constructed and proposed in this study, illustrates the interconnectivity between the drivers, barriers and recommendations, and the subsequent benefits be derived by government, citizens and smart city service providers. A limitation of this study is that the results may not be appropriate for other developing countries that do not portray similar characteristics as SA. A suggestion for future research is to duplicate this study in other developing countries.

**Keywords**

Urbanisation, smart city, drivers, barriers, SA government challenges

**Declaration**

I declare that this research project is my own work. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination in any other University. I further declare that I have obtained the necessary authorisation and consent to carry out this research.

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# Chapter 1: Introduction to the Research Problem

## 1.1. Introduction

This study explores various drivers and barriers to adopting the smart city paradigm in developing countries, with a particular emphasis on South Africa. An exploratory study was utilised to identify the rationale and barriers for the development of smart cities in South Africa, with the rationale being expressed in terms of drivers and benefits.

## 1.2. Background to the research problem

Significant urban growth is anticipated to occur in developing countries (United Nations, 2014). According to Zhang (2016), urbanisation has reached a stagnant stage in developed countries, and about 93 percent of urban population growth will occur in developing countries. The United Nations (2018) estimated that 68.4 percent of people worldwide will be residing in urban areas by 2050, that Africa's urban population is expected to be 58.9 percent by 2050, and that South Africa's urban population is predicted to increase from 64.8 percent in 2015 to 79.8 percent in 2050. This rapid rate of urbanisation leads to challenges for both government and citizens, such as resource management, waste management, increased management complexity, air pollution, traffic congestion, inadequate and deteriorating infrastructure, data privacy and security, increased operating costs, issues due to accelerating digitisation, sustainability issues and the need to improve citizen's wellbeing (Das & Emuze, 2014; Rana, Luthra, Mangla, Islam, Roderick, & Dwivedi, 2019).

Within the South African context, it was identified that "exogenous migration" shocks that have been occurring during the post-apartheid period will generate a higher level of urbanisation (Bakker, Parsons, & Rauch, 2016, p. 21). Congruent with the UN statistics indicated above, urbanisation, based on the notion that wealth and success can only be found in big cities, encourages migration from rural villages and has led to various socio-economic challenges in South Africa (SA), such as unemployment and poverty, which have resulted in high crime rates, housing issues that have caused overcrowding and "mushrooming of informal settlements", a lack of basic services such as water and sanitation, and traffic congestion (Mokoele & Sebola, 2018, p. 576).

### 1.3. The research problem

The smart city concept involves harnessing the use of information and communication technology (ICT) to manage the challenges and needs of urbanisation as outlined earlier (Albino, Berardi & Dangelico, 2015; Pezzutto, Fazeli, & De Felice, 2016; Rana et al., 2019; Veselitskaya, Karasev & Beloshitskiy, 2019). Smart cities address urbanisation challenges through ICT integration in all spheres of urban activities, such as smart meters, renewable energy tools (that promote energy efficiency, pollution control and reduced emissions), smart transport systems, "urban services electronic payment systems" (Vishnivetskaya & Alexandrova, 2019, p. 2), "semi-automated infrastructure enhancing city stability and manageability" (Vishnivetskaya & Alexandrova, 2019, p. 3), and service delivery digital platforms and ICT tools that target "crime, traffic, social cohesion, education and health" (Trencher, 2018, p. 4). The structural elements of the smart city framework suggested by Vishnivetskaya and Alexandrova (2019) are provided in Appendix 1.

The smart city notion is flexible and can be adapted for any type of urban environment. In addition, this concept is continuously evolving and is mostly being implemented within the boundaries of developed countries (Silva, Khan, & Han, 2018). Smart city initiatives are driven worldwide by both government and private organisations to promote economic growth, to address the socio-economic challenges caused by urbanisation and to improve the citizens' wellbeing (Vu & Hartley, 2017). The two main drivers for smart city projects are governance and technology (Guedes, Alvarenga, Goulart, Rodriguez & Soares, 2018), whereas another study with respect to smart city drivers indicated that the drivers are categorised as follows: community, technology and policy (Yigitcanlar, Kamruzzaman, Buys, Ioppolo, Sabatini-Marques, da Costa & Yun, 2018).

Some successful smart city initiatives around the world include the FUTAR system in Budapest, which is aimed at improving the quality and level of transport services, resulting in less traffic congestion (through a centralised traffic management centre which analyses the real-time data of the public transport vehicles and traffic), and "control lights at junctions on major routes of the city"; hybrid buses at Estonia that meet "Euro 6 standard" emissions level which leads to pollution control and a green economy; e-government services in Bulgaria which provide 50 different services online to its residents targeting service-delivery efficiency (Kola-Bezka, Czupich & Ignasiak-Szulc, 2016, p. 82); 'smart nation' initiatives by Singapore such as the "ultra-

high-speed optical fibres" extension for greater connectivity, and the government's open data portal that has disclosed data from 70 public agencies to the citizens to co-create solutions that target "problem areas that needs improvement" (Hoe, 2016, p. 327).

SA has also attempted a few smart city initiatives in three major cities, namely, Johannesburg, Ekurhuleni and City of Cape Town (Musakwa & Mokoena, 2018). Furthermore, the importance of smart cities in SA has been emphasised by the South African president, Cyril Ramaphosa, and finance minister Tito Mboweni by highlighting the various initiatives and budget allocation for the development of smart cities in the state of the nation address (SONA) 2020 and budget speech 2020 respectively (South African Government, 2020b, 2020a). One example is the smart city initiative that is planned to be developed in Lanseria.

Smart city concepts are also relevant to realise the "ambitious aspirations for a pan-African renaissance" which is part of the African Union's Agenda for 2063 (Slavova & Okwechime, 2016, p. 14). However, the 2015 smart city initiative at Modderfontein, Johannesburg, which was expected to be built by a Chinese developer based in Shanghai, has not been realised thus far (Brill & Reboredo, 2019). Research conducted by the authors to determine the causes of the failed smart city initiative highlighted the following reasons: transnational capital challenges, governmental institutions' "strong negotiating position", and a need for "legislative and regulatory environment's support" for the state's agenda (Brill & Reboredo, 2019, p. 186). According to Musakwa and Mokoena (2018), the smart city initiatives in Johannesburg, Ekurhuleni and City of Cape Town were transplanted from developed countries and did not consider South African citizens' wants and interests, which led to enhanced inequality. In this regard, an example that further entrenched inequality is the Gautrain initiative which is expensive and unaffordable for low-income groups.

Other developing countries, such as India, has also welcomed the smart city notion by announcing its desire to build "100 smart cities". However, only 20 cities have been selected thus far (Musakwa & Mokoena, 2018, p. 3). This implies that there are barriers to adopting the smart city paradigm within developing countries. A study by Rana et al. (2019) suggests that there are 31 barriers identified in developing a smart city within the Indian context. As noted by Musakwa and Mokoena (2018), these barriers cannot be generalised and need to be determined and evaluated from an individual country perspective due to the differences in factors such as "the

geographic location, the social and economic landscape, and the availability of resources" (p. 3). A study conducted on a comparison between the European Union and SA with respect to smart city concepts revealed that the "benefit, drivers and means" for smart cities in SA are not clearly developed, and that the drivers and barriers for smart cities in SA differ from Europe (Coetzee, Smith, Rubalcava, Corici, Magedanz, Steinke & Mwangama, 2015, p. 5). A comparison framework is provided in Appendix 2.

In addition, SA faces a digital divide due to high income inequality, differences in global competitiveness among various cities, limited infrastructure, and spatial inequalities and policies (Musakwa & Mokoena, 2018; Todes & Turok, 2018). Due to the high digitalisation nature of smart cities, the digital divide was further analysed, and it was identified that, in 2015, the internet did not play a significant role for 33 percent of family units in SA (Bezuidenhout, Leonelli, Kelly & Rappert, 2017). In contrast, the usage of mobile phones tended to equalise the digital divide (James, 2014). However, Krönke (2020, p. 1) noted that the Covid-19 pandemic has resulted in schools and universities moving towards remote learning and teaching, and even the wealthiest countries in Africa, such as SA, has shown resistance to change and "often have to play catch-up with emerging technologies used by students".

In synthesising the smart city literature review of 104 publications within the information systems context, Ismagilova, Hughes, Dwivedi and Raman (2019, p. 97) noted that smart cities have been widely studied over the past ten years but "the majority of the studies were conducted in Spain, USA, India, UK and Italy". The studies related to smart city barriers within developing countries were conducted only in a few countries, such as India and Vietnam (Rana et al., 2019; Vu & Hartley, 2017). Having considered the differentiating factors between SA and other countries, it is evident that there is a literature gap in terms of understanding the drivers and barriers to the adoption of the smart city paradigm from a South African perspective. Given the urbanisation trends and the importance of smart cities, research is therefore needed to determine the rationale for smart city projects and why developing countries, and SA in particular, are lagging in the adoption of the smart city paradigm.

## 1.4. Research purpose and objectives

The purpose of this research was to establish the drivers and barriers in adopting the smart city paradigm in developing countries, with the emphasis on SA. The overarching research question in this study was, “What are the drivers and barriers in adopting the smart city paradigm in SA?”. To enable answering the overarching research question, a qualitative study was performed to obtain in-depth information pertaining to various drivers and barriers for the development of smart cities in SA. This research, therefore, aimed to identify the following:

1) What is the rationale/drivers for the adoption of the smart city paradigm in SA?
2) What are the barriers that are hindering the adoption of the smart city paradigm in SA?
3) What are the recommendations to overcome these barriers?

Given the innovative nature of smart cities, this study utilised the diffusion of innovation theory (DIT) to examine the barriers affecting the adoption of the smart city paradigm. The theory is recognised for helping envisage “how people make decisions to adopt a new innovation by finding their adoption patterns and understanding its structure” (Min, So, & Jeong, 2018, p. 3).

## 1.5. Scope of the research

The scope of this research was limited to understanding the drivers and barriers to adopting the smart city paradigm in SA. The participants for this research were selected from public and private entities within SA, with public entity participants selected from metro and district municipalities. Although the participants and the research were limited to the South African context, the insights gained from the research are useful and applicable to other cities outside SA that portray similar characteristics to those of South African cities and municipalities.

## 1.6. Significance of the research

Given the urbanisation trends, and the “transitioning” nature of cities within SA due to urbanisation, it is critical that South African cities become “smart” to address socio-economic challenges, challenges arising from population growth, and urbanisation challenges (Oke, Aghimien, Aigbavboa, & Akinradewo, 2020, p. 110). In addition, the authors noted that small businesses create approximately “56%-60% of the country’s

employment" (p. 1) in SA and that they perform better through various smart city solutions and services, such as educational tools and training materials, small business support portals, e-government and open-data policies, city-wide Wi-Fi, smart meters, electricity grid and lighting, and smart security, transport and traffic management (Du Plessis & Marnewick, 2017). It is therefore evident that the development of smart cities is imperative for SA's growth. Given this background, it is vital to understand the drivers and barriers for the adoption of the smart city paradigm from an SA perspective.

Smart city drivers and barriers have been studied worldwide. However, a literature review of SA specific smart city studies showed that there are limited studies within the SA context. One study explored the drivers of smart cities within South Africa (Oke, Aghimien, Aigbavboa & Akinradewo, 2020), but the study had limitations such as possible selection bias, as it was conducted with "a larger population of construction professionals", a geographical scope restriction because the study "was conducted in Gauteng province of the country", and finally the study was quantitative with a questionnaire that included a set of drivers identified around the world, and therefore did not provide an opportunity to identify any new drivers within the SA context (Oke et al., 2020, p. 123). Furthermore, these drivers were studied in isolation and did not include the barriers to the adoption of the smart city paradigm in SA. In terms of barriers, the literature review indicated that there was one study conducted to identify the causes of the failed smart city initiative of Modderfontein, Johannesburg (Brill & Reboredo, 2019). However, this study was restricted to this specific smart city initiative, and did not focus on the general barriers that could be applied to the entire country.

Given the gap in the academic literature with respect to the smart city drivers and barriers in SA, and the importance and benefits that smart cities could provide to the country, this research is positioned to add to the existing body of literature by explicitly focusing on the smart city drivers and barriers for SA. From a business perspective, the insights acquired from this research will be helpful for city managers, city planners, policymakers and other relevant stakeholders to understand the rationale for the development of smart cities in SA, and to strategically formulate changes in both policies and procedures in order to ensure that barriers identified via this research are addressed.

## 1.7. Conclusion

The UN predicted a significant increase in urbanisation, with a corresponding increase in social and economic challenges, such as poor living standards, an increase in crime due to higher costs of city living, increased pressure on transportation and infrastructure, safety and security issues and overcrowding due to a mushrooming of informal settlements. Both developed and developing countries have utilised the smart city paradigm to successfully resolve a few social and economic challenges, which are highlighted in the research problem section.

This section further evaluated the drivers for the development of smart cities, the barriers identified within developing countries such as India and Vietnam, and postulated that these drivers and barriers cannot be wholly adopted for the South African context due to differences in terms of geographic location, resource availability, economic landscape and social and cultural characteristics. In highlighting the importance of identifying the smart city drivers and barriers from a South African perspective, an argument was therefore constructed for this research. This research, therefore, sought to understand the drivers and barriers to the adoption of the smart city paradigm within the SA context. This section is concluded with the scope and the significance of the proposed study in terms of business and academic relevance.

The structure of this research is set out as follows: Chapter two presents a literature review related to smart cities, and its drivers and barriers; Chapter three outlines the research questions; Chapter four describes the research methodology; Chapter five presents the results obtained from the study; Chapter six provides a critical analysis of the results presented in Chapter five; and Chapter seven presents the conclusions and recommendations.

## Chapter 2: Literature Review

### 2.1. Introduction

The purpose of this research was to identify the drivers and barriers to the adoption of the smart city paradigm in developing countries with an emphasis on SA. Albino, Berardi and Dangelico (2015) indicated that there are studies performed which are both against and in favour of the smart city concept, and that some studies were inclined towards framing smart cities as simply corporate designed cities for their own benefits. In contrast, other studies have shown that technology has improved the wellbeing of citizens. This section, therefore, provides an overview of the academic literature that was pertinent in bolstering the need for this research.

The first part of this section provides an analysis of all factors that may impact the drivers and barriers of smart city developments, as it was important to understand the context of the country in which this research was conducted. The factors that are discussed in terms of the country analysis are politics and governance, municipalities and service delivery, economic growth and inequality, poverty and unemployment, and e-government and the digital divide.

The country analysis is followed by a preamble around smart cities that offered insights required to appraise the research outcomes. Arguments were developed to highlight the importance of smart cities for a country's development by reviewing the various definitions of a smart city and its dimensions. The literature review on smart city initiatives in developed and developing countries, including SA, was then evaluated to demonstrate why an understanding of the drivers and barriers to the adoption of the smart city paradigm in developing countries is crucial.

This section also explores the diffusion of innovation theory to determine the adoption level of smart cities from an SA perspective, followed by a discussion on different drivers and barriers identified in the literature. Given the background to the country's context, while smart cities have been studied for more than ten years, the drivers and barriers to the adoption of the smart city paradigm within South Africa are not well understood and this underscores the need for this research, which is further elucidated at the end of this section.

## 2.2. A country analysis of South Africa

### 2.2.1. Background

While countries in the world were repositioning themselves from “racial classification and segregation” from the late 1940s, SA was considered an outlier in sociological literature as it was setting an example for racial inequality due to its apartheid history (Seidman, 1999, p. 419). The apartheid government developed neighbourhoods based on race, and it included fragmented planning systems focused primarily on “land-use control” (Marais, Denoon-Stevens & Cloete, 2019, p. 2). However, in 1994, SA transitioned from an apartheid system to a democracy, and this transition was considered a “miracle” around the globe as a civil war was averted (Wilkins, 2017, p. 12). In contrast to the apartheid government, the new democratic government focused on urban planning based on “high densities, spatial integration and public transport” (Marais et al., 2019, p. 2).

SA is deemed to be a middle-income country, with different race groups comprising of 76 percent Africans, nine percent coloureds, nine percent whites and three percent Indians (Morrell, Jewkes & Lindegger, 2012). The country also pre-dominantly comprised of youth with one-third of the population aged below 15 years, and characterised with a “high unemployment rate, disproportionately affecting black youth, and extreme wealth inequalities” (Morrell et al., 2012, p. 13). Furthermore, SA is still considered a developing country despite the fact that the country is characterised by “the abundance of goods and natural resources” and “the remarkable progress in the fields of industry and manufacturing” (Bakari, 2017, p. 1).

Against this preamble, the important factors that may have an impact on the development of smart cities in SA are discussed.

### 2.2.2. Politics and governance

Although apartheid ended in 1994, sociologists were critical that the post-apartheid government displayed a strong continuation from the apartheid government in that the economic policies were framed to protect the economic elite’s interests and that the transition from apartheid to democracy was “merely a transfer of political power” (Wilkins, 2017, p. 13). In addition, Mbandlwa (2020) argued that political leaders, after 26 years of democracy, still utilise the SA’s apartheid history as a defence mechanism for poor public-service delivery.

Since 1994, the African National Congress (ANC) has been ruling and driving the policy agenda (The World Bank, 2019). However, according to Southall (2014), the ANC's accountability is questioned as the party is significantly prone to "corrupt and predatory behaviour by significant elements of the party's elite" (p. 48), since the ANC has attained a "political monopoly" (p. 65) due to its successive election victories. The Electoral Commission of South Africa (2019) indicated that the ANC achieved 69.69 percent votes in 2004, 65.90 percent in 2009 and 62.15 percent in 2014. Southall (2014) further noted that the ANC have utilised this dominance to undermine parliament's autonomy. Although SA is a unitary state, "political squabbles and victories" have transformed the country into a "pseudo-federal state" loaded with "localised municipal problems" (Mello, 2018, p. 3).

Irrespective of its successive election victories, the ANC has lost the majority of its support in four of the eight metropolitan cities in the August 2016 local government elections, which was the "most competitive local government election since 1994" (The World Bank, 2019, para. 1).

Southall (2014, p. 58) noted that the selection of members of parliament (MPs) is highly political, and that "party bosses" control these MPs and members of the provincial legislatures (MPLs), which in turn results in "strict control of the parliamentary agenda by the executive, thus compromising the quality of debate, the legislative processing of bills, and the ability of parliament to hold the government to account". Furthermore, the author stated that most of the MPs and MPLs lack the capacity to perform their roles effectively. Furthermore, Masuku and Jili (2019, p. 2) asserted that "the appointment of politicians in senior bureaucratic positions, such as senior management and general management, is viewed as a means of controlling bureaucrats and civil service", and that municipal officials' performance is affected by political influence as the municipal managers are appointed by the entire municipal council.

Munzhedzi (2016, p. 1) described corruption as "an abuse of official authority with intent for personal advantage". In SA, due to the high level of unemployment, state employment is widely considered as a means to gain wealth rather than serving the public's interests, and that public sectors are "transformed into a major site for class formation and material accumulation" (Southall, 2014, p. 63). The author further highlighted that this has resulted in "tenderpreneurship" (p. 63) wherein contracts were awarded to politicians' families and associates.

A few noteworthy cases are a property deal investigation involving a government minister and an ex-police chief general, an investigation of an ex-communications minister having gifted six million rands of taxpayers money to her fiancé, an investigation into the ex-minister of agriculture for alleged misconduct relating to an 800 million rands tender process and an investigation into the former eThekwini municipality mayor's family related to a tender 'hijack' in Durban worth three billion rands (Munzhedzi, 2016).

Another key facet of maladministration and corruption is state capture, a buzz word that has characterised political circles in SA. State capture is described as an "essentially parasitic plundering of public resources, poses a serious threat to the nascent South African democracy and needs to be taken seriously" (Dassah, 2018, p. 9). Approximately "40% of South Africa's procurement budget of R600 billion for goods and services is lost as a result of corruption" and "more than 60% of tenders are linked to corruption" (Bruce, 2019, p. 3).

This rampant corruption and maladministration has resulted in very few qualified audits of government entities in the 2011–2012 financial year as "only 22 percent of the 536 national and provincial government entities audited received clean audits, 55 percent received financially unqualified audit opinions, and 14 percent qualified audit opinions" (Southall, 2014, p. 64).

Corruption has also resulted in the consistent misuse of state resources, an inflation in procurement costs, procurement of poor quality products, and poor quality of service delivery or non-delivery of services, which has ultimately contaminated social relationships and resulted in taxpayers non-compliance to pay taxes due to the mistrust and disrespect for the government (Bruce, 2019).

Skenjana, Ngamlana, Mabhula, Mgwebi, Sokupa, Kimemia (n.d.) described the impact of maladministration and corruption as, "Its effects can seriously limit the development of national economies and undermine good governance. Corruption erodes stability and trust, and it damages the ethos of democratic governance" (p. 1), which is clearly reflected by the credit rating provided by major credit rating agencies. "Standard & Poor's credit rating for South Africa stands at BB- with stable outlook", "Moody's credit rating for South Africa was last set at Ba1 with negative outlook", "Fitch's credit rating for South Africa was last reported at BB with negative outlook"

(Trading Economics, 2020a, para. 1). According to the Trading Economics (2020a), these ratings will affect the country's borrowing costs.

Given the background of SA's politics and governance, an analysis of municipalities and service delivery within SA is provided in the section below.

### 2.2.3. Municipalities and service delivery

SA consists of eight metropolitan municipalities, 44 district municipalities and 228 local municipalities (Mello, 2018). All municipal, legislative and executive powers are held within metro municipalities, while district and local municipalities focus on "capacity-building and district-wide planning" (para. 11), and "service delivery, governance, financial management and infrastructure development" (para. 13) respectively (South African Government, 2019).

Ndevu (2019, p.1) highlighted the importance of SA municipalities in enhancing the citizens' quality of life, such as "job creation, safety and health, education and recreation" via "continuous, coordinated, cooperative strategies, decisions and actions".

However, a study on the monitoring and evaluation of SA municipalities noted that many SA municipalities are underperforming, which is highlighted in the 2012-2013 financial audit report wherein 90 percent of municipalities "did not comply with laws and regulations" (Mello, 2018, p. 2). According to the author, the under-performance of municipalities is due to the lack of ability to attract and retain highly qualified staff, which has led to higher "turnover of qualified employees" (p. 2), "incapacity of councillors, ineffective interventions, ineffective monitoring of interventions and poor management of transitions after interventions, as well as outright avoidance of interventions for political expedience" (p. 5). The author also stated that municipalities that are performing well have strong leadership, strong monitoring systems and that they are "good at record keeping and discipline" (p. 2).

The inability of municipalities to attract highly qualified individuals within municipalities is further emphasised by another study conducted on the capacity of disaster risk management (DRM) in SA municipalities which confirmed that only metro municipalities stood out in terms of trained employees (Wentink & Niekerk, 2017). The study also revealed that employees who belonged to DRM were also actively engaged and involved in other departments that led to the negligence of work in their departments.

A study conducted on training and development within an SA local municipality highlighted that the "lack of training and development leads to employee demotivation, as well as an increase in labour turnover with the municipality" and that there is a strong relationship between employees performance (in terms of better service delivery) and training and development (Luthuli, Nyawo, & Mashau, 2019, p. 117).

The study by Luthuli et al. (2019) further revealed that training and development within municipalities are not very effective, due to factors such as a lack of coordination between a workplace skills plan and training and development needs, a misperception amongst the employees that training and development programmes are included to satisfy the skills audit purposes and not for their own capacitation, a lack of more than one company training employees, misalignment between plans, such as a service delivery budget implementation plan and the IDP, and training and development programmes, a lack of systems and processes to "measure and evaluate the impact of training programmes offered by the tendered external company" (p. 123), a lack of senior management's support and follow-up on the training programmes, a lack of an effective performance management system within the municipality, and a lack of opportunities to apply the training materials and learning practically.

Major concerns in SA are poor service delivery, corruption, and a mismanagement of funds which has resulted in "widespread protest actions by the communities" (Young, 2018, p. 10). The author suggested that "the development and implementation of an operational risk management framework" (p. 10) may provide a coordinated method to effectively manage these "risk-related incidents" (p. 10).

Ndevu (2019) stated that SA has all the necessary laws and regulations, such as the Municipal Structures Act (117 of 1998), the Municipal Systems Act (32 of 2000), the Municipal Planning and Performance Management Regulations (MPPMR), the Integrated Development Plan (IDP) and the National Development Plan (NDP) to ensure consistent "systems, processes, stages, operations and management at all organisational levels" (p. 2). However, Masegare and Ngoepe (2018) contended that, while SA has all the necessary laws, regulations and corporate governance frameworks, such as King III, SA municipalities still face service delivery challenges due to poor corporate governance implementation. This has resulted in "several issues such as loss of credibility for local government, little interest from investors to

invest in municipalities, service delivery protests from communities, maladministration and unexpected change of leadership in municipalities without succession planning" (p. 581).

Some reasons for poor service delivery by SA municipalities are the existence of power relationships between elected and administrative leaders, "political factionalism, as well as employee capacity gaps, lack of active participation, information sharing and budget constraints", the leadership's lack of "transparency, integrity, legality and collegiality", a "lack of commitment from leadership", and a lack of trust in performance evaluation and management processes (Ndevu, 2019, p. 10).

Since SA municipalities are decentralised, diverse, and "operate in unique social, demographic and economic spaces" (p. 2), they have their own ability to manage their incomes and expenses to provide sustainable service delivery (Kleynhans & Coetzee, 2019). However, the authors highlighted that 26 percent of SA municipalities were in a poor financial position by the end of 2015 and that there is substantial vagueness regarding their continued operation. In addition, while the boosting of revenue collection is crucial for SA municipalities to meet service delivery demands, it remains a challenge, as municipalities serve mostly the poor and enforcing revenue collection is impossible due to their "rights and access to basic services" (Chauke & Sebola, 2016, p. 431)

According to Kleynhans and Coetzee (2019), other significant factors that are affecting the municipalities financial position are "the ratio of people of non-working age to the total population" and a number of socio-economic factors, such as "population size, age, profile of the population, density, poverty levels, and economic environment" (p. 23).

In this section, it was highlighted that municipalities are under performing, that service delivery is severely affected, and that socio-economic challenges are indicated as reasons for a municipality's financial challenges. Given this background, the following section provides an analysis of SA's economic growth and inequality.

### 2.2.4. Economic growth and inequality

Numerous studies had been conducted to analyse the relationship of economic growth with respect to education, economic openness and freedom, energy consumption, carbon dioxide emissions, human capital investments, government expenditure, household savings and financial development (Akinwale & Grobler,

2019; Bekun et al., 2019; Ilesanmi & Tewari, 2017; Mongale et al., 2018; Odhiambo, 2015), and these studies have consistently highlighted the significance of economic growth as it underpins almost all aspects of a country's wellbeing.

SA's economic growth was 1.3 percent in 2017, 0.8 percent in 2018, 1.1 percent in Jan 2019, and "gross domestic product (GDP) per capita growth has been close to nil since 2014". Although the population has grown, this implies that poverty is not reduced as yet (The World Bank, 2019, para. 2). Furthermore, according to Trading Economics (2020b, para. 1), SA's "GDP shrank an annualized 51% on quarter in the three months to June of 2020" and "it was the steepest economic contraction since at least 1990", due to the Covid-19 pandemic. It is evident from the World Bank and Trading Economics data that the GDP of South Africa is comparatively lower than other developing countries.

The World Bank (2019, para. 4) also highlighted that SA's consumption expenditure Gini coefficient had increased from 0.61 in 1996 to 0.63 in 2015, which resulted in SA being "a dual economy with one of the highest inequality rates in the world". The World Bank (2019, para. 4) further noted that this inequality has persisted from the beginning of democracy, and "inequality in wealth is even higher: the richest 10% of the population held around 71% of net wealth in 2015, while the bottom 60% held 7% of the net wealth". According to Southall (2014, p. 49), even though racism has been addressed by the post-apartheid government, high levels of "socioeconomic disparities between classes and races" still remain in the country.

One of the major factors contributing to overall economic growth is investment in infrastructure which can create production facilities to encourage economic activities that can reduce transaction costs and trade costs; that can raise the level of competitiveness; that can provide employment opportunities; and that can provide physical and social infrastructure to the poor (Chotia & Rao, 2017). However, according to the South African Government News Agency (2018, para. 1), "the infrastructure investments needed in South Africa far exceeds the available fiscal resources", thereby posing a threat to SA's economic growth.

### 2.2.5. Poverty and unemployment

Irrespective of the SA government's attempts to improve the quality and wellbeing of their citizens lives, "based on the international poverty line of $1.90 per day, (2011 Purchasing Power Parity, exchange rates), 18.8% of South Africans were poor in

2015, following a decline from 33.8% in 1996" (The World Bank, 2019, para. 3). Although there is a 44.4 percent decline in poverty from 1996 to 2015, 18.8 percent is still high, and The World Bank (2019, para. 3) noted that aspects that have had an impact on poverty are "real income growth, expansion of social safety nets, access to basic services including subsidised housing credit", poor economic growth following the 2008 global financial crisis, and SA's lack of highly skilled individuals.

Another key challenge in SA is unemployment which stands at "27.6% in the first quarter of 2019", and that "the unemployment rate is even higher among youths, at around 55.2%" (The World Bank, 2019, para. 3). According to Lannoy, Swarts, Lake and Smith (2015), youth unemployment is an effect of the increased demand for highly skilled labour. Another major factor that has resulted in the high unemployment levels is racism as "the legacies of apartheid persist in disadvantaging black Africans and those of lower socio-economic status, even after their attainment of a higher education qualification", irrespective of the fact that SA's higher education system is deracialised (Baldry, 2016, p. 807). The author further noted that challenges faced by SA in terms of employment are "skills shortage or skill mismatch between higher education supply and labour market demand" (p. 790).

According to The World Bank (2019), SA lags behind its peers on inequality, poverty and inclusiveness of consumption growth, and that factors such as commodity prices (mineral exports and oil imports) and increasing investment including foreign direct investment will be essential to alleviate SA's unemployment and boost its economic growth.

Due to the high digitalisation nature of smart cities, it is also vital to understand the important technology factors affecting the country. The section below provides an analysis of the e-government and digital divide within the country.

### 2.2.6. e-Government and the digital divide

Electronic government, also referred to as e-government, is not successful in SA, even though various strategic plans and policies are in place to support the initiative (Mawela, Ochara & Twinomurinzi, 2017). The authors identified that a "lack of funding, shortage of skills, poor leadership and the profile of ICTs in municipalities" (p. 165) are the main reasons for the minimal successful implementation of e-government initiatives in SA.

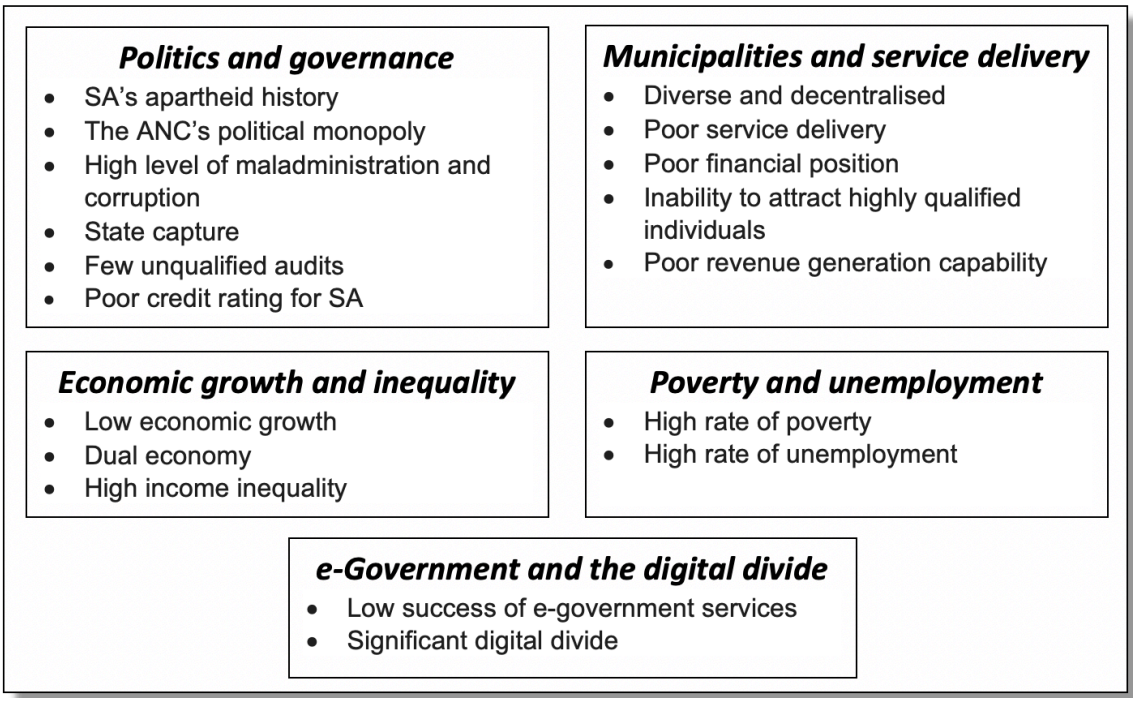
The digital divide is referred to as “the differential ability of individuals and groups to benefit from the presence of the technologies” (Carlson & Isaacs, 2018, p. 247). In SA, it was identified that 33 percent of households did not find any significance in having internet access at home. The reasons for this are a lack of knowledge/skills/confidence, a lack of interest, high equipment cost, access to the internet outside of the home, high subscription costs, and concerns about harmful or inappropriate content (Chetty, Qigui, Gcora, Josie, Wenwei & Fang 2018).

According to Lavery et al. (2018), the primary reasons for the digital divide are due to the economic gap and geographical gap, and that much of the population in South Africa is not connected due to market driven deployment. The authors further stated that SA “would need some 160,000 km of fibre to provide network access comparable with developed nations” which requires a considerable capital investment thereby “creating an impenetrable economic barrier to provide even basic network infrastructure” (p. 2). In addition, Nyahodza and Higgs (2017, p. 1) highlighted other factors that influence the digital divide which include a “lack of Information and Communication Technology (ICT) infrastructure, a lack of or low internet connections, a lack of skills, and high levels of poverty”. The authors also identified that access to ICT and information-related skills are key challenges that need to be overcome in bridging the digital divide.

### 2.2.7. Summary of the country analysis of SA

Section 2.2 provided an overview of the country analysis of SA in terms of politics, governance, SA municipalities and issues surrounding service delivery and financial constraints, economic growth, socio-economic challenges such as poverty, unemployment and inequality, and technology factors such as e-government and the digital divide. **Figure 1** below depicts the most significant factors that are impacting SA.

**Figure 1**: *Significant factors impacting SA*




Source: (Baldry, 2016; Bruce, 2019; Chauke & Sebola, 2016; Chetty et al., 2018; Kleynhans & Coetzee, 2019; Lavery et al., 2018; Mawela et al., 2017; Mello, 2018; Munzhedzi, 2016; Southall, 2014; The World Bank, 2019; Trading Economics, 2020b, 2020a; Wentink & Niekerk, 2017; Young, 2018)

The following sections present the literature review conducted on smart cities.

## 2.3. Smart city definitions and dimensions

### 2.3.1. Definitions

Ruhlandt (2018) noted that the smart city concept is vague and that there is no common definition available. It is therefore critical to explore different definitions that are available in the smart city literature to arrive at an ubiquitous definition that is adopted for the purpose of this research. **Table 1** below highlights a few of the latest smart city definitions.

**Table 1:** *Smart city definitions*

| Author(s) | Smart city definition |
|---|---|
| (European Parliament, 2014) | "a place where the traditional networks and services are made more efficient with the use of digital and telecommunication technologies, for the benefits of its inhabitants and businesses" (as cited in Kumar, Singh, Gupta, & Madaan, 2018, p.1) |

| Author(s) | Smart city definition |
|---|---|
| (United Nations Economic Commission for Europe & International Telecommunication Union, 2015) | "an innovative city that uses information and communication technologies (ICTs) and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social and environmental aspects" (as cited in Al-Nasrawi, Adams, & El-Zaart, 2015, p.546) |
| (Ruhlandt, 2018) | "a multi-dimensional mix of human, infrastructural, social and entrepreneurial capital that are merged, coordinated and integrated into the fabrics of the city using new technologies to address social, economic and environmental problems involving multi-actor, multi-sector and multi-level perspectives" (p.1) |
| (Ismagilova et al., 2019) | "use an IS centric approach to the intelligent use of ICT within an interactive infrastructure to provide advanced and innovative services to its citizens, impacting quality of life and sustainable management of natural resources" (p.90) |
| (Rana et al., 2019) | "technologically advanced and modernised territory with a certain intellectual ability that deals with various social, technical, economic aspects of growth based on smart computing techniques to develop superior infrastructure constituents and services" (p.503) |

Source: (Al-Nasrawi et al., 2015, p. 546; Ismagilova et al., 2019, p. 90; Kumar et al., 2018, p. 1; Rana et al., 2019, p. 503; Ruhlandt, 2018, p. 1).

In assessing the common factors among the above definitions as listed in **Table 1**, this research adopted the following as the definition of a smart city: “A smart city is an innovative city that utilises ICT to address social, economic and environmental aspects that will improve the citizen's quality of life, improve the efficiency of urban operations, improve competitiveness, provide sustainable management of resources, develop superior infrastructure and provide superior services to citizens” (Al-Nasrawi et al., 2015, p. 546; Ismagilova et al., 2019, p. 90; Kumar et al., 2018, p. 1; Rana et al., 2019, p. 503; Ruhlandt, 2018, p. 1). The characteristics and dimensions of a smart city are discussed below.

### 2.3.2. Dimensions

The six dimensions of a smart city are economy, people, governance, mobility, environment and living (Albino et al., 2015; Anthopoulos, Janssen & Weerakkody, 2015; Kumar et al., 2018).

The role of these dimensions was further elaborated by Winkowska and Szpilko (2020, p. 526), as noted below:

I. The role of a smart economy is to drive innovation through partnerships between businesses, creation of innovation teams, and involving research units and citizens;

II. The role of smart people is to co-create and utilise smart solutions through highly intellectual, highly qualified, innovative and willing residents of the city;

III. The role of smart governance is to ensure transparency, and to improve citizens' involvement through improved governance systems and engaged stakeholders;

IV. The role of smart mobility is to ensure easy "mobility of people in cities – by developing clean public transport, technology-supported fuels and propulsion systems and citizens' proactive behaviour";

V. The role of a smart environment is to promote a sustainable and green economy, and efficient resource management;

VI. The role of smart living is to improve the citizens quality of life (such as cultural, educational and tourism events) and to provide a quality healthcare system.

Nilssen (2019) emphasised that the three important dimensions of a smart city are, "technology, human capital and collaborative governance" (p. 99). However, Silva et al. (2018) identified that sustainability, quality of life, smartness and urbanisation are key characteristics of a smart city, and that "institutional infrastructure, physical infrastructure, social infrastructure and economic infrastructure are the four pillars of a smart city" (p. 699). The authors further noted that a smart city is composed of a smart community, smart hospitality, smart transportation, smart healthcare, smart warehouse, smart factory and smart grid.

Vishnivetskaya and Alexandrova (2019) also confirmed that the different elements of a smart city framework are smart infrastructure, smart utility, smart mobility, smart environment, smart business, smart living, smart education, smart citizen/community, and smart government.

While these characteristics, dimensions and elements of a smart city are critical from a country's perspective, a far more extensive evaluation needs to be undertaken to explain how these factors have affected different countries and their growth. The section below delves further into key smart city initiatives undertaken by a few developed and developing countries.

## 2.4. Smart city initiatives

### 2.4.1. Smart cities in developed countries

The European Union (EU) is faced with the need for transitioning to a low-carbon economy due to its extensive dependence on fossil fuel imports from various countries, and one method of achieving a low carbon economy is through the implementation of smart city projects (Veselitskaya et al., 2019). The authors further stated that energy efficiency measures are one of the key drivers of implementing smart city projects in the EU.

The city of Dubai is an example of how smart city initiatives have contributed towards improving service delivery to citizens and tourists. “Smart Dubai” was officially launched in March 2014 and comprised “hundreds of initiatives and ten times as many government services in the areas of infrastructure, urban planning, transport, electricity, communications and economic services” (Khan, Woo, Nam, & Chathoth, 2017, p. 7).

The popular mobile applications implemented as part of smart city initiatives in Dubai are iDubai (Dubai municipality's official app), RTA Dubai (provides information related to road and transportation), Dubai Calendar (an official listing of Dubai's events), Time Out Dubai (popular lifestyle magazine), mParking Dubai (online payment app for parking in Dubai), The Dubai Mall (mall navigation app using GPS and a 3D map), UAE Yellow Pages (local businesses contact information) and Careem/Uber (transport app) (Khan et al., 2017)

A text mining analysis was conducted to understand how Dubai is perceived, and the results indicated that citizens and tourists perceive Dubai to be an exciting and competent city. However, it was also highlighted that there are limitations in Dubai's smart city systems, which are related to adaptive criteria, that is, “Situational and idiosyncratic needs” (p. 20) need to be improved and implemented from a citizen’s perspective, as the current approach is aligned more towards tourists and visitors (Khan et al., 2017).

While countries around the world are taking initiatives to develop smart cities, Singapore announced in 2014 that it would transform into a smart nation by "coordinating and intensifying the effort to develop the institutions, regulations and talent for a hyper-connected, data-fed urbanity" (Hoe, 2016, p. 6).

Angelidou (2017) conducted a study on various smart city cases across different countries, namely, The Netherlands, Spain, the United Kingdom, Portugal, Sweden, Singapore, Saudi Arabia, United Arab Emirates, Russia, South Korea and the USA. The survey revealed that technology played a vital role in "a better function of ICT infrastructures, education in cities, businesses and finance, research, and transport management and city hall services" (p. 9) and that a critical goal of all these smart cities is to enhance "citizen participation and civic innovation" (p. 12).

However, according to the authors, these smart cities have issues with data security and privacy, and that they are completely disconnected from their environment. It was also identified that the "knowledge and innovation economy" (p. 10) growth is dependent on the "hard and soft infrastructure" (p. 13) of the country (Angelidou, 2017). The hard infrastructure refers to "buildings, energy grids, natural resources, water and waste management, mobility, logistics", while soft dimensions refer to "education, culture, policy innovations, social inclusion and government" (Albino et al., 2015, p. 10).

Despite the data privacy and security issues, it is evident that smart city projects drive a country's triple bottom line, that is, people, planet and profit by providing a low carbon economy, improving energy efficiency, and by creating an exciting and competent city that drives efficient service delivery and enhanced citizen collaboration. The following section discusses the smart city initiatives in developing countries.

### 2.4.2. Smart cities in developing countries

According to Vu and Hartley (2017), smart cities in developing countries are not just a choice, but "a critical strategic choice" to improve quality of life (p. 12). The authors conducted research on Vietnam with respect to smart cities, and it was identified that "improving basic infrastructure", "enhancing government competence", "upgrading the education system", "strengthening the fight against corruption" and "promoting job creation" are the five topmost policy priorities that Vietnam needs to place emphasis on, in order to succeed in smart city developments (p. 10).

This study also revealed that e-government services could control corruption activities and that the lack of a strategic vision is a greater impediment in developing smart cities than the funding and procurement of resources. In contrast, another smart city study within the Indian context revealed funding as the main inhibitor to developing a smart city (Chatterjee & Kar, 2015). It was also noted that smart cities in developing countries such as Vietnam could face the risk of being applied more to operational improvements such as “public document availability, day-to-day work efficiency, and connectivity to citizens”, than to institutional developments such as “citizen consultation and performance feedback systems”, as operational improvements could provide government with the “quick wins” they require (Vu & Hartley, 2017, p. 10).

A study within the Chinese context revealed that the government plays a major role in developing smart cities. However, in future, the creation of a smart city will be more market-oriented and driven whilst the government will focus more on “standardisation, law-making, planning and comprehensive arrangement”, and private companies will be the major stakeholders in developing smart cities, given that the sensors, network and infrastructure are in place (Li et al., 2015, p. 17).

A progress report on Chinese smart city pilots by Liu and Zhenghong (2014) noted that smart cities in China had created a positive impact in terms of “life enrichment, public administration and service, and wide-scale resource management” (p. 75). According to the authors, life enrichment included “home, community, healthcare and education” (p. 75), while public administration and service included “public safety supervision, food safety supervision, smart traffic and environmental protection” (p. 76), and wide-scale resource management includes “water, electricity and agriculture” (p. 77).

In reviewing the smart city literature within the Indian context, it was identified that smart cities in India would have a positive impact on citizens’ standard of living; however, data security and privacy may pose problems (Chatterjee & Kar, 2018). The smart cities mission in India is aimed at improving city competitiveness to attract business and investment, and although 100 smart cities were planned in 2014, very little progress has been made (Das, 2020). This clearly indicates that there are barriers to developing smart cities in India.

### 2.4.3. Smart cities in South Africa

Das and Emuze (2014) argued that cities do not need to perform exceptionally well in all six smart city dimensions to become smart. The authors conducted a study on Bloemfontein, a city in SA, from a smart city perspective. It was identified that the city performed poorly in mobility, economy, people and living aspects, while the city performed better on environmental and governance factors. These two factors can, therefore, form the building blocks to inspire Bloemfontein to become a smart city (Das & Emuze, 2014).

South Africa's "public transport is lacking structure and efficiency" (p. 12) which results in high traffic congestion, and a solution to address this issue is through smart transportation and traffic systems that utilise smart city technologies such as "autonomous vehicles" (p. 8), "smart navigation systems" (p. 8), internet-of-things (IOT) enabled parking reservation systems, dynamic buses that include on-the-fly changes in GPS systems and integrated emergency response systems (Jordaan, Malekian & Malekian, 2019). Lange (2016) noted that the City of Johannesburg (COJ) has included smart city development as part of its integrated development plan (IDP) and aims to become a "world class African city that is resilient, sustainable and liveable" (p. 12).

The authors further stated that South Africa is facing issues in "accessibility to health services" (p. 13) due to an uneven ratio between the increasing urban residents and decreasing healthcare professionals which requires new modes of healthcare, which can be addressed through smart health systems that include "new prognosis capabilities", "remote patient monitoring, personal healthcare data management, remote tele-health consultation, location based services", "timing based services" and "IOT based wearable devices and sensors" (p. 10).

In contrast, Musakwa and Mokoena (2018) noted that smart city initiatives undertaken in Johannesburg, the City of Cape Town and Ekurhuleni are misplaced priorities, as SA has other critical needs such as the provision of basic services, for example, water and sanitation, housing facilities, unemployment and crime, and that these issues need to be addressed prior to implementing smart cities. Nevertheless, the authors agreed that smart city initiatives in these three municipalities has "led to improved governance, participation and better response on problems and service delivery" (p. 8).

Some smart city initiatives undertaken in Johannesburg are smart mobility projects, such as the building of “cycling lanes in Johannesburg CBD” (p. 4), the Rea-Vaya project – “Africa’s first full Bus Rapid Transit” (BRT) (p. 4), the “Gautrain high speed train” (p. 5), and Internet connectivity projects such as public libraries fibre connectivity, video learning facilities in libraries, “free wi-fi hotspots in the city” (p. 4), ICT training for youth programmes, and “smart policing through closed circuit television (CCTV)” (p. 4) (Musakwa & Mokoena, 2018).

The City of Cape Town is considered “a leader in Africa in smart city initiatives” and has won several awards. Some of its initiatives are internet connectivity projects similar to Johannesburg; smart grid projects; implementation of an integrated “enterprise resource planning (ERP) system” that manages “financial, revenue, human resources, operations and other services”; smart mobility projects such as My Citi bus, an integrated BRT system and ongoing investment in building cycling lanes (Musakwa & Mokoena, 2018, p. 7).

Ekurhuleni’s smart city initiatives focus on interconnectivity projects such as Wi-Fi connectivity for the public and employees; service delivery projects, such as the implementation of a mobile application to report “crime, potholes and vandalism”, “smart electricity metering”; smart mobility projects, such as a “transport monitoring and control centre” and a new BRT system that is under construction (Musakwa & Mokoena, 2018, p. 8).

Modderfontein, a city in Johannesburg, was a “private sector-led, large-scale” smart city project initiated in 2014. However, it has not realised its goals of achieving a “smart/sustainable urbanisation” comprising “55,000 housing units, 1,468,000 square meters of office space” with all the necessary amenities for urban life (Brill & Reboredo, 2019, p. 186). A qualitative analysis performed by the authors consisting of extensive fieldwork and 50 interviews revealed that the reasons for the failure are transnational capital challenges, governmental institution’s “strong negotiating position” and a need for “legislative and regulatory environment’s support” for the state's agenda (p. 186).

Lange (2016) encouraged South African municipalities to become “early adopters” (p. 12) of smart city technologies for improved service delivery and to achieve a reduction in service delivery costs through an enhanced revenue collection process.

The diffusion of innovation theory will therefore be utilised to assess smart city adoption levels.

Smart city initiatives in developing and developed countries were discussed with an emphasis on SA. However, it is important to assess SA's smart city initiatives through a theoretical lens to understand its level of adoption of smart city technologies. The following section provides the theoretical framework for this study.

### 2.5. Theoretical framework: diffusion of innovation theory (DIT)

The diffusion of innovation theory (DIT) is an "extensive social and psychological theory that aims to help predict how people make decisions to adopt a new innovation by finding their adoption patterns and understanding its structure", and portrays five innovation characteristics, namely, "relative advantage, complexity, compatibility, observability and trialability" (Min et al., 2018, p.3).

Congruent with this definition, the smart city concept portrays all characteristics of innovation, that is, "relative advantage, compatibility, complexity, trialability, cost efficiency, evidence and risk" (Ojo, Curry, & Zeleti, 2015, p.2). Relative advantage refers to the measurement of the impact of smart cities on citizens' wellbeing and other smart city dimensions; compatibility refers to the flexibility of the smart city concept to cater for various stakeholders' interests and the city's context; complexity refers to the difficulty level of smart cities; trialability refers to the smart city's experimentation nature; cost efficiency refers to the effective cost of smart cities compared to existing approaches; and evidence refers to the past experience and history available, and risk refers to the risk level associated with a smart city implementation (Ojo et al., 2015).

Furthermore, Tachizawa, Alvarez-Gil and Montes-Sancho (2015, p. 243) noted that the adoption of smart cities can be better understood under the theoretical lens of the diffusion of innovation theory, that "specific characteristics of the technology determine IT adoption", and that the adoption of smart city systems/technologies "is driven simultaneously by the demand of firms in the network and the supply of new technologies".

The five stages of adoption within the DIT context are the "knowledge stage, persuasion stage, decision stage, implementation stage and confirmation stage" (Kaminski, 2011, p. 5). In the knowledge stage, an innovation is exposed to potential adopters, but lacks the complete information; the persuasion stage refers to the stage

in which potential adopters indicate an interest in the innovation; the decision stage refers to the stage in which potential adopters make decisions to either adopt or not; the implementation stage refers to the stage in which the adopters “makes full use of innovation”; and the confirmation stage is the stage in which the adopters “decide to continue the full use of innovation” (Kaminski, 2011, p. 5).

In analysing smart city developments in SA, and in light of the President’s 2020 SONA address, it is evident that South Africa has moved beyond the decision stage to the implementation stage; but that its adoption of innovation is disjointed. In addition, one can also argue that the demand for smart city technologies in SA will be high as smart city developments in SA are driven by political leaders, thereby increasing the adoption rate, which is in line with the contention of Tachizawa et al. (2015). Furthermore, Ojo et al. (2015, p. 2) advised that, from a DIT perspective, a smart city should be communicated to various stakeholders including “different city authorities or departments” and citizens “through several channels such as events, briefings or explicit directives from city administrators” to derive the benefits of smart cities. SA, therefore, needs to employ widescale integration of innovation to fully benefit from the adoption of smart cities.

Given the background above, and considering smart city developments in SA, it is evident that there are not many successful smart city initiatives implemented. Although SA has moved from the decision stage to the implementation stage, it is evident that the adoption level is low. It is therefore essential to identify the drivers and barriers for the adoption of the smart city paradigm within the SA context.

A literature review of the smart city drivers and barriers is provided in sections 2.6.1 and 2.6.2 respectively.

## 2.6. Drivers and Barriers for smart cities development

### 2.6.1. Smart city drivers

Although smart cities have been studied extensively, there is no unanimous agreement on the factors or drivers that are important to make a city smart (Guedes et al., 2018). This was also affirmed by Yigitcanlar et al. (2018), wherein the authors noted that there is no consensus on what constitutes a smart city, smart city drivers, smart city outcomes or benefits, and the conceptualisation of the smart city notion, even though the concept of a smart city is highly popular in academic literature.

A quantitative study focusing on the drivers to increase the intelligence of cities involving participants from Brazil revealed that all highly prioritised drivers are related to governance, which include “urban planning, cities infrastructure, sustainability, mobility, public safety, health, and public policies”, and that drivers such as “the sociotechnical impacts of digitization, logistics applications, and relationship management” are considered to be of low priority (Guedes et al., 2018, p. 13). In contrast, a systematic review of the literature on smart city drivers revealed that the three main drivers of smart cities are “community, technology and policy”, and that the key desired outcomes are “productivity, sustainability, accessibility, wellbeing, liveability, governance” (Yigitcanlar et al., 2018, p. 145).

When studying the above two articles, it is evident that their perceptions differ. For example, governance factors are considered to be the key drivers in the first study, whereas it is considered to be a desired outcome in the second study. Similarly, the first study indicated detailed drivers, while the second study indicated a very high level of drivers such as community, technology and policy.

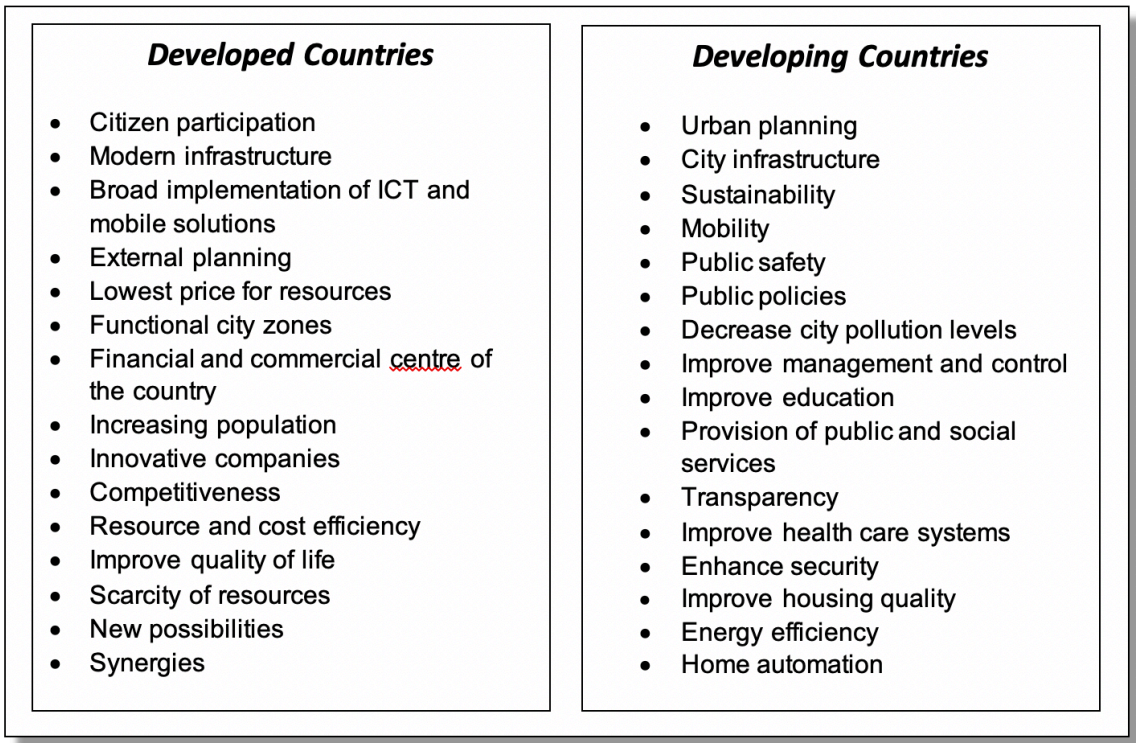
According to a study conducted by Veselitskaya et al. (2019) on the drivers of “smart cities development in Europe (Barcelona), the USA (Charlotte), and Asia (Shanghai and Tokyo)” (p. 88), utilising a case study method, it was identified that “citizens participation in city management, modern infrastructure and broad implementation of ICT and mobile solutions” (p. 107) are the main drivers for Barcelona; that “citizens participation in city management, and external planning” (p. 107) are the drivers for Charlotte; that “lowest prices for resources, functional zones of the city, and financial and commercial center of the country” (p. 107) are the drivers for Shanghai; and that “high achievements in energy efficiency and home automation, and high demand from the EU on the green technologies” (p. 107) are the drivers for Tokyo (Veselitskaya et al., 2019).

An article on participative foresight for smarter cities in Winterthur indicated that “increasing population, innovative companies, competitiveness, resource and cost efficiency, quality of life improvement, scarcity of resources, new possibilities and synergies” are the main smart city drivers (Furrer, Carabias, Musiolik, Yildirim, Kuehn, Sokolov, Saritas & Veselitskaya, 2017, p. 15). When comparing the smart city drivers for Winterthur against Barcelona, it is evident that these drivers are different for each country; even though these cities exist on the same continent and belong to the EU.

A study, conducted on “drivers of smart city developments in South Africa through the survey of professionals currently practising in the construction industry in Gauteng province”, assessed these drivers based on the six smart city dimensions through a pre-populated list of smart city drivers identified via a literature review (Oke et al., 2020, p. 122). The study indicated that key smart city drivers in SA are, “decreasing the pollution levels within cities”, improving “the city’s utility management and control using smart meters”, “the provision of improved education and facilitating lifelong learning among South Africans, provision of public and social services and government transparency, improved health care delivery, innovative educational institutions, enhanced security, and improving housing quality” (p. 122).

In summary, it was identified that not all smart city drivers are applicable to all countries, and that each country has its own drivers due to the difference in the context between the countries. These drivers will differ among countries based on their needs and priorities. **Figure 2** provides an overview of the smart city drivers of developed and developing countries based on the literature review conducted.

**Figure 2***: Overview of smart city drivers based on the literature review*




Source: (Furrer et al., 2017; Guedes et al., 2018; Oke et al., 2020; Veselitskaya et al., 2019)

The barriers for developing smart cities are discussed in the following section.

### 2.6.2. Smart city barriers

A SWOT analysis of EU smart city projects revealed that the weaknesses of such projects were communication between project participants and the public to increase awareness, expertise in designing new technologies and solutions, and inertia, while threats were subsidies, requirements from the European Commission concerning reporting and accountancy and ownership structure of realities (Pezzutto et al., 2016). In contrast, most of these factors were not listed as barriers in developing countries, such as India. Rana et al. (2019) performed a study on understanding the barriers in developing smart cities within the Indian context and the following factors were identified as barriers.

I. Governance factors - “political instability, lack of cooperation and coordination between city’s operational networks, unclear ICT management vision, poor private-public participation, lack of trust between governed and government and lack of developing a common information system model” (p. 510);

II. Economic factors - “lack of competitiveness, global economic volatility, high ICT infrastructure and intelligence deficit, higher operational and maintenance cost, cost of IT training and skills development” (p. 510);

III. Technology factors - “lacking technological knowledge among the planners, lack of access to technology, privacy and security issues, system failure issues, integration and convergence issues across ICT networks, poor data availability and scalability” (p. 510);

IV. Social factors - “lack of involvement of citizens, low awareness level of community, geographical diversification problems, degree of inequality” (p. 510);

V. Environmental factors - “growing population problems, carbon emissions effect, lacking ecological view in behaviour, degradation of resources, lack of sustainability considerations” (p. 510);

VI. Legal and ethical factors - “lacking standardisation, issues of openness of data, lack of transparency and liability, cultural issues, lack of regulatory norms, policies and directions” (p. 510).

However, Chatterjee and Kar (2015, p. 4) listed factors such as, “budget constraints, smart technology is still in pre-commercial stage, a lack of technology related skills,

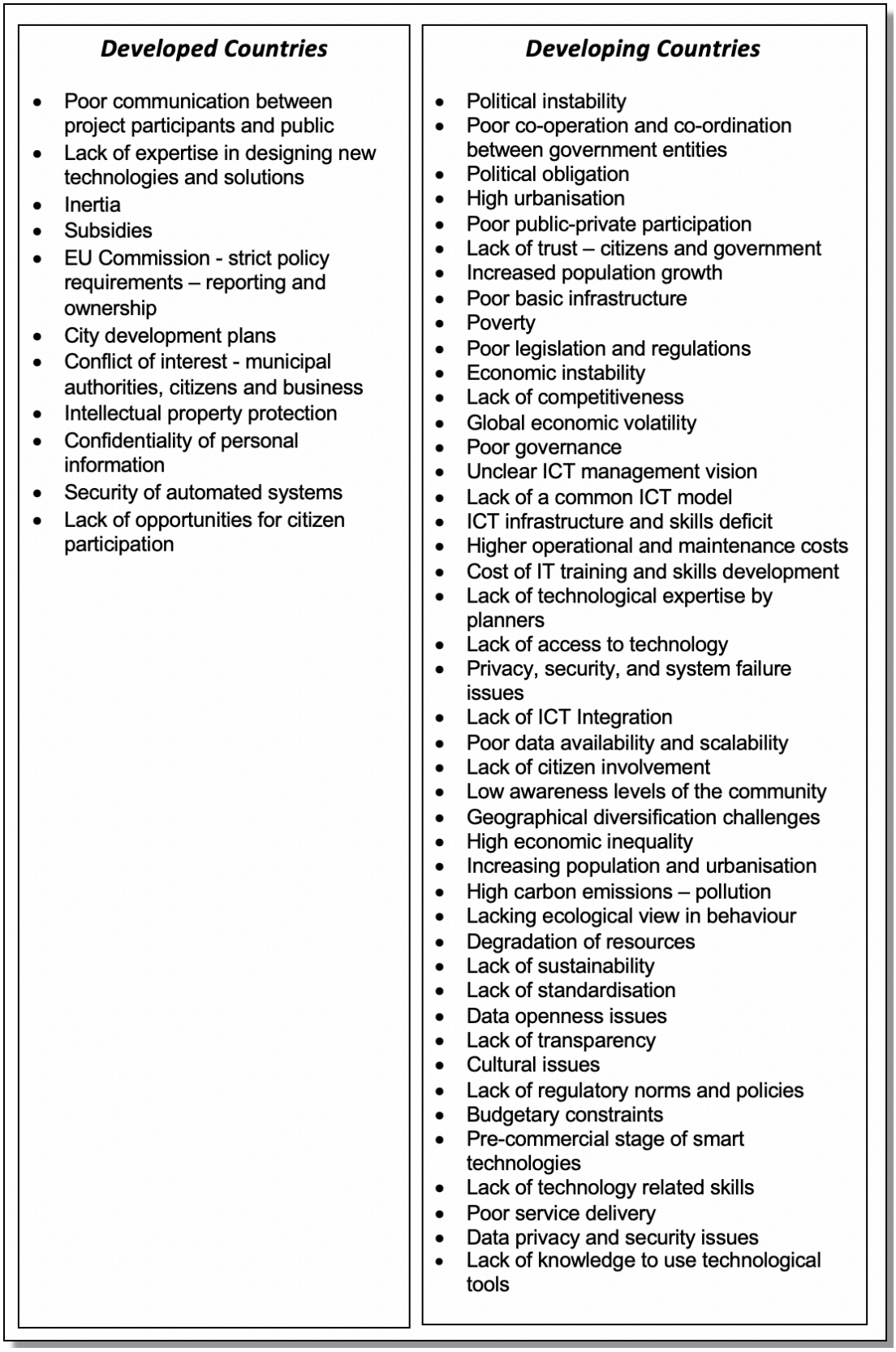
the constraint of integration, limited influence over some basic services, an issue of data privacy and security, lack of knowledge of people for use of modern technology, political obligation" to be the challenges in developing smart cities within the Indian context.

Veselitskaya et al. (2019) performed a case study analysis on smart cities within Barcelona, Charlotte, Shanghai and Tokyo and identified a few new barriers compared to the barriers identified by the studies above, such as "land lease, plan is the main document that determines the city development, and conflict of interests of municipal authorities, citizens and business" (p. 107) along with the common barriers identified in the Indian context, such as "intellectual property protection, confidentiality of personal information, security of automated systems, lack of opportunities of citizens to participate in city management" (p. 107).

A study conducted in Nigeria revealed that "high urbanisation, increased population growth, poor basic infrastructure, poverty, poor legislation and regulations, economic instability, poor governance" are the major smart city barriers (Aghimien, Aigbavboa, Edwards, Mahamadu, Olomolaiye, Nash & Onyia, 2020, p. 13).

**Figure *3*** provides an overview of the smart city barriers of developed and developing countries based on the literature review conducted.

**Figure 3***: Overview of smart city barriers based on the literature review*




Source: (Aghimien et al., 2020; Chatterjee & Kar, 2015; Pezzutto et al., 2016; Rana et al., 2019; Veselitskaya et al., 2019)

An analysis of the above barriers indicated that data privacy and security, and a lack of citizens' participation are common factors. Similar to the analysis of the smart city drivers, it is evident from the literature review that each country's context will affect the barriers that are hindering their development of smart cities. It is also clear from the above studies that each country has different barriers from a smart city perspective.

The section below provides the concluding remarks for the literature review and the rationale for this research.

## 2.7. Conclusion

This chapter analysed the factors pertaining to politics, governance, SA municipalities, service delivery, economics, inequality, poverty, unemployment, e-government and the digital divide within the context of SA to provide a background of the country within which this research is conducted.

The country analysis was followed by a smart city definition that will be adopted for the purpose of this research. This chapter also illustrated the role of ICT in the development of smart cities to address the social, economic and environmental challenges within a country, by exploring the various smart city dimensions. In addition to highlighting the advantages of adopting the smart city paradigm, this literature review has outlined various smart city initiatives within developed and developing countries, including SA. The diffusion of innovation theory was utilised to understand the adoption level of the smart city paradigm within SA, followed by a review of various drivers and barriers of smart city developments worldwide.

This chapter also illustrated that a 'one size fits all' approach for smart cities is not a viable option, and that smart city ideas need to be contextualised from a country's perspective as they "vary in sizes and their associated problems" (Aghimien et al., 2020, p. 2). Furthermore, the smart city paradigm cannot be studied in general, and needs to be studied within a country's context due to the difference in various factors, such as resource availability, geographic location, and the social and economic landscape (Musakwa & Mokoena, 2018). It was evident that each country has its own drivers and barriers, and that very few drivers and barriers are common between cities and countries. This research therefore focuses on understanding the drivers and barriers to the adoption of smart cities within the SA context. The next chapter presents the research questions utilised to obtain data for this research.

## Chapter 3: Research Questions

### 3.1. Introduction

This research aims to answer three specific questions that have been derived from the literature review presented in Chapter two. These research questions were formulated to provide insights into the rationale for the development of smart cities in SA. Furthermore, these research questions sought to identify different barriers hindering the development of smart cities in SA and the suggested recommendations to overcome these barriers.

### 3.2. Research question 1

*What is the rationale for the adoption of the smart city paradigm in SA?*

Within the smart city context, smartness refers to "context aware economy and governance" (Arroub, Zahi, Sabir, & Sadik, 2016, p.1). As highlighted in the literature review, smart cities need to be developed from a country's perspective and an 'out-of-the-context' smart city development may not provide the intended benefits desired (Musakwa & Mokoena, 2018). The literature review has also indicated that smart city drivers differ between countries (Oke et al., 2020). This research question is therefore aimed at identifying the rationale for the development of smart cities within the SA context. The rationale is expressed in terms of the drivers for SA smart cities development, and the benefits that these smart cities may derive.

### 3.3. Research question 2

*What are the barriers that are hindering the adoption of the smart city paradigm in SA?*

The development of smart cities assist in alleviating the challenges facing urbanisation that were outlined in Chapter one (Albino et al., 2015; Pezzutto et al., 2016; Rana et al., 2019; Veselitskaya et al., 2019). However, the development of smart cities in SA is limited, and only a few municipalities, such as the City of Cape Town, Johannesburg and Ekurhuleni, have implemented smart city technologies (Musakwa & Mokoena, 2018).

The literature review also suggested that the barriers for smart city developments identified in other countries may not be applicable to SA due to different factors, such as geography, social factors, economic factors and resource availability (Aghimien et al., 2020; Musakwa & Mokoena, 2018). This research question, therefore,

identifies various barriers that are hindering the adoption of the smart city paradigm within the SA context, and also identifies the most impactful barriers among those identified.

### 3.4. Research questions 3

*What are the recommendations to overcome these barriers?*

Research question two therefore prompts research question three, as it is equally significant to discuss the recommendations that are specific to the SA context, that is, to overcome the barriers that have been identified in research question two. This research question aims to understand the recommended sectors or areas in SA that should prioritise the implementation of smart city technologies, and the recommendations to overcome the smart city barriers identified.

### 3.5. Conclusion

This chapter presented three specific questions that formed the basis of this research. This study, through these research questions, is expected to add to the existing body of knowledge in smart city literature by understanding the rationale and barriers to smart city developments within the SA context, and the recommendations to overcome these barriers. The following chapter discusses the research methodology that was utilised to conduct this research.

## Chapter 4: Research Methodology

### 4.1. Introduction

This chapter presents the methodology that was utilised to answer the three research questions that were outlined in Chapter three.

An interpretive paradigm aims to understand the subjective meanings of people in studied domains (Goldkhul, 2012). According to Chowdhury (2014, p. 433), interpretive research is denoted as “methods of the research which adopt the position that people’s knowledge of reality is a social construction by human actors, and so it distinctively rules out the methods of natural science”.

The purpose of the study is to identify the rationale and barriers within the SA context to smart city developments which required an exploration of the participants' viewpoints in order to congregate subjective interpretations. This research thus followed an interpretive philosophy within the research methodology continuum.

### 4.2. Research Methodology and design

According to Jebb, Parrigon and Woo (2017, p. 265), inductive research is aimed at “phenomenon detection”. Inductive composition, as advocated by Berends and Deken (2019), is about presenting a rich narrative on participants’ perceptions and illustrating how the theory emerged from the data. This study, therefore, utilised an inductive approach, as the drivers and barriers within SA were unknown at the commencement of the research and were subsequently identified and ranked from analysing the data collected.

The study encompassed the following aspects: (1) a literature review; (2) interview of the smart city vendors and various stakeholders who were involved in technology roadmap planning and development for the SA municipalities or involved in city planning, development and management within South Africa; (3) collection of data from the interviews; (4) data analysis through Atlas.ti; and (5) theme development on the rich data obtained from the semi-structured interviews.

The study also followed the mono-method qualitative approach due to a single data technique being utilised to identify the drivers and barriers in developing smart cities within the SA context (Saunders & Lewis, 2018). Saunders and Lewis (2018, p. 155) defined an exploratory study as “research that aims to seek new insights, ask new questions and assess topics in a new light”. The drivers and barriers identified within

other developing countries, such as India and Vietnam, cannot be wholly adopted for the SA context due to the differences in terms of geographic location, resource availability, the economic landscape and social and cultural characteristics (Musakwa & Mokoena, 2018).

The literature review conducted as part of this research indicated that there are limited studies on smart cities in SA, and that they mostly pertain to specific cities, such as Modderfontein, Bloemfontein and Gauteng. One study explored only the drivers and not barriers, with its own limitations, such as geographical restriction and the majority of the participants being from the construction industry only. Another study conducted on Modderfontein focused only on its specific smart city initiative, while the Bloemfontein study did not focus on the drivers and barriers of smart cities. It is evident that there is a gap in the literature in terms of understanding the drivers and barriers for the adoption of the smart city paradigm from an SA perspective. This research interviewed participants to acquire new insights and to obtain a deeper understanding of the drivers and barriers to the adoption of the smart city paradigm in SA. An exploratory research design was therefore deemed appropriate.

The term phenomenology, as stated by Gill (2014, p. 3), refers to the “study of phenomena, where a phenomenon is anything that appears to someone in their conscious experience”. The author also stated that among the various types of phenomenology, interpretive phenomenology accentuates the understanding of the participants' perception, and formulating the common ideas among the participants' experiences and knowledge on the studied domain. The phenomena identified within this study were the drivers and barriers in developing smart cities in SA. The study, therefore, focused on an understanding of the participants’ reflective perceptions, opinions, and the common themes of these drivers and barriers. Consequently, Benner’s interpretive phenomenology was considered appropriate for this study.

According to Saunders and Lewis (2018, p. 129), cross-sectional research is “a snapshot of a particular research setting at a particular time”. Data for this study was collected from the participants during a specific time period and, therefore, implied a cross-sectional time horizon.

According to Mcintosh and Morse (2015), semi-structured interviews are utilised when there is adequate objective knowledge about the context but a lack of subjective knowledge. The authors further explained that this objective knowledge

could be utilised as a guideline to frame the interview questions for which the participants can respond as they desire, and the researcher is allowed to delve into these responses. This agility allows the interviewer to gain deeper insights. The data for this study was collected utilising semi-structured interviews in which the participants were interviewed on a set of themes and topics utilising predetermined questions that varied in order, based on the participants' responses (Saunders & Lewis, 2018).

Due to the explorative nature of this study, semi-structured interviews were deemed to be a more suitable approach for this research, as it allowed the interviewer to obtain new insights, gain an in-depth understanding and further probe the responses when required concerning the drivers and barriers to the adoption of the smart city paradigm within the SA context. The research questions identified through the literature review were utilised as a guideline to frame the open-ended questions (see Appendix 3), and the participants were probed to provide their responses based on their subjective knowledge.

### 4.3. Population

According to Rahi (2017, p. 3), the population is defined as "all people or items that one wishes to understand". In line with this definition, the population of this study was identified as smart city vendors and various stakeholders who were involved in technology roadmap planning and development for SA municipalities or involved in city planning, development and management within South Africa. The participants were from private and public entities (mostly from metro and district municipalities), who are knowledgeable about smart cities.

### 4.4. Unit of analysis

In this study, the unit of analysis was the individual's insights and perceptions explicitly related to the drivers and barriers to the adoption of the smart city paradigm within the SA context. These perceptions, insights and acumen allowed for a more comprehensive understanding of the drivers and barriers within a country's context and their perceived importance in terms of smart city developments and the suggested recommendations to overcome those barriers.

### 4.5. Sampling method and size

A non-probability sampling technique was utilised due to an incomplete list of the population and the inaccessibility of the entire population list (Saunders & Lewis, 2018). Accordingly, the possibility of choosing a participant is unknown. With non-probability sampling types, a purposive sampling technique, also referred to as judgement sampling, is defined by Rahi (2017, p. 3) as "a process where researcher uses their own judgment to select a group of people who knows about the problem". This study, therefore, employed a purposive non-probability sampling technique as the study comprised a selection of suitable participants based on the researcher's judgement. The participants were selected based on their merits, expertise, skills, and experience related to smart cities or city planning and management with a basic knowledge of the ICT field. This allowed for meaningful data collection.

Boddy (2016) argues that, in an exploratory study, the sample size is determined based on the context of the study. The author further states that theoretical saturation could also guide the sample size with a sample size of 12 being the data saturation point if the population is relatively homogenous. Saunders and Lewis (2018, p. 165) confirmed this sample size by stating that "for homogeneous populations the sample size will need to be between 4 and 12, while for the heterogeneous populations the sample size will need to be larger, say between 12 and 30". For the purpose of this study, the sampling size was 13. Since this study was inductive and exploratory in nature, the decision over the sufficient sample size was an "iterative, context-dependent decision" made during the data analysis process (Sim, Saunders, Waterfield, & Kingstone, 2018, p. 24). The sample included participants who are knowledgeable about smart cities and belonged to both the private and public sectors. The number of respondents from each sector and their role are provided in **Table 2.** Further details of the respondents are provided in Chapter five (Section 5.2).

**Table 2:** *Sector and role of the chosen sample*

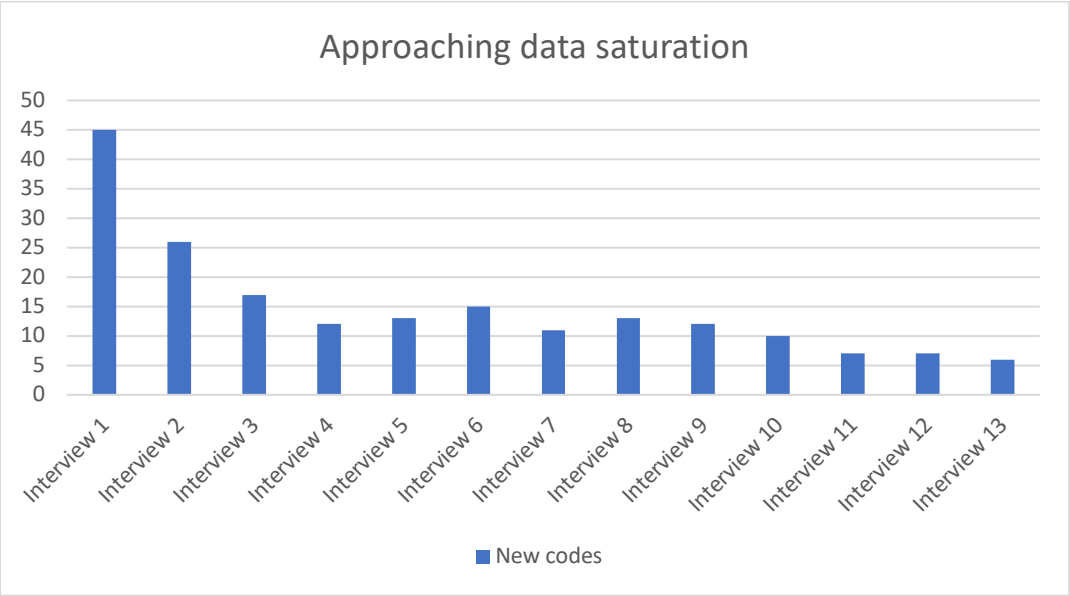
| Sector | Municipality / Company type | Role | Number of respondents |
|---|---|---|---|
| **Public** | District | ICT Manager | 2 |
| | Metro | ICT Manager | 1 |
| | N/A | Project Manager: Smart cities research | 1 |
| | Metro | Deputy city manager | 1 |
| | Metro | Divisional head: Innovation and knowledge management | 1 |
| | Metro | CIO, chair of the Smart City Committee | 1 |
| **Private** | JSE listed company | CEO | 1 |
| | SMME | CEO | 1 |
| | Global company | Country manager | 1 |
| | Global company | Smart Real Estate & Smart Cities Leader | 1 |
| | Global company | Global Markets Executive: Public Sector | 1 |
| | Global company | Safe city Solutions Director | 1 |
| | | Total | **13** |

Source: (author's own)

According to Guest, Bunce and Johnson (2006, p. 65), theory saturation is a process whereby "the researcher deliberately searches for extreme variations of each concept". In terms of this research, there were no extreme variations after ten interviews. Approximately 58 percent of the codes were created after five interviews and 90 percent of the codes were created after ten interviews. The data saturation is also depicted in

**Figure *4*.**

**Figure 4:** *Number of new codes per interview*




Source: (author's own)

### 4.6. Discussion guide

This study relied on semi-structured interviews to gain an in-depth understanding of the drivers and barriers concerning the development of smart cities in SA. The set of interview questions were derived from the literature review. The interview guide is provided in Appendix 3.

This study utilised the five-step process developed by Kallio, Pietilä, Johnson and Kangaseniemi (2016, p. 2961), namely, "1) identifying the prerequisites for using semi-structured interviews, 2) retrieving and using previous knowledge, 3) formulating the preliminary semi-structured interview guide, 4) pilot testing the interview guide and 5) presenting the complete semi-structured interview guide", to ensure trustworthiness and reliability of the study and to provide more credible results.

Open-ended questions were framed in order to avoid confirmation bias related to this guided approach. In addition, the researcher was vigilant of the fact that the participants were providing unrestricted responses when probing. Validity is concerned with the extent to which the study has measured what it was intended to measure (Saunders & Lewis, 2018). The validity of this study was improved with the

use of a consistency matrix as per the guideline provided by the Gordon Institute of Business Science (2020) that included research questions, sections of the literature review pertaining to each research question, and data collection and data analysis methods as depicted in Appendix 4.

According to Saunders and Lewis (2018), pilot testing of this semi-structured interview approach is important to check: (1) if the participants are able to understand the questions; (2) if the questions are not leading; (3) if the questions will provide the researcher with the data that is needed; and (4) if the interview length is within the set time limits. The interview guide for this study was pre-tested with two suitable participants (one from the private sector and one from the public sector) with the required domain knowledge. Since there were no changes required after pre-testing, the interview guide was not amended.

### 4.7. Data gathering process

Data for this study was gathered utilising semi-structured interviews via video conferencing tools. Two-pilot interviews were conducted at the commencement of the data gathering process. Since the pilot interviews were satisfactory and no changes were included, these pilot interviews were included as part of the final sample.

An email request including the research objective, data collection technique and research consent form, were sent to the participants requesting them to partake in the interviews. This email also served as an official introduction between the researcher and the participants, who then reviewed, completed, signed, and returned the research consent form via email.

Upon approval from the participants, appointments were scheduled at a time and medium convenient for them. Prior to the commencement of the interview, permission was obtained from the participants to audio record the interview. Confidentiality was also confirmed to all participants prior to the interview to ensure the credibility and trustworthiness of the study.

Interviews started with a formal introduction, a brief description of the title, the research objective and the smart city definition that was adopted for the purpose of this research. The interview continued with a predetermined set of questions as a guideline. **Table 3** below presents the mapping of the research questions and the interview questions. These questions were probing and open-ended so that

participants could respond without any restrictions. Key points were noted during each interview. The interview recordings were transcribed and utilised, along with the notes, for data analysis.

**Table 3:** *Mapping of research and interview questions*

| Research questions | Interview questions |
|---|---|
| Research question 1:<br>What is the rationale for the adoption of the smart city paradigm in SA? | 1. What do you believe are the main drivers behind these smart city projects?<br>2. What benefits have you derived / did you derive from implementing the smart city project? |
| Research question 2:<br>What are the barriers that are hindering the adoption of the smart city paradigm in SA? | 3. What barriers, if any, did you encounter for the approval of the project? (More emphasis will be given to this question and follow up questions will be based on the responses received)<br>4. What barriers did you encounter / are you encountering / may encounter with respect to the implementation of these projects? (More emphasis will be given to this question and follow up questions will be based on the responses received)<br>5. Which barriers, as discussed above, do you consider to be most significant? |
| Research question 3:<br>What are the recommendations to overcome these barriers? | 6. What are your recommendations to address these barriers?<br>7. Which sector do consider to be most important to implement a smart city project? |

Source: (author's own)

### 4.8. Analysis approach

According to O'Kane, Smith and Lerman (2019, p. 1), analysing qualitative data "involves iterating among coding, verifying, and exploring the research data". Since the nature of the study was qualitative and the data was collected utilising semi-structured interviews, the data to be analysed was in text form. The interview recordings were "transcribed and word-processed and then analysed as text-data"

along with the notes taken during the interviews (Saunders & Lewis, 2018, p. 202). The text-data was subjected to a data scrutiny process to understand the initial insights and data saturation. The data was then analysed utilising computer-aided/assisted qualitative data analysis software (Atlas.ti) to address the drawbacks associated with manual data analysis, as the manual process could be “extremely time-consuming, messy, and mysterious” (O’Kane et al., 2019, p. 1).

The data analysis followed a six-phase process suggested by Braun and Clarke (2006, p. 87) to cater for accuracy. The six-phase process is listed in **Table 4** below.

**Table 4:** *Phases of Thematic Analysis*

| **Phase** | **Description of the process** |
|---|---|
| 1. Familiarising yourself with your data: | Transcribing data (if necessary), reading and rereading the data, noting down initial ideas. |
| 2. Generating initial codes: | Coding interesting features of the data in a systematic fashion across the entire data set, collating data relevant to each code. |
| 3. Searching for themes: | Collating codes into potential themes, gathering all data relevant to each potential theme. |
| 4. Reviewing themes: | Checking in the themes work in relation to the coded extracts (Level 1) and the entire data set (Level 2), generating a thematic „map“ of the analysis. |
| 5. Defining and naming themes: | Ongoing analysis to refine the specifics of each theme, and the overall story the analysis tells; generating clear definitions and names for each theme. |
| 6. Producing the report: | The final opportunity for analysis. Selection of vivid, compelling extract examples, final analysis of selected extracts, relating back of the analysis to the research question and literature, producing a scholarly report of the analysis |

Source: (Braun & Clarke, 2006, p. 87)

The preliminary list of codes were created based on the literature review conducted. New codes were created when the analysed text could not be categorised by the initial coding scheme (Hsieh & Shannon, 2005). However, these new codes were

examined to ensure that there were no duplications. Once the new code was validated, it was added to the preliminary code list (Braun & Clarke, 2006), and this process was iterative until the data analysis process was completed. The frequency of the code and the number of participants against each code were also examined to understand the importance of the drivers and barriers. This analysis was also utilised to identify common themes and patterns from the data.

### 4.9. Quality controls

Validity is concerned with the extent to which the study has measured what it intended to measure (Saunders & Lewis, 2018). The validity of this study was improved with the use of a consistency matrix that included the research questions, the findings and a literature review matching the research questions. This is depicted in Appendix 4.

Reliability is related to consistent findings (Saunders & Lewis, 2018). The reliability of this study was ensured through the semi-structured interview process as it yields consistent data due to the utilisation of an interview guide based on a predetermined set of questions; which also allowed for further discussion within the context of the research questions. The researcher developed trust with the participants so that they were ready to share the necessary information, and this led to rich, valid and reliable data.

According to Shenton (2004), the criteria that contribute to trustworthiness are credibility, transferability, dependability and confirmability. This study ensured trustworthiness by adopting the techniques stated by the authors, namely, data triangulation by verifying the data against city reports and municipal documents, iterative questioning, the researcher's reflective commentary, the researcher's development of an early familiarity with the participants to receive honest responses, and other relevant methods, as listed in Appendix 5.

### 4.10. Limitations

There are multiple limitations for this study which are listed below:

1) The selected participants may not be an equal representation of the population as the study utilised a purposive non-probability sampling technique.
2) Since the study was performed in SA, the applicability of the study to other developing countries that do not portray similar characteristics may be limited.

3) The cross-sectional data of this study may not always be appropriate due to the dynamic nature of the country.
4) The researcher's bias and the potential subjectivity in the research outcomes may affect the findings due to the interpretive nature of the study.
5) The qualitative nature of the research may lead to the inability to make strong scientific claims (Jebb et al., 2017).

### 4.11.Conclusion

This section provided an outline of the research methodology that was adopted for this study, which included the population, the unit of analysis, the sampling method and size, the discussion guide, the data gathering process, the data analysis approach, quality controls and limitations.

The following section presents the results of this research in terms of smart city drivers, smart city barriers, recommended sectors and areas, recommendations, and smart city benefits.

## Chapter 5: Results

### 5.1. Introduction

This chapter presents the results derived from an analysis of the qualitative data obtained via semi-structured interviews, wherein the interview questions were formulated based on the research questions. The data collected was analysed utilising a coding scheme in Atlas.ti software, and the themes and categories were created based on the coding results.

The beginning of this chapter describes the participants, followed by the results which are presented in the order of the research questions discussed in Chapter three.

### 5.2. Description of participants

There were 13 participants involved in this research. An overview of the sector and designation of the participants was outlined in Chapter four (see Section 4.5). As listed in **Table 2,** the participants from both the private and public sectors, were selected via a purposive non-probability sampling technique. The participants were selected based on their merits, expertise, skills, and experience related to smart cities or city planning and management with a basic knowledge of the ICT field. **Table 5** provides an overview of the participants' roles, responsibilities and experience.

**Table 5:** *Description of participants*

| Participants | Smart City experience | Sector | Designation | Roles & Responsibilities | Smart city projects |
|---|---|---|---|---|---|
| Participant 1 | 15 years and above | Private (SMME – a provider of smart city solutions) | Chief Executive Officer (CEO) | Sales of smart city products, smart city project supervision, ICT steering committee member | Citizen mobile application, service delivery management systems, enterprise resource planning systems (ERPs), and billing systems, smart contact centres, Telemetry and SCADA systems |
| Participant 2 | 1 to 5 years | Public – district municipality | ICT Manager | Project team member – facilitates IT components of | service delivery systems, Telemetry and |

| Participants | Smart City experience | Sector | Designation | Roles & Responsibilities | Smart city projects |
|---|---|---|---|---|---|
| | | | | smart city projects | SCADA systems, smart contact centre |
| Participant 3 | 15 years and above | Private (One of SA's leading safe city products and solutions provider) | CEO – JSE listed company | Assists municipality's in obtaining funds, Builds, operates and transfers smart city projects, smart city projects business model creation and changes, smart city requirements gathering and analysis | Broadband infrastructure, communication and collaboration tools, ERPs and billing systems |
| Participant 4 | 6 to 10 years | Private (One of the leading global service provider of smart city products and solutions) | Country Manager | Build and validate designs by connecting technology partners together, design and development of smart city OEM technologies, sharing experiences across the globe - thought leadership, smart city requirements gathering and analysis | Digital libraries, smart public safety projects |
| Participant 5 | 6 to 10 years | Private (One of SA's leading smart city advisory and consulting services) | Smart Real Estate & Smart Cities Leader | Design and development of smart city OEM technology, high-level strategy formulation and advisory services | Smart city advisory services, smart city strategy development |
| Participant 6 | 6 to 10 years | Public – metro municipality | ICT Manager | Innovations team member, smart city steering committee member, management of system integration | Citizen mobile application, smart contact centre projects |

| Participants | Smart City experience | Sector | Designation | Roles & Responsibilities | Smart city projects |
|---|---|---|---|---|---|
| Participant 7 | 15 years and above | Private (One of the leading global service provider for smart city products and solutions) | Global Markets Executive: Public Sector | Network creation and opportunity identification, Smart city ambassador /evangelist, Smart city keynote speaker, smart city project facilitation | Smart city projects in Barcelona, Rio and Malta |
| Participant 8 | 6 to 10 years | Private (One of the leading global service provider for smart and safe city products and solutions) | Safe city Solutions Director | build validated designs by connecting technology partners, Design and development of smart city OEM technologies, high-level strategy and advisory services, Knowledge management and dissemination, sharing experiences across the globe - thought leadership | safe city projects, Water, electricity and refuse collection systems |
| Participant 9 | 6 to 10 years | Public – metro municipality | Divisional head: Innovation and knowledge management | Initiate, allocate fund and implement innovative pilot projects | e-bikes, e-government app, hearing screen pilot, online payment systems, revenue management systems, safety app, urban agriculture |
| Participant 10 | 1 to 5 years | Public – metro municipality | Chief Information Officer (CIO), chair of the Smart City Committee | General ICT projects and Smart city projects facilitation | Citizen mobile application, safe city projects, unified command centre |

| Participants | Smart City experience | Sector | Designation | Roles & Responsibilities | Smart city projects |
|---|---|---|---|---|---|
| Participant 11 | 15 years and above | Public – district municipality | Senior Manager: ICT | Feasibility study and advisory services | An interactive website, smart contact centres, Smart water meters, |
| Participant 12 | 1 to 5 years | Public – SA cities network | Project Manager: Smart cities research | Project management - smart cities research | Knowledge management and knowledge dissemination projects, smart cities research projects, Town planning |
| Participant 13 | 15 years and above | Public – metro municipality | Deputy city manager | Development of turnaround strategies | Smart water meters, smart contact centres, service delivery management systems |

Source: (author's own)

The participants' experience in smart cities was categorised into four groups: '1 to 5 years', '6 to 10 years', '11 to 15 years', and '15 years and above'. Although three participants had '1 to 5 years' of experience, and had relatively lower experience compared to the others, they were chosen based on their current role which specifically focused on smart cities, such as project manager for smart cities research and chair of the smart city committee and ICT manager. One participant whose designation was 'ICT Manager', and had '1 to 5 years' of experience in smart cities, had worked in the ICT department over 20 years and had an in-depth knowledge of ICT projects and the technology roadmap within the municipality. Whilst there were no participants in the '11 to 15 years' of experience range, five participants had '6 to 10 years' of experience, and another five participants had 15 years of experience in smart cities.

The private entity participants include, inter alia, global tech companies, a Johannesburg stock exchange (JSE) listed company, and a small, medium and micro-enterprise (SMME), whilst public entity participants are from metro and district municipalities, and the SA cities network. The companies that the private entity participants belonged to had tremendous experience in smart city implementations,

both locally and internationally, with their companies being well-known for smart city projects worldwide. The SMME that one of the participants belonged to has implemented smart city projects in three district municipalities thus far.

The public entity participants chosen from metro and district municipalities had implemented at least one smart city project and had sufficient experience in smart cities to provide the necessary insights required for this research.

In terms of the participants' designation, participants were either in a managerial or executive role, and their roles and responsibilities were mostly specific to facilitating or managing smart city projects, or city planning and development. The specific details of the roles and responsibilities of each participant are listed in **Table 5.**

All participants are either senior managers, executives or board members who have a strategic focus on smart city developments, and are therefore prime candidates to provide rich data for this research. Most interviewees are able to derive and execute strategies based on their knowledge and experience, as they have a helicopter view of the organisation, the business, and the political landscape that drives this research.

All participants were involved in at least one smart city project. A few of the interesting, smart city projects that the participants were involved in are listed below.

**Citizen engagement and service delivery systems**, wherein the CEO of an SMME, who also worked as an ICT management consultant, and headed the ICT department in a metro municipality for over 11 years, noted:

> *"We looked overall from a perspective of citizen engagement, how they can engage with citizens from a safe city perspective"* … *"the ability of citizens to log queries directly, without having to come into a walk-in centre, for example, and to provide that kind of leverage for citizens"* (Participant 1).

**Broadband infrastructure**, wherein the CEO of a JSE listed company noted:

> *"Gauteng, the whole of Gauteng, what we have been doing is to connect schools with broadband infrastructure, connecting clinics, connecting hospitals, connecting the police stations" … "We have done Johannesburg, and we now also won a deal to do something similar in the city of Tshwane"…*

*"And then two years ago, we won a deal to do something similar in Limpopo, as a province, the whole province"* (Participant 3).

**e-bikes and e-government app**, wherein the divisional head of innovation and knowledge within a metro municipality noted:

*"We purchased new bikes and developed this app and just wanted to see if citizens will be able to share bikes and support mobility"* … *"e-government app, and it is an app really to facilitate the public participation process, between the office of the speaker and community members"* ( Participant 9).

**the unified command centre**, wherein the CIO and the chair of the smart city committee within a metro municipality noted:

*"one of the things is the installation of intelligent CCTV infrastructure in certain hotspots within the city, and then, from that, we will be able to provide things like unified command centre, which can be used by both the emergency services and the metro police, issues of feature like number plate recognition, facial recognition and all those"* (Participant 10).

**Smart city advisory services**, wherein a smart city leader within a global company noted as follows:

*"We also provided advice to the City of Ekurhuleni with regards to their future smart city. We have worked with all municipalities – Cape Town – so sometimes what they ask for is an over-arching strategy, and sometimes it is specific advisory pertaining to particular things, like a waste management strategy"* (Participant 5).

**Internationally accredited smart city projects**, wherein the global market executive of a global company noted as follows:

*"but those who claim they want to be prizeworthy on Barcelona, our contributions are there, and we have done stuff in Rio, and we have been really active"* (Participant 7).

The following section presents the results of research question one.

### 5.3. Results for research question one

*What is the rationale for the adoption of the smart city paradigm in SA?*

The aim of this research question was to understand the rationale for the development of smart cities within the SA context. The two interview questions pertaining to this research question are listed below:

(i) What do you think are the main drivers for your smart city project?
(ii) What benefits will you/municipality/organisation/people derive/derived from implementing smart city projects?

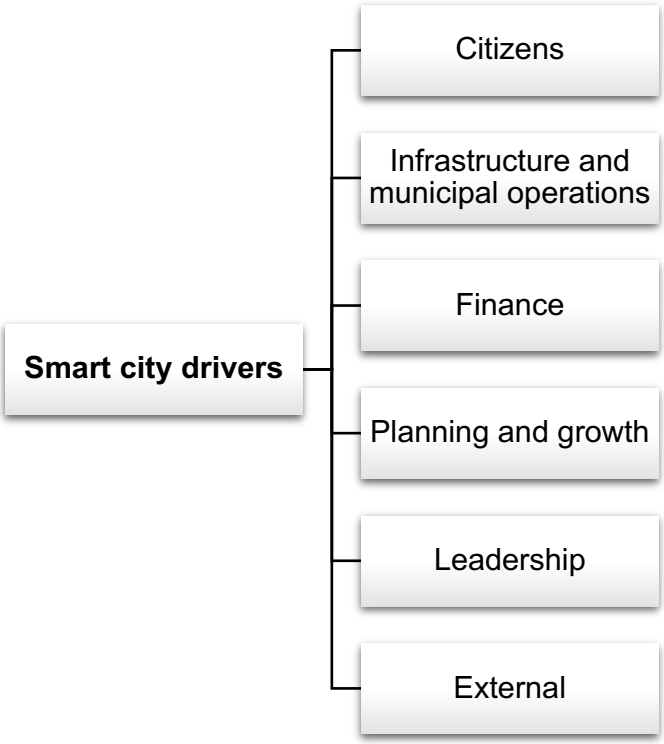
These interview questions were specifically formulated to identify various factors that drive the development of smart cities in SA, and the benefits that these smart cities may achieve. These two interview questions were intended to delve into the rationale for the adoption of the smart city paradigm in SA.

From the interviews conducted, it emerged that there are 23 different smart city drivers in SA, and 15 different benefits that these smart cities can derive. These drivers and barriers are discussed in section 5.3.1 and 5.3.2 respectively.

#### 5.3.1. Smart city drivers

Smart city drivers are the factors that motivate and create the need for the development of smart cities in SA. The identified drivers are grouped into six categories which are depicted in **Figure 5**. Factors related to citizens and communities are grouped into the 'citizens' category, while municipality related drivers such as infrastructure and operations are grouped into the 'infrastructure and municipal operations' category. Cost and investment related factors are grouped into the 'finance' category, while factors pertaining to the country's growth and spatial planning are categorised within the 'planning and growth' category. Management and leadership related factors are grouped into the 'leadership' category, and any other external factors outside the country are categorised as 'external'.

**Figure 5***: Categories of smart city drivers*




Source: (author's own)

**Table 6** below illustrates the different smart city drivers that emerged from these categories.

**Table 6:** *Smart city drivers*

| No. | Smart city drivers | Frequency |
|---|---|---|
| | **Citizens** | |
| 1 | Service delivery | 8 |
| 2 | Improve the citizens quality of life | 4 |
| 3 | Ease of use for millennials | 2 |
| 4 | Better citizen management | 1 |
| 5 | Citizen engagement | 1 |
| 6 | Safety and security | 1 |
| 7 | Citizens high expectations of smart city projects | 1 |
| | **Infrastructure and municipal operations** | |
| 1 | Resource savings | 2 |
| 2 | Efficient municipal operations | 2 |
| 3 | Infrastructure improvement | 2 |
| 4 | Need for municipal departments interconnectedness | 1 |

| No. | Smart city drivers | Frequency |
|---|---|---|
| 5 | Effective management of the municipality | 1 |
| 6 | Stakeholder relationship management | 1 |
| 7 | sustainability | 1 |
| | **Finance** | |
| 1 | Attract investment | 3 |
| 2 | Cost reduction | 3 |
| 3 | Economic competitiveness | 1 |
| | **Planning and growth** | |
| 1 | Spatial planning | 2 |
| 2 | Cities growth | 1 |
| 3 | Country's resilience and sustainability | 1 |
| | **Leadership** | |
| 1 | Alignment of citizens priorities with leaders' vision | 1 |
| 2 | Visionary leadership | 1 |
| | **External** | |
| 1 | Global influence | 1 |

Source: (author's own)

Amongst the categories of smart city drivers identified by this research, the drivers within the 'citizens' and 'infrastructure and municipal operations' categories had the highest number with seven drivers each, followed by the 'finance' and 'planning and growth' categories with three drivers, and all the other categories having less than three drivers. When comparing the frequency, and the number of drivers within each category, it was identified that leadership and external factors are of relatively low importance.

In analysing the different smart city drivers, 'service delivery' is ranked as the highest priority with 61 percent of participants citing 'service delivery' as one of the key smart city drivers. Around 31 percent of the participants agreed that 'improving the citizens' quality of life' is the main driver, while 23 percent of participants stated that 'attracting investment' and 'cost reduction' are key smart city drivers. Other key drivers that were cited by more than one participant are, 'resource savings', 'ease of use for millennials', 'better citizen management', 'infrastructure improvement', 'spatial

planning', 'economic competitiveness' and 'efficient municipal operations'. The remaining drivers were cited by only one participant.

The following section presents the smart city drivers related to citizens and communities.

#### 5.3.1.1. Citizens

The different citizen related factors that were acknowledged by the participants to be key factors in driving the development of smart cities in SA are, service delivery, improving the citizens quality of life, ease of use for millennials, better citizen management, citizen engagement, safety and security, and the citizens' high expectations of smart city projects.

Service delivery was also indicated as a key driver by numerous participants.

A global market executive within a global company, which is well-known for smart city implementations, stated as follows:

> *"They must provide improved and quality service delivery to their citizens"* (Participant 7).

The divisional head of innovation and knowledge within a metro municipality noted:

> *"We want to action excellent services and to speed up our service delivery process as well"* (Participant 9).

A CIO of a metro municipality, and chair of the smart city committee, noted as follows:

> *"The drivers is all in the name of service delivery, our citizens becoming more and more aware of wanting to get value for money in terms of the services they get from the city"* (Participant 10).

An ICT manager of a district municipality noted as follows:

> *"I think it is basically the improved service more than anything because if we really want to see an improved service, that is where the smart cities initiatives come in handy because we can't be providing the same service we were delivering ten years back!"* (Participant 11).

It is evident from the above quotes that both public and private entity participants regard service delivery as the main driver.

A total of four out of 13 participants ascertained that improving the citizens' well-being, and their quality of life, as a key smart city driver. This is illustrated by the participants' statements listed below:

> *"Benefit to the life of the citizens or the community member as a result of implementing this project"* (Participant 2).
>
> *"To ensure they provide a quality of life to their citizens – that is their main thing"* (Participant 7).
>
> *"The driving factor would be to improve the quality of life."…"So it is the kind of things that we are looking in terms of employing in smart city, in terms of what we need to actually focus on it in terms of smart city, how does technology enable this to actually improve the quality of life indicators"* (Participant 13).

A few participants highlighted that the current population mostly consists of millennials, that it is vital to cater for them, and that providing services of utmost ease to them would be a key driver for the development of smart cities in SA.

One CEO from the private sector noted as follows:

> *"Because the millennial now, he does everything from his mobile phone. I don't need to walk into a store or do anything, and I think even with COVID-19, where people have now accepted that online ordering is the new way of doing business, the same with the municipality. I am going to engage my municipality online"* (Participant 1).

Another participant from a metro municipality stated as follows:

> *"that is fuelled by citizens becoming more educated, the younger generation is more connected so to speak, and we then have to cater for their needs"* (Participant 9).

The following section presents the drivers related to infrastructure and municipal operations.

#### 5.3.1.2. Infrastructure and municipal operations

Resource savings, efficient municipal operations, infrastructure improvement, the need for interconnectivity between municipal departments, effective management of the municipality, stakeholder relationship management and sustainability were ascertained to be the main drivers related to infrastructure and municipal operations.

The participants statements in terms of key smart city drivers within the infrastructure and municipal operations category are listed below. As per the participants, the management of essential resources such as water is critical. The importance of resource management is highlighted by the following statements:

> *"it is also saving of their resources in terms of water, for example, bursts and leaks"* (Participant 1).

> *"I think mainly, some of the key drivers comes from urban planning, it actually comes from (if I can reiterate) infrastructure management, and resource management optimisation"* (Participant 8).

Effective and efficient municipal operations play a vital role in ensuring service delivery. Some participants noted that the operational efficiency of municipalities can be significantly improved through the implementation of smart city projects which is reflected in the following statements:

> *"The second aspect is efficiencies, making sure that we are rolling out or moving the leaks from the system and the technology around that"* (Participant 5).

> *"maybe I would give it the same kind of scoring, also from an operational perspective from the municipality side, it is easier to know what your status is at any given time through the implementation of that project"* (Participant 9).

A key factor in urban planning includes infrastructure improvement and management, which is also a vision for the SA government. The importance of Infrastructure in driving smart city projects is highlighted by the statements below:

> *"I think mainly some of the key drivers comes from urban planning; it actually comes from (if I can reiterate) infrastructure management"* (Participant 8).

> *"government is pushing for a vision of a smart city, that like, responds to the definition you gave, to improve infrastructure"* (Participant 12).

One interesting factor identified by another participant is the need for different departments to interconnect. He noted that a key driver for the development of smart cities is to bridge the challenges arising due to departments working in silos. He stated as follows:

> *"So, we all know that we would love our cities to be having, for example a single view of us as a citizen, but you have to work from department, to*

*department, to department. And one department will issue identification for your licence, and you have to go and do this and that; if you register your property you go to a different one; you want to pay your city bill you go to another one. So, it is not interconnected; it is not a single view, and that is the biggest challenge that many, many cities in the world have"* (Participant 7).

The following section presents the drivers related to finance.

#### 5.3.1.3. Finance

The major smart city drivers within the finance category are, cost reduction, attraction of investment and economic competitiveness.

One participant noted that departments needed to work together, and that different systems needed to be integrated. This integration may attract investment which is crucial to the country's development, as highlighted by the following statements:

*"So, if things are working well, if there is integration, then there is more investment into the country, right?"* (Participant 4).

*"To improve infrastructure, to grow cities, to bring in investment"* (Participant 12).

Another participant stated that global and local companies' intention to invest in a city, or country, is dependent on smartness. According to the participant, companies consider opening branches, factories, or plants in a city where it is easy to conduct business. This is highlighted by the following statement:

*"So, if an investor wants to invest in SA, they look at how smart the city is before they decide whether they should put their plant in Cape Town or Pretoria or in Joburg. So it is important that we are able to attract the best investors into the city, and that can only happen if the city is set for their investment and also the city itself is easy to do business in – and that comes with having all these smart city solutions" … "not only foreign but also local investment because for organisations like the motor industry, Mercedes Benz, BMW, they are already in the country so you wouldn't really call them foreign*" (Participant 10).

As highlighted in this study, the SA government is facing severe overtime issues which increases costs for municipalities, and it is imperative for them to contain and reduce costs. Cost reduction is not only applicable to government, but also to private

enterprises and citizens. The importance of cost reduction is highlighted by the following statements:

> *"It is cost reduction in terms of issues like overtime"* (Participant 1).
>
> *"So, it is leveraging processes, visual processes, and to try and cut the costs so that we can consider the opposition, and with time ticking by in a country where so many enterprises are under strain, it needs to be very efficient at our expense"* (Participant 5).
>
> *"We also need to make sure that the solutions or services we provide to the citizens are sustainable and also cost-effective in addition to being smart"* (Participant 10).

To promote economic growth, it is important to improve economic competitiveness from both a city, and national government level. One factor that drives smart city developments in SA is economic competitiveness which is highlighted by the statements below:

> *"It is understood that economic competitiveness is one of the most important components to, I would say national… what is the word I am looking for… to progressing the national imperative."…"So the biggest driver for us is to ensure that we keep our citizens happy, because at the end of the day, even though we are a government, we are competing with other cities in terms of investment"* (Participant 10).

The following section presents the results pertaining to planning and growth related drivers for smart city developments in SA.

#### 5.3.1.4. Planning and growth

The drivers within the planning and growth category are, spatial planning, cities growth, and the country's resilience and sustainability. According to the participants, spatial planning is critical to address urbanisation challenges and to bring people closer, and that spatial planning is one of the key factors that drives smart city developments. This is highlighted in the following statements:

> *"So looking at that spatial planning and bringing people closer through the various smart projects that are out there"* (Participant 4).
>
> *"Remember for that rural to urban migration there is need for planning"* (Participant 8).

The smart city drivers within the leadership category are presented in the following section.

#### 5.3.1.5. Leadership related factors

The alignment of citizens' priorities with leaders' vision and visionary leadership are the main drivers within this category. Leadership factors were highlighted as participants believed that a visionary leader would have a long-term vision of how they perceive SA to be in the future, and therefore drive smart city projects according to that vision. However, they also emphasised that a leader's vision must align with citizens' priorities which is highlighted below:

> "*So if you have got people who are leading these cities and they have conceived of a city that is better than where they are now, they have a vision of a city that is able to serve its citizens and serve them well – you start with that. … Getting or rallying the troops, rallying the people within your city, aligning with the priorities of the city, you know? How will I be able to serve this to the citizens? … will I justify if I say it is going to improve in terms of service delivery? And are those services regarded as important by the citizens?"* (Participant 3).

The following section presents the external factors that drive smart city developments in SA.

#### 5.3.1.6. External factors

One external factor that drives smart city developments within the SA context is global influence. According to one participant, successful smart city developments worldwide will influence SA to follow suit. This is highlighted by the statement below:

> *"I also understand that something that strongly drives a smart city also is global influence as well"* (Participant 12).

In this research, the rationale for smart city developments was divided into drivers and benefits. The drivers for smart city developments were discussed in the above section while the following section presents the benefits that SA could derive from smart city implementations.

### 5.3.2. Smart city benefits

The interview question specific to smart city benefits was focused on both the benefits that were derived from past smart city projects that the participants were

involved in, and the benefits that participants believed that smart city solutions could achieve in the future.

**Table 7** below illustrates the various benefits and frequency.

**Table 7:** *Smart city benefits*

| No. | Smart city benefits | Frequency |
|---|---|---|
| 1 | Ensures effective and efficient service delivery | 2 |
| 2 | Increases citizens safety and security | 2 |
| 3 | Improved communication | 2 |
| 4 | Improved access to the municipality | 2 |
| 5 | Lower maintenance costs | 1 |
| 6 | Improves citizen engagement | 1 |
| 7 | Ensures ease of doing business | 1 |
| 8 | Ensures availability of information across different government departments | 1 |
| 9 | Improves convenience and wellbeing of citizens | 1 |
| 10 | Improves city interconnectedness | 1 |
| 11 | Improves city modernisation and transformation | 1 |
| 12 | Ensures economic and social progress | 1 |
| 13 | Ensures effective functioning of city | 1 |
| 14 | Ensures quicker turnaround times | 1 |
| 15 | Ensures cost reduction | 1 |

Source: (author's own)

Although eight participants indicated that service delivery was a key driver for smart city developments in SA, only two participants highlighted effective and efficient service delivery as one of the benefits that a smart city could achieve.

One participant, the CEO of a JSE listed company, stated that smart city projects could bring all departments, such as health, safety and security together and provide options to share information between them as indicated below:

> *"The other one is effective delivery of service, of service delivery, you know? If I am in hospital, I know I would be able to get the services from the hospital. If I am going to the police and they will be able to share their files, they are not going to have lost files, 'oh, your file has gone, it's missing' – it is not going to go missing because it is electronic format"* (Participant 3).

According to another participant, the CIO of a metro municipality, a smart city will help achieve seamless integration between different departments and can create a holistic service delivery system for citizens. This is highlighted by the following statement:

> *"But once we integrate all these services, it will be easier for the citizens as well to access all these services because they will have a one-stop shop as opposed to having multiple facets of the same services spread across different departments"* (Participant 10).

The safety and security of citizens was also listed as a significant benefit that smart city developments could achieve. According to a few participants, the safety and security of citizens can be improved if smart city projects are implemented. It is evident from the statements below that safety and security is a rationale for the development of smart cities in SA.

> *"And the third one is safety. Safety and security. That is very, very important"* (Participant 3).

> *"If we implement a safe city in full, we will be providing a safe environment for the citizens"* (Participant 10).

A few participants noted that smart city solutions assist in improving communication between citizens and municipalities, thus providing comfort to citizens that they are heard. The statements below highlight the importance of smart city solutions in terms of improved communication:

> *"Even if I had to look overall with the examples that I have cited, one major benefit would be speed: if I look at public participation, etc. When I say speed, I am talking about quicker turnaround times, better communication, in the areas where we did the pilot, where we know our customers and our citizens better"* (Participant 9).

> *"And I think the last thing is also improved communication because I also think, if you are able to reach out as many people as you can before they even struggle to know what is happening you have already posted on the website, you have already sent proper messages and stuff. So, there is that communication. So, they also feel that 'Okay, at least these people are talking*

*to us. They are not like closing the doors, and we don't even know what they are up to"* (Participant 11).

Another significant smart city benefit is improved access to the municipality. The municipality is able to reach out to more citizens through different digital platforms which can assist in improving service delivery. Although SA district municipalities provide water services to rural areas that are furthest from the main district, the implementation of smart city solutions can alleviate accessibility issues between the citizen and the municipality. A few statements highlighting this benefit are listed below:

*"There are a number of benefits, the most important one is, or one of them is, easy accessibility of services from the city. … And also the citizens having access to all the services that the city offers"* (Participant 10).

*"And another benefit also, I think, is access. It broadens the access for the municipality to be accessible as far as possible, unlike to say now like us, our district, we have the furthest city there xxxx, and then you find still within the district you have people at xxxx; then the ones at xxxx will look like they have more access to us than the ones at xxxx. But if we have a platform where anyone can have a platform, whether it is a system or an application, a login, so it is accessible, so it also improves the accessibility. So, it is also beneficial for us as a municipality"* (Participant 11).

The other drivers, such as lower maintenance costs, improving citizen engagement, ensuring ease of doing business, ensuring availability of information across different government departments, improving convenience and wellbeing of citizens, improving city interconnectedness, improving city modernisation and transformation, ensuring economic and social progress, ensuring the effective functioning of the city, ensuring quicker turnaround times and ensuring cost reduction are listed by one participant only, and are therefore perceived to be of low importance by the author.

The rationale for smart city developments in SA in terms of drivers and benefits was presented in the sections above. While participants highlighted the importance of smart city developments in SA, the literature review of this study indicated that the country is lagging in terms of smart city developments as there are very few successful smart city initiatives being implemented. It is therefore critical to understand the barriers that are hindering the development of smart cities in SA.

The section below presents the barriers identified by this study.

### 5.4. Results for research question two

*What are the barriers that are hindering the adoption of the smart city paradigm in SA?*

This research question was aimed at identifying various barriers that are hindering the adoption of the smart city paradigm within the SA context and identifies the highest impact barriers.

#### 5.4.1. Overview of the results

In total, 128 barriers were identified and categorised into ten groups. The country analysis of SA, as presented in the literature review, provided the basis for the formulation of the categories which are listed in **Figure 6**.

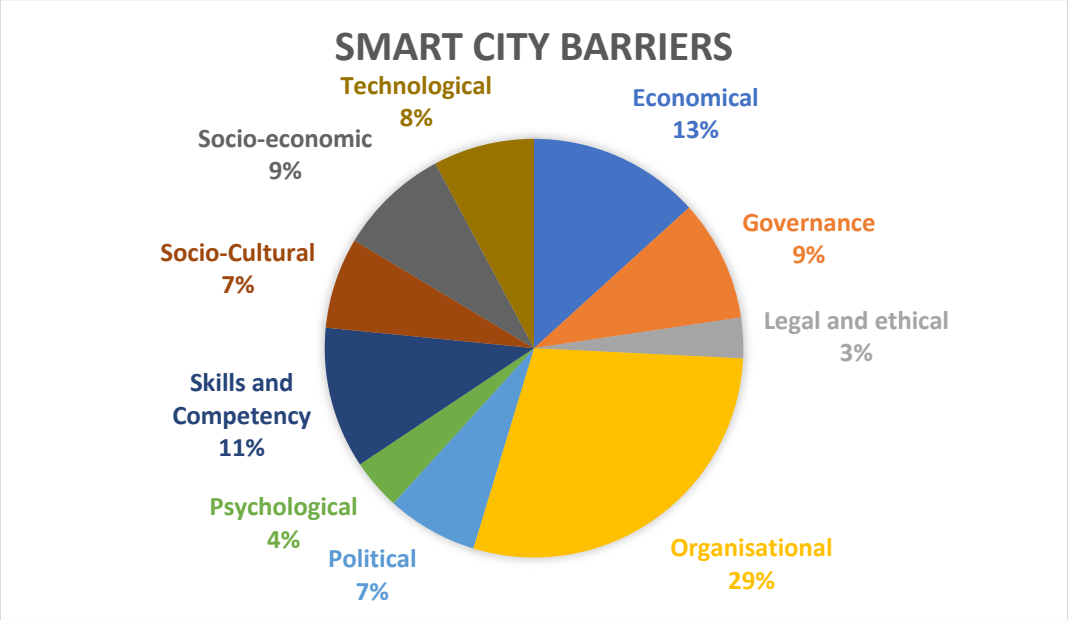
**Figure 6:** *Categories of smart city barriers*

| | |
|---|---|
| Smart City barriers | Organisational |
| | Economical |
| | Skills and Competency |
| | Governance |
| | Socio-economic |
| | Technological |
| | Political |
| | Socio-cultural |
| | Psychological |
| | Legal and ethical |

Source: (author's own)

The pie chart (see **Figure 7**) below, depicts the percentage number of barriers within each category in comparison to the total number of barriers identified. From **Figure 7**, it is evident that organisational barriers, economic barriers, and skills and competency barriers consist of more than 50 percent of the total barriers identified; resulting in them being key categories of smart city barriers.

**Figure 7:** *percentage of categories of smart city barriers*




Source: (author's own)

Sections 5.4.2 to 5.4.11 below, present the barriers that are perceived by interviewees to be hindering the development of smart cities in SA. The section below presents the organisational barriers.

### 5.4.2. Organisational barriers

A total of 36 barriers were identified within the organisational barrier's category. **Table 8** below illustrates these barriers and their frequency.

**Table 8:** *Organisational barriers*

| No. | Organisational barriers | Frequency |
|---|---|---|
| 1 | Municipal departments work in silos | 8 |
| 2 | Policy makers/leadership's unwillingness to see the intangible benefits of IT systems | 8 |
| 3 | Lack of a smart city vision or mission statement | 8 |
| 4 | Smart city projects are identified as a lower priority | 6 |
| 5 | Smart city projects / IT is not seen as an enabler of service delivery | 5 |
| 6 | Lack of information sharing between municipal departments | 4 |
| 7 | Unclear ownership of smart city projects | 4 |
| 8 | Municipality's lack of creativity and forward-thinking to generate revenue | 3 |

| No. | Organisational barriers | Frequency |
|---|---|---|
| 9 | Lack of an effective communication strategy within a municipality | 3 |
| 10 | Lack of a high-level smart city strategy | 3 |
| 11 | Poor participation and input from key municipal staff | 2 |
| 12 | Lack of a proper change management strategy | 2 |
| 13 | Lack of integrated planning | 2 |
| 14 | Poor urban planning | 2 |
| 15 | Lack of strong and bold leadership | 2 |
| 16 | Lack of stakeholder's commitment and participation | 2 |
| 17 | Lack of a dedicated municipal smart city department municipality | 2 |
| 18 | Non-strategic nature of smart city initiatives | 2 |
| 19 | The disconnected culture within the municipality | 1 |
| 20 | Application of smart city concepts out of context | 1 |
| 21 | Lack of visionary leadership | 1 |
| 22 | Duplication of effort | 1 |
| 23 | The mismatch between customer-driven business and changing technologies | 1 |
| 24 | Organisational politics within the municipality | 1 |
| 25 | Stakeholder's lack of understanding of smart cities | 1 |
| 26 | Leaders lack of a long-term vision | 1 |
| 27 | Smart city concepts still need to be absorbed and accepted (Hype stage) | 1 |
| 28 | Government's lack of support for local IT systems | 1 |
| 29 | Lack of coordination between municipalities | 1 |
| 30 | Misalignment between line functions (customer facing departments) and the support functions (ICT department) | 1 |
| 31 | Lack of practical implementation of municipal direction and strategy | 1 |
| 32 | Lack of Trade Union support | 1 |
| 33 | Poor municipal performance and rewards systems and processes | 1 |
| 34 | Lack of cross-functional engagement | 1 |
| 35 | Lack of smart city drivers within local government | 1 |
| 36 | Lack of technological and strategic continuity | 1 |

Source: (author's own)

While there are many barriers identified in this category, it is evident that most of them are interconnected. For example, the lack of integrated planning could occur due to a silo structure, the lack of an effective communication strategy within a municipality or due to a lack of cross-functional engagement within the municipality. Similarly, smart city projects can be perceived as having a lower priority due to the lack of a smart city vision or mission statement, or the lack of a high-level smart city strategy. Another issue could be the misalignment between line functions (customer facing departments), and support functions (ICT department) due to IT not being perceived as an enabler of service delivery, and policymakers/leadership's unwillingness to grasp the intangible benefits of IT systems. Although these barriers are interlinked, they are listed due to their uniqueness. This section provides an in-depth finding of the barriers that were perceived to be of high importance by considering the frequency counts.

The above analysis is supported by 62 percent of participants who noted that a silo municipal structure, policymakers/leadership's unwillingness to see the intangible benefits of IT systems, and the lack of a smart city vision or mission statement as being the main barriers in this category.

This study also revealed that each department wants to build its "own ivory tower", and that municipal departments are therefore not willing to share information between each other, or to work in a coordinated manner. Furthermore, departments report to different ministers which results in a lack of integrated planning. Due to this silo nature, each department perceives its priorities to be of the utmost importance, thus ignoring the holistic objectives of the municipality and the country. These factors are highlighted in the statements below:

> *"So, the one department will run one system, whereas the electricity department is running another system. So, they don't necessarily talk to each other, even though you can still provide the information. So what we have is clusters of people within the organisation, who are building their own ivory towers"* (Participant 1).

> *"And why it tends to be a problem is because all of these areas are managed in a siloed way. So, having now to get people to 'relinquish' their power so as to become more integrated, is a bigger part of the problem"* (Participant 4).

*"actual fact, it spans across all departments because it touches on everyone – it touches on supply chain, on payments, on service delivery, utilities, refuse – so each has their own department, each has their own different accountability; they are on budgets, and each sometimes reports to different ministries"* (Participant 5).

*"as a result, all initiatives run at different units with different departments"* (Participant 6).

*"You may ask yourself that question as well: if you were in their shoes why would water not be more important than electricity, or why would water and electricity not take precedence over transport, or healthcare not take precedence over something else? So, each one drive the agenda of business, and without disagreement or pushback tools, they have their objectives"* (Participant 7).

*"we seem to plan in isolation; we don't plan in an integrated manner"* (Participant 13).

Many participants highlighted that policymakers and municipal leaders are unwilling to implement smart city projects as the benefits are intangible and long-term. Consequently, the senior and executive management team responsible for budget allocation are not willing to approve projects that do not provide a quick financial return on investment. Instead, approval is given to short-term projects that provide quick returns. A few statements that illustrate this barrier are listed below:

*"You didn't understand the value that the project at that day may not have been giving you value immediately because it was so new. But it was ahead of its time and time has caught up with you before you have managed to finish the project"* (Participant 2).

*"A smart city is something that is not visible, you cannot touch the infrastructure really, so it does not bring value of publicity by typical politicians. So, it does not play to that"* (Participant 3).

*"so, it is more tangible to want to buy implements to demonstrate progress than it is to spend time upfront developing a strategy that would appear to almost push the deliverables down the line or further down the line in terms of showing tangible progress"* (Participant 5).

*"And also sometimes when you show something off, someone wants to be able to see the impact of the project from point a to point b, within a financial area, and if you can't show the final output then it is harder to vouch for the project"* (Participant 12).

*"Sometimes policymakers and officials, you know unless you put a physical pipe in the ground, they are not able to translate that into an IT system providing value – which is intangible!"* (Participant 13).

The third major barrier in this category is the lack of a smart city vision or mission statement. Many participants noted that the smart city vision and mission is not clearly defined, or that there is a lack of a grander smart city vision. This is perceived to be a major barrier as smart city projects can only be successful and efficient if there is a clear vision with clear objectives. Furthermore, these objectives should be SMART, that is, specific, measurable, attainable, relevant and time-based. The following statements highlight this barrier:

*"So, I wouldn't say there is a lack of vision because certainly everybody has a vision, everybody understands what the city needs to be. What I am saying is that the vision statement or mission statement; so to take the desire and translate that to something, like a project charter, or a definition of what we want to achieve – like you did with your statement in the beginning as to what a smart city should be – that process of getting to a vision statement is actually not something you just do, it has to be quantifiable, measurable, have a time frame aligned to it"* (Participant 5).

*"To have a smart city, you need to have a smart system. And I think that is where thinking differently comes in, in where you have to have that grander vision. And so far thinking of smart cities has not necessarily been"* (Participant 12).

A total of six participants stated that SA municipalities prioritise other projects over smart city projects. Another five participants noted that the ICT department is not considered as a strategic function within the municipality or seen as an enabler of service delivery. In addition, other participants noted that service delivery will only improve if the ICT component is considered when initially implementing service delivery projects. For example, when implementing water provisioning services, service delivery departments could consider smart water meters as a smart city

solution that could make data instantly available to management. However, these participants noted that the ICT department is not invited to project meetings by the user or service delivery departments, as highlighted below:

> *"just because you are coming from a corporate services department making that request, you are immediately pushed to the side, because the conversation is all about the core services department"… "So then there is a misperception, IT being an enabler. They don't understand that is the role of IT purely, is as an enabling role. But it enables you to therefore do a process much smarter, more efficient, more economical, whatever the impact is of that project"* (Participant 2).

Around 33 percent of participants identified the lack of information sharing between municipal departments as an organisational barrier, which is ranked 6$^{th}$ in this category. This barrier is also perceived to be a direct result of "Municipal departments working in Silos" which was identified by 62 percent of participants. This view is corroborated by their statements below:

> *"So, the one department will run one system, whereas the electricity department is running another system. So, they don't necessarily talk to each other, even though you can still provide the information. So, what we have is clusters of people within the organisation, who are building their own ivory towers. And so, lack of sharing of information becomes another problem"* (Participant 1).

> *"You see, when people operated independently, there was no need to share or understand each other's problems and operations. Because everyone operated independently, so I do my business, you do your business, and we carried on like that. Now we all need to understand each other's business to come up with a holistic proposal and we are not just educated enough, we may not be willing enough because we have so many things of our own to worry about, and we have different priorities"* (Participant 6).

> *"But also within the municipalities as well, when it comes to adoption of technology, there is a lot of resistance in terms of wanting to open up and sharing their visions and strategies"* (Participant 10).

Around 33 percent of participants also identified unclear ownership of smart city projects within the municipality as an organisational barrier. Departments working in

silos, coupled with the lack of a dedicated team to manage smart city projects, exacerbate the problems related to project ownership. Business users and operational teams deem any technological implementation to be within the ambit of the IT department and therefore do not take ownership of the project. The impact of this barrier is illustrated by the following quotes from participants:

> *"Another thing I find is that the minute something is IT-related, people don't think they have a role to play in it; they want to push it off to an IT corner"* (Participant 2).

> *"So, once you get all of that glued together and stuck together, the big challenge is who owns what, who is responsible and who keeps what updated. You see? So that is when it gets tricky"* (Participant 7).

Other key barriers identified in this category are, the municipality's lack of creativity and forward-thinking to generate revenue, the lack of an effective communication strategy within the municipality, the lack of a high-level smart city strategy, poor participation and input from key municipal staff, the lack of a proper change management strategy, a lack of integrated planning, poor urban planning, the lack of strong and bold leadership, the lack of stakeholder's commitment and participation and the lack of a dedicated smart city department within the municipality.

The next section presents the economic barriers for smart city developments in SA.

### 5.4.3. Economic barriers

A total of 17 barriers were identified in this category which are listed in **Table 9** below.

**Table 9:** *Economic barriers*

| No. | Economic barriers | Frequency |
|---|---|---|
| 1 | Lack of funding | 9 |
| 2 | High cost associated with smart city technologies/products | 7 |
| 3 | Municipalities revenue generation capability / inability of municipalities to generate revenue | 6 |
| 4 | Lack of investment | 3 |
| 5 | Lack of dedicated smart city grant funding | 3 |
| 6 | Country's poor economy | 3 |
| 7 | Lack of ROI calculations in smart city projects | 2 |
| 8 | Financial viability of smart city projects | 2 |

| No. | Economic barriers | Frequency |
|---|---|---|
| 9 | Avaricious nature of smart city service providers | 2 |
| 10 | Lack of foreign direct investment | 1 |
| 11 | Lack of dedicated R&D budget | 1 |
| 12 | Data affordability | 1 |
| 13 | Increase in support costs due to multiple complex systems within a municipality | 1 |
| 14 | Funding prioritisation of metro over district municipalities | 1 |
| 15 | Excessive spending on foreign IT systems | 1 |
| 16 | Increase in the total cost of ownership due to multiple systems within the municipality | 1 |
| 17 | Inability to share economies of scale | 1 |

Source: (author's own)

The most significant barriers in this category are, a lack of funding, the high cost associated with smart city technologies/products, and the municipalities' revenue generation capability/the inability of municipalities to generate revenue.

This study identified that municipalities would like to implement smart city projects. However, 69 percent of participants noted that the reason for smart city projects not being implemented in SA is due to a lack of funding. All ICT projects, including smart city projects, need to be funded via the municipality's budget as there is no specific grant funding for ICT projects as grant funding only assists with the implementation of new projects pertaining to the core functions of a municipality that are implemented due to financial constraints. The statements below highlight the lack of funding as one of the major barriers to the development of smart cities in SA:

> *"There is no IT-specific grant funding. Anything IT-specific has to be funded from your internal budgets. That is why if you look at the two smart city type projects that we have, they weren't motivated for on an IT basis; they were more from a service delivery basis"* (Participant 2).
>
> *"And then the next issue you face is that they don't have money to fund this. So, all these wishes but they don't have money."… "Most of the problems we are facing in SA, in general, is the lack of funds"* (Participant 3).
>
> *"firstly funding – and I am sure you will hear that everywhere – funding is a huge challenge"* (Participant 9).

*"because no. 1 it doesn't get the funding that it deserves because, as we are looking, budget issues are always there"* (Participant 10).

*"And then secondly is also the budget. Sometimes you find you have got the approval, you have got the buy-in, but you don't have sufficient resources in terms of finance"* (Participant 11).

Another barrier which was emphasised by 58 percent of participants was the high cost associated with smart city technologies/products. The participants believed that smart city technologies and projects are too expensive, and this hinders approval for these projects. In addition, the maintenance cost of smart city products and services are high; and this is also linked to vandalism which is listed as another barrier under the socio-cultural category. Government is therefore hesitant to implement smart city projects as the country is prone to vandalism and infrastructure theft, and it is expensive to replace or reinstate damaged smart city infrastructure. Listed below are some statements from the participants corroborating the above:

*"funding is a huge challenge because most of these projects are very, very costly"* (Participant 9).

*"and these projects are also very expensive to run"* (Participant 10).

*"speaking back to context is the South African challenge, in my opinion, is technology, is something that requires a lot of money and investment"* (Participant 12).

*"has a huge implication because for a smart city to work you need to pump a lot of money in it. So, unless the economy is performing well"* … *"well you need to pump a lot of money in it"* (Participant 13).

The third important barrier is that of the municipality's revenue generation capability. According to participants, the municipalities inability to generate revenue that meets all their expenses deters them from investing in smart city projects. One participant noted that 80 percent of customers do not pay the municipality for water as they think that essential services, such as water and electricity, should be provided free of charge, and that government should not be collecting money from citizens for the provision of these services. This forces the municipality to utilise funds allocated for infrastructure projects to meet its operational expenses.

> *"So 80% of your customers don't pay you in any case for the water they consume, they expect it as a human right, a basic human right, and the 20% that are paying you is supposed to cover the remainder that isn't paying, but you are supposed to give service to everybody. So that rand is being stretched in that way"* (Participant 2).

In contrast, another participant noted that customers are not paying due to poor service delivery, as reflected below:

> *"but that money needs to be supplemented by that one that is generated locally by the city itself through service provision. But if they are providing poor services or no service, they are not going to be able to generate revenue at a local level"* (Participant 3).

Another participant noted that municipalities are serving mostly the poor and are therefore unable to collect payment from them.

> *"When you do try to provide services to the poor, generally you are not getting payment for it"* (Participant 6).

According to another participant, municipalities are not collecting sufficient payment to maintain their existing infrastructure, let alone invest in smart city projects.

> *"I think it is basically with us, specifically, the municipalities, you find that they are unable to generate enough income. We are unable even to collect enough revenue just to sustain the current infrastructure that we have"* (Participant 11).

Other important barriers within this category are a lack of investment, the lack of dedicated smart city grant funding, the country's poor economy, a lack of return on investment (ROI) calculations in smart city projects, the financial viability of smart city projects and the avaricious nature of smart city service providers.

The skills and competency barriers for smart city developments in SA are presented in the following section.

### 5.4.4. Skills and competency barriers

There were 14 different barriers identified with respect to skills and competency, as illustrated in **Table 10**.

**Table 10:** *Skills and competency barriers*

| No. | Skills and competency barriers | Frequency |
|---|---|---|
| 1 | Leadership's lack of understanding and connection to the smart city concept | 10 |
| 2 | Lack of smart city-specific skills within the municipality | 6 |
| 3 | Lack of human capital with technology skills within the municipality | 6 |
| 4 | Technology readiness of senior managers and executives | 5 |
| 5 | Incapable and incompetent leaders | 4 |
| 6 | Lack of progressive/future-thinking leaders | 4 |
| 7 | Lack of innovation | 3 |
| 8 | Lack of qualified leaders | 2 |
| 9 | Service providers lack of skills, competency, and experience | 2 |
| 10 | Lack of entrepreneurship | 1 |
| 11 | Leadership capability mismatch | 1 |
| 12 | Lack of service provider's understanding of smart city projects context and environment | 1 |
| 13 | Lack of leadership capacity building programmes | 1 |
| 14 | Lack of confidence in IT skills | 1 |

Source: (author's own)

Many participants indicated that leaders do not understand the smart city concept, and therefore do not connect with it. The role of technology, and specifically ICT, was not well understood by the management team who need to allocate and approve funding for projects. Therefore, ICT projects, including smart city projects, are not prioritised, as highlighted below:

> *"There tends to be like I will say 'a laziness' the higher up you get. So, I think it comes back to that lack of understanding of the role of IT, the process in the smart city environment"* (Participant 2).
>
> *"If the people below them bring those ideas to them, they cannot connect to those ideas, the people who make decisions cannot connect"* (Participant 3).
>
> *"So, the people you are motivating sometimes too don't have a close enough understanding of the technology or the business as the person motivating it"* (Participant 6).

With technology being an essential contributor towards the municipality's operational efficiency and service delivery, it is important for municipal staff to be equipped with the requisite ICT skills. However, according to the results of this study, SA municipalities lack the necessary technology skills, especially those within the smart city domain. In addition, smart city technologies are agile; hence staff need to keep abreast of technology to efficiently execute smart city projects. This barrier is highlighted in the statements below:

> *"the inability of many of these cities – which is another barrier – another barrier is the capability of the city. They are even incapable of producing a tender or putting together specifications for a smart project"* (Participant 3).

> *"The skill levels seem to be much more shallow, not as deep an understanding of things as what we used to have in the past. As a result, now to do smart projects specifically, you really have to know what you are talking about, because when you are signing up 30 millions of Rands for a project, you need to be clear on what you are achieving and why you are doing it, etc"* (Participant 6).

> *"With the skills set in SA, you know with the changes in technology we always have a challenge when it comes to skills set"* (Participant 8).

In addition to the lack of technology skills within a municipality, it was also noted that municipalities lack sufficient resources in terms of human capital to execute smart city projects once executive management approval is given. A reason for the lack of human capital is that SA is not focused on developing ICT skills, resulting in a shortage of skilled ICT resources which cumulatively affects the ICT pool in SA. Therefore, a lack of human capital with the requisite technology skills in the municipality is another major barrier for the implementation of smart cities in SA. This is highlighted by the following statements:

> *"Sometimes you find you have got the approval, you have got the buy in but you don't have sufficient resources in terms of finance, in terms of human capital"…"think it starts from the qualifications there, having to produce people who are qualified in this sector or in this industry of IT. So, the less people who are qualified, obviously it will have less intake or less employment of human capital that you will require"* (Participant 11).

*"And by that, I mean a lot of the time what I observe, especially in local government is that a lot of things – or maybe it is in all of government – a lot of things are outsourced. So, you don't necessarily have the capacity within a municipality"* (Participant 12).

Around 42 percent of participants identified the technology readiness of senior managers and executives as a barrier in this category. Technology readiness is essential for leaders to be au-fait with technology in order to ensure a meaningful shift towards smart city developments. One participant noted that leaders are not comfortable with technology which limits the implementation of smart city projects, as indicated by the following extracts from interviewees:

*"So that is the second big thing, there is no service-orientation from leaders. I will say the third one is many of them have got no clue about technology"* (Participant 3).

*"They have that fear of technology, they are not comfortable"* (Participant 11).

Around 33 percent of participants identified incapable and incompetent leaders as a barrier to the implementation of smart city projects. This is especially significant as leaders drive the vision and strategy of the organisation and its success. Based on the interviews from which the quotes below are extracted, it is evident that there are leaders who are appointed incorrectly and to the detriment of the organisation, resulting in stifled technological innovations and implementations. The following extracts from interviewees substantiate these assertions:

*"That is a whole other conversation – are they really suitable to the roles they are occupying? On what basis are you putting them in those positions? Is it because of their progressive thinking or is it because of their political connotations and who they make happy?"* (Participant 2).

*"we have a significant number of leaders who are not capable or do not have the competencies to be running the cities that they are running"* (Participant 3).

Around 33 percent of participants noted that a lack of progressive future-thinking leaders is another barrier for the implementation of smart cities. The smart city paradigm requires a mental shift from the norm, and leaders need to embrace this mindset in order to drive smart city implementations. In analysing the results, it is

clear that a lack of progressive/future-thinking leaders is an obstacle in terms of smart city implementations which is evidenced by the following quotes:

> *"if progressive thinking was at play, people would understand 'I need to invest a little bit today but it is going to secure my pension for three/four years' time'"* (Participant 2).

> *"we have people who cannot see the big picture, and because they cannot see the big picture, they are making poor decisions and end up investing in the wrong things"* (Participant 3).

The other key barriers within the skills and competency category are, a lack of innovation, a lack of qualified leaders, and the service providers' lack of skills, competence, and experience.

The section below presents the smart city barriers within the governance category.

### 5.4.5. Governance barriers

There were 12 different barriers identified with respect to governance, as listed in **Table 11**.

**Table 11:** *Governance barriers*

| No. | Governance barriers | Frequency |
|---|---|---|
| 1 | Corruption | 5 |
| 2 | Poor alignment between national, provincial, and local government | 5 |
| 3 | Municipal management / officials' unwillingness to be transparent about their spending | 3 |
| 4 | Lengthy supply chain processes for agile (fast moving) technologies | 3 |
| 5 | Mismanagement in municipal supply chain processes | 3 |
| 6 | Mismanagement of municipal funds / incorrect investments | 2 |
| 7 | Procurement processes do not prioritise successful pilot projects | 1 |
| 8 | IDP review process | 1 |
| 9 | General project management barriers | 1 |
| 10 | Lack of authority for city planning department | 1 |
| 11 | No specific process to introduce technology in government | 1 |
| 12 | Lack of accountability for infrastructure projects by national or provincial government | 1 |

Source: (author's own)

Approximately 42 percent of participants in this category identified corruption as a primary barrier to the adoption of the smart city paradigm. Corruption affects the financial stability of the organisation, and its ability to invest in smart city technologies. It drains the coffers of much-needed funds, and cripples the municipality which is only capable of providing essential services due to leaders serving their own financial interests. Tender fraud is also a significant contributor to the impending collapse of municipalities and hinders the ability of the organisation to be progressive and to implement advanced IT technology solutions. This rampant corruption in municipalities is evidenced by the following extracts from interviewees:

> *"we have to come back to the very simple fact that SA, there is a massive amount of corruption in SA, in public sector"* (Participant 1).
>
> *"But it is self-interest orientation. So the motivation to be in the leadership of the city, most of those people are motivated by selfish reasons, which is likely linked to serving themselves and getting their hands into the resources of the city, rather than servicing the city"* (Participant 3).
>
> *"when I say this generally as a nation, we see lots of media reports around corruption and I imagine that across local government it would also be a barrier, because if someone is making money or an income from existing technologies and you want to bring in new, the chances are you will never be supported"* (Participant 9).

The SA legislative framework consists of autonomous national, provincial, and local government entities; with local government's powers being derived from the constitution and not from national or provincial government. Around 42 percent of participants highlighted the poor alignment between these autonomous entities as a barrier which is validated by the following quotes:

> *"But the reality is that, when you then go down into a city, that city is not able to respond to what is happening at a national level and what is happening at the provincial level"* (Participant 12).
>
> *"because you have district, you have local municipality, you have district municipality, you have provincial government, you have national government – and due to a number of reasons sometimes, which might be the political*

*barrier, you will find the province doesn't talk to the district when they are going to be doing a project. Sometimes the local doesn't talk to the"… "like in the district where I am, the local does not talk to the district that supply water but they go ahead because the function is a function of the local"* (Participant 13).

Another participant added that this misalignment does not allow local government to leverage economies of scale or the ability to learn from the experiences of other government or municipalities as indicated below:

*"So because of the model where you have got provincial, and you've got local government, sometimes that becomes a bit of a problem because you want to have solutions, you want to share economies of scale in terms of especially the infrastructure when it comes to things like broadband type of projects, which are basically the foundation for any smart city solution" … "But if there was an alignment between the three tiers of government, we could say instead of each metro having its own broadband project, let's have a provincial broadband project and then the provincials could share the costs"* (Participant 10).

Other major barriers in this category are, the municipal management/officials' unwillingness to be transparent about spending, lengthy supply chain processes for agile (fast moving) technologies, the mismanagement of municipal supply chain processes, and the mismanagement of municipal funds / incorrect investments.

The following section presents the socio-economic barriers for the development of smart cities in SA.

### 5.4.6. Socio-economic barriers

There were 11 barriers identified with respect to the socio-economic category, as illustrated in **Table 12**.

**Table 12:** *Socio-economic barriers*

| No. | Socio-economic barriers | Frequency |
|---|---|---|
| 1 | Lack of infrastructure/ageing infrastructure | 5 |
| 2 | High income inequality | 4 |
| 3 | Theft of resources | 2 |
| 4 | High unemployment levels | 2 |

| | | |
|---|---|---|
| 5 | Lack of access to basic services | 2 |
| 6 | Poverty | 2 |
| 7 | High level of emigration of skilled individuals to developed countries | 1 |
| 8 | Inefficient and unreliable service delivery | 1 |
| 9 | Gap between needs and resources | 1 |
| 10 | Massive differences in the provision of basic services and infrastructure between places/suburbs | 1 |
| 11 | Digital divide between people | 1 |

Source: (author's own)

In this category, 42 percent of participants identified a lack of infrastructure/ageing infrastructure as a barrier, and that there is tremendous pressure on officials to replace ageing infrastructure while continuously expanding the infrastructure to incorporate rural settlements. This creates a significant barrier as leaders are focused on managing and driving infrastructure challenges which are tangible issues. Smart city implementations are therefore relegated to a lower level of importance due to budgetary constraints, and that the benefits may be intangible and not necessarily immediate. The following quotes substantiate this issue as a barrier:

> *"So, you have to enhance the infrastructure and the architecture and urban planning of that city, and that can be a daunting thing. So, I think, when we look at practical things there is a myriad things"* (Participant 7).

> *"For example, if we were to look at our towns, our towns have infrastructure to a certain degree, but if you look at our rural areas and the informal areas, it is challenging"* (Participant 13).

Around 33 percent of participants indicated that high income inequality is an important barrier in this category. The provision and delivery of basic services becomes a challenge due to the mindset of citizens. One interviewee noted that it may be a "luxury in some areas while it is considered essential in others". This income inequality affects the budget, and subsequently, the ability of municipalities to engage in smart city implementations. This is highlighted by the following quotes:

> *"SA has two different people – first world and third world"* (Participant 1).

*"the barrier in my view is our social dynamics. Remember we are coming from the environment of apartheid whereby there was a deliberate strategy of making others poor and others rich. So the gap is so big, which is what I believe is one of the reasons why the issue of smart cities is not able to actually work very well"… "Because one of the dividing of barriers to this content is that some of the things that you can consider as essential in other areas, they are luxury in other areas"* (Participant 13).

The other major barriers identified were the theft of resources, high unemployment levels, the lack of access to basic services, and poverty.

The section below presents the barriers within the technology category that are hindering the adoption of the smart city paradigm in SA.

### 5.4.7. Technological barriers

There were 10 different barriers identified with respect to technology as listed in **Table 13**.

**Table 13:** *Technological barriers*

| No. | Technological barriers | Frequency |
|---|---|---|
| 1 | Lack of integration between systems | 4 |
| 2 | Too many competing systems | 3 |
| 3 | Lack of access to data | 3 |
| 4 | Slow uptake of technology | 2 |
| 5 | Inconsistent data issues | 2 |
| 6 | Information technology (IT)/operational technology (OT) convergence problems | 1 |
| 7 | Lack of scalability of IT solutions | 1 |
| 8 | Digital divide – infrastructure | 1 |
| 9 | Lack of standardisation of IT infrastructure | 1 |
| 10 | Lack of standardisation between service providers | 1 |

Source: (author's own)

Around 42 percent of participants identified the lack of integration between systems as a barrier in this category. This creates challenges in terms of smart city implementations which require integration across multiple disparate systems. Vendors also compete with each other and therefore choose not to integrate systems

in order to maintain their competitive advantage, and to protect their intellectual property rights. Internal power struggles between people and departments within a municipality also contributes to the lack of integration between different systems. Departments and individuals prefer to maintain control of their systems, and do not want to be answerable to other departments when an issue arises. These power struggles, therefore, undermine efforts to integrate systems which are identified by participants as a barrier. The above factors are highlighted in the following quotes:

> *"Even the municipality itself, within a large metro like eThekwini, has got maybe 50 or 60 applications, that don't necessarily talk to each other"* (Participant 1).

> *"So, having now to get people to 'relinquish' their power so as to become more integrated, is a bigger part of the problem"* (Participant 4).

> *"So, to get a consolidated view and get a single point of departure, to actually enable a smart city project as common purpose, is the biggest problem"* (Participant 5).

The other major barriers identified are, too many competing systems, the lack of access to data, the slow uptake of technology in municipalities, and inconsistent data. The section below presents the political barriers for smart city developments in SA.

### 5.4.8. Political barriers

There were nine barriers identified with respect to politics, as illustrated in **Table 14**.

**Table 14:** *Political barriers*

| No. | Political barriers | Frequency |
|---|---|---|
| 1 | Lack of political buy-in | 7 |
| 2 | constant change of administration - 5-year tenure | 4 |
| 3 | Policymakers/leaders lack of interest in serving citizens | 3 |
| 4 | Poor hiring processes and systems for leadership | 3 |
| 5 | Lack of coordination and communication between different political parties to run municipalities | 2 |
| 6 | Politicians' urge to implement quick wins, and not futuristic projects | 2 |
| 7 | Unstable political environment | 2 |
| 8 | Politicians block smart city projects due to the need for personal glorification | 1 |

| No. | Political barriers | Frequency |
|---|---|---|
| 9 | Politicians'/government's fear of losing power/votes | 1 |

Source: (author's own)

Around 58 percent of participants noted that a lack of political buy-in is a significant barrier in this category as it is viewed as a critical success factor for smart city implementations. The lack of political buy-in is clearly evident by the corresponding lack of successful smart city implementations in SA, and is corroborated by the following extracts from interviewees:

> *"And that kind of decision is always going to be a political and top management decision, because those are the people who approve budgets, and if you don't have the buy-in and understanding of tech from them, and why it is important"* (Participant 2).

> *"So, if you look at it, the strategies are there, the buy-in tends to be a problem"* (Participant 4).

> *"So many, many times and instances you will find that executive buy-in is important, and everyone has a different perspective and it is hard to get the things to change"* (Participant 7).

> *"I mean, if they do not have the political support to do it, it is hard to go through the procurement processes"* (Participant 12).

Another participant noted that officials (administrative leaders) are unable to convince their political heads of the benefits which stifles smart city implementations. This is reflected by the following quote:

> *"but as administrative leaders it is very important to convince your political heads with the technologies, and then I am just saying that in some cases it may be difficult to see eye to eye in terms of the importance of a specific technology"* (Participant 9).

Around 33 percent of participants noted that continuity was a barrier in this category. Smart city projects are acknowledged for yielding long-term benefits; hence political leaders are not willing to approve these projects as they extend beyond their five-year tenure, and they will not receive the credit for the implementation. The leadership, therefore, opt for projects that demonstrate short-term benefits so that

they can showcase these projects for political gain. Furthermore, when a new council is elected, the incoming team reviews all approved projects and prioritises the ones that they perceive to be of most importance to them. This barrier is illustrated in the following quotes:

> *"They want immediate solutions. Their contracts are five years. So, if you are talking ten/fifteen year futuristic projects, I don't think many of them even intend to be here at that time"* (Participant 2).
>
> *"I think a lot of it also has to do with just the constant change of administration, because somebody wants to start from the beginning again, as opposed to picking up from what was or could have been working"* (Participant 4).
>
> *"if anything progresses beyond say a two-year period of implementation, it becomes a challenge because of the cycle of local government kind of elections and leadership changes. So, very often, the implementor of a solution will probably not be around to see it, though if it takes more than four years certainly, but anything between two to four years. So that is why they want the quick returns inside of a year because then it is possible to execute within the term of responsibility"* (Participant 5).
>
> *"within a city itself, you have the administrative side of government, and then you have the council side of government. And the council side will sit for five years, so you will have local government elections and then a new mayor is brought in. And when the new mayor is brought in he has different priorities or different ideas of what they want to push"* (Participant 12).

The other major barriers within this category are, the policymakers/leaders' lack of interest in serving citizens, poor hiring processes and systems for leadership, the lack of coordination and communication between different political parties managing municipalities, politician's urge to implement quick win solutions, and an unstable political environment.

The socio-cultural barriers that are hindering the development of smart cities in SA are presented in the following section.

### 5.4.9. Socio-cultural barriers

There were nine barriers identified in the socio-cultural category which are listed in **Table 15**.

**Table 15:** *Socio-cultural barriers*

| No. | Socio-cultural barriers | Frequency |
|---|---|---|
| 1 | Citizens unwillingness to pay for municipal services | 2 |
| 2 | Vandalism | 2 |
| 3 | Citizens resistance to change | 2 |
| 4 | Citizens lack of trust in technology | 1 |
| 5 | Citizens lack of trust in the municipality | 1 |
| 6 | Citizens resentment towards the government | 1 |
| 7 | Apartheid history - isolated spatial planning | 1 |
| 8 | Poor awareness of smart city initiatives | 1 |
| 9 | Lazy mindset to innovate/learn IT skills | 1 |

Source: (author's own)

A key barrier in this category is the citizens' unwillingness to pay for municipal services as they deem the provision of such services to be a basic right. This severely affects the economic viability of the municipality, and its ability to engage in smart city implementations which is highlighted by the following quotes:

> *"People are utilising services but they are not paying for it, which then creates a huge impact on the economic ability of the municipality to provide and extend services"* (Participant 1).

> *"But their mentality is whether we pay or we don't pay, but we will still have the right to these services" … "and you find that if guys were serious about paying they will be able to give that R100 per month but because their mentality is saying 'No, government can do this', and they take their R100 and use it for liquor or something else, and are not prioritising the services"* (Participant 11).

Around 17 percent of participants indicated that vandalism is a barrier to smart city implementations. Vandalism increases costs due to repairs of the damaged infrastructure and therefore this places a significant strain on the budget. The following quotes substantiate this statement:

> *"So, when you put smart technology somewhere, some card and wireless devices out in the field, it becomes harder to protect in the poorer areas"* (Participant 6).

*"And vandalisation. You will find out now that you already have some infrastructure, basic, and they vandalise. Now they are angry because of a child that was raped by their uncle. It's a police matter, but they take out their anger on the municipal infrastructure and they burn the tyres and the schools, and then you find out that the funding that was maybe planned for these smart cities now has to go and repair those schools so kids can continue going to school"* (Participant 11).

Around 17 percent of participants identified citizens' resistance to change as a socio-cultural barrier. The participants noted that citizens are comfortable with the status quo in terms of technology, and many are unable to embrace new technologies, especially the older generation. If municipalities are unable to obtain the buy-in of citizens, then citizens resistance would be a significant barrier to overcome as indicated below:

*"And also, the users who are supposed to now use the system and get the buy-in from them"* (Participant 11).

*"And people are dependent on 'government is going to do this for us'. When you come with some of the bright concepts like this smart cities that would have been like prepayment and all of that, you need to work on their mindset, because they have been used to a particular way of doing things, and now you need education to actually make them realise there is a different way of doing it. It is not easy, it is something that you have been taught for 30 years, and it cannot be changed over one day"* (Participant 13).

The section below presents the psychological barriers to the development of smart cities in SA.

### 5.4.10. Psychological barriers

There were five barriers identified in this category. These are listed in **Table 16**.

**Table 16:** *Psychological barriers*

| No. | Psychological barriers | Frequency |
|---|---|---|
| 1 | Leaders resistance to change | 8 |
| 2 | Municipal staff's fear of losing job / overtime | 2 |
| 3 | Management's personal glorification | 1 |
| 4 | Middle/lower level employees' resistance to change | 1 |

| | | |
|---|---|---|
| 5 | Risk of failure | 1 |

Source: (author's own)

Around 67 percent of participants noted that the leaders' resistance to change is a major barrier in this category. Leaders are hesitant to implement new technologies due to a lack of understanding of the value to be derived from it, and a departure from the traditional manner of conducting business, which makes them nervous. The following quotes corroborate this view from a psychological barrier standpoint:

> *"So, the minute we are coming up with a change in a process or in the way things are done, people naturally are hesitant for the change and therefore the lack of understanding makes them nervous of it"* (Participant 2).
>
> *"So, if I look back into my career in any technology, there has always been a resistance to change"* (Participant 4).
>
> *"So therefore there is a lot of nervousness of the officials, because you are not so certain by the time you are implementing, what you are putting in and what value you will get from it"* (Participant 6).

Other participants noted that senior management and leaders are comfortable with traditional business norms, and therefore resist any change from the established business practices as it may result in financial or reputational challenges. The following quotes illustrate this concern:

> *"So many, many times and instances you will find that executive buy-in is important, and everyone has a different perspective and it is hard to get the things to change; it is what they are accustomed or what they are comfortable with and these type of smart city transformations is uncomfortable to many because it is a dramatic change, and that change is always linked or referenced to financial constraints and challenges"* (Participant 7).
>
> *"think key management also plays a huge role, because most of the time you find out we have got our traditional way of doing things, and if now with the idea that is probably coming in, we can quickly find out people are reluctant to actually approve on that because they think the traditional way is still the best way"* (Participant 11).

Around 17 percent of participants highlighted issues such as job losses, and the loss of additional income as barriers in this category. Municipal staff are afraid that implementing technology will make them redundant, and they therefore resist such implementations. In addition, any technology that enables management to track and verify overtime claims are not supported by staff, as it impacts their livelihood. This mindset is reflected in the following quotes by interviewees.

> *"people feel uncertain, is this going to make me redundant?"... "Many of the mundane tasks might be made redundant but they create new opportunity for you!"* (Participant 7).

> *"So, for instance, if now you have an option of employing 4000 metro police officers or deploying a safe city solution that can only employ 200 officers who are going to be monitoring hotspots 24/7, and then only when there is an incident in the city do they despatch, obviously because of employment issues in the country, the smart city solution won't be supported because it will be deemed as not being employment friendly; one that is going to employ more people will be supported – and that is just the nature of the country because of high unemployment rate"* (Participant 10).

The section below presents the barriers within the legal and ethical category.

### 5.4.11. Legal and ethical barriers

There were four barriers identified with respect to the legal and ethical category which are listed in **Table 17**.

**Table 17:** *Legal and ethical barriers*

| No. | Legal and ethical barriers | Frequency |
|---|---|---|
| 1 | Municipal Finance Management Act (MFMA) regulations and legislation | 2 |
| 2 | Data security and privacy issues | 1 |
| 3 | High focus on compliance | 1 |
| 4 | Regulations are not changing as technology changes | 1 |

Source: (author's own)

Around 17 percent of participants identified the MFMA as a barrier in this category. While pilot projects are deemed to be successful, the companies conducting the pilot are not appointed, and a lengthy tender process ensues. These projects also need to be incorporated into the budget before it can be implemented, and this does not occur as smart city implementations are not viewed as a priority. These assertions are substantiated by the following quotes:

> "*it is very specific around budgeting and spending regulations. So, what the FMA expects you to do, the new way of doing things, the MSCA, the Municipal Standard Chartered Accounts, that legislation, what it brought in is that each municipality must have a project. Every budget that they get given must relate back to a project that you will find on the IDP"* (Participant 2).

> *"so, like I said, we did test and pilot many of these solutions, but what is interesting is not all of them, but most of them have been extremely successful. But one of the challenges we are facing is that we cannot implement it ourselves, and the restriction there would be the MFMA. So what I mean is the legal framework then suggests that, even if we test it, and are successful in the city, we then have to go out on tender to implement the solution, and that is a long and lengthy process and I mean it is not a given that when you tested it and it works you will actually get the implementation"* (Participant 9).

Sections 5.4.1 to 5.4.11 presented the barriers that are perceived to be hindering the development of smart cities in SA, and it is therefore vital to understand the participants' perceptions on how these barriers can be overcome. The recommendations to overcome the smart city barriers identified in question two of this research, forms the basis for research question three, and is presented in the section below.

### 5.5. Results for research question three

*What are the recommendations to overcome these barriers?*

Research question two prompts research question three, as it is equally significant to discuss the recommendations to overcome the barriers that have been identified from an SA perspective. This research question also aimed to understand the recommended sectors or areas in SA that should prioritise the implementation of

smart city technologies in conjunction with the recommendations to overcome the smart city barriers identified by this research.

The recommended sectors for the implementation of smart city projects are presented in section 5.5.1, and the recommendations to overcome the barriers identified in this research are presented in section 5.5.2.

### 5.5.1. Recommended sectors

There were 13 different recommended sectors/areas identified, as listed in **Table 18**.

**Table 18:** *Recommended sectors/areas*

| No. | Recommended sectors/areas | Frequency |
|---|---|---|
| 1 | Core service delivery departments | 9 |
| 2 | Safety and security | 5 |
| 3 | Health | 2 |
| 4 | Communication and connectivity infrastructure | 2 |
| 5 | Education | 1 |
| 6 | Projects that can reduce operational costs | 1 |
| 7 | Workforce management | 1 |
| 8 | Resource management | 1 |
| 9 | Data management | 1 |
| 10 | Department of housing | 1 |
| 11 | Transport | 1 |
| 12 | Urban planning | 1 |
| 13 | Governance | 1 |

Source: (author's own)

Each municipality is mandated to provide services to its citizens. District municipalities in SA ,are mandated as a water service authorities, and provide water and sanitation services to all of its citizens, including the local municipalities within its confines. Local municipalities are mandated to provide all other services excluding water provisioning. Around 69 percent of participants noted that government should prioritise the implementation of smart city projects in core service delivery departments to improve service delivery. This is highlighted by the following statements:

*"Certainly it would be water services. So, it would be the core service delivery department"* (Participant 2).

*"My personal point of view alludes to your previous definition of what a smart city is, service of creating a public environment and rendering services to citizens. So, it is always a good idea to start with the measured pain points"* (Participant 5).

*"My response to that would be to say from a technology point of view, ICT firstly, implementation of technology across the different sectors – water, waste, electricity and the likes"* (Participant 9).

*"It is the core business functions, like for instance, with municipalities their core is usually service delivery in terms of water, electricity and all the services that must get to the people. So those are the ones that should be prioritised to implement smart cities"* (Participant 11).

According to the participants, the safety and security of citizens plays an important role in creating a better environment for sustainable living and attracting investment. Participants noted that government needs to consider implementing smart city projects to improve the safety and security of citizens, which is evidenced by their statements below:

*"If you start to reduce crime then you are creating a better environment for people to come and make an investment"* (Participant 3).

*"So in SA, yes, specifically I would say it is safety and security, the city life line is actually because you need to manage, and also maybe actually public safety includes emergency rescue and police and metro police and everything"* (Participant 8).

Participants also noted that government needs to consider implementing smart city technologies, products, and services in the health sector as SA lacks an integrated approach to health care, and that it is crucial to maintain a centralised system. The statements below highlight this recommendation:

*"The other big one is the health system, the public health, in keeping of records, etc. We have a lot of clinics that are not connected, and generally we find that if somebody is in one area, and if they go to another clinic, then the records are not kept. If we had to centralise that database, for example, then*

*I can go to any clinic, I can look at what my treatment was, the medication that was provided, who the doctors were, etc. So, we don't have to start that entire process from scratch again"* (Participant 1).

*"We are seeing as a priority being the health care"* (Participant 3).

According to the participants, smart city technologies will fail without a proper communications infrastructure. The government's priority should be to install connectivity infrastructure, such as fibre, to ensure that citizens are connected and are able to access various smart city services that government can offer. This is highlighted by the statements below:

*"At the basic level, I would say the things that any city needs to be thinking about, it needs to be the physical infrastructure, meaning at the basic level the communication infrastructure, your connectivity – that before anything else – otherwise it is just a dream, if there is no thinking about connectivity. So that would be the first thing"* (Participant 3).

*"So make sure they are offered and provided and then do so in a way we can at least do something about connecting people – if not connecting people correctly – but the right mechanisms to monitor whether consumption is to expectation, with the right mechanisms in place when things go wrong in order to spot them efficiently and effectively in the municipalities"* (Participant 5).

The recommendations to overcome the smart city barriers identified in section 5.4 are presented in the section below.

### 5.5.2. Recommendations

There were 24 recommendations by participants to overcome the barriers identified by this research, which are hindering the development of smart cities in SA. These recommendations are listed in **Table 19.**

**Table 19:** *Recommendations*

| No. | Recommendations | Frequency |
|---|---|---|
| 1 | Ensure strict laws to stamp out corruption | 2 |
| 2 | Create awareness and education about smart cities | 2 |

| No. | Recommendations | Frequency |
|---|---|---|
| 3 | Ensure the appointment of qualified leaders | 2 |
| 4 | Government to take concrete decisive action against corruption | 1 |
| 5 | Create a task team | 1 |
| 6 | Ensure young skilled people remain in SA | 1 |
| 7 | Appoint people from outside government to the task team | 1 |
| 8 | Create financially sustainability models | 1 |
| 9 | Encourage public/private partnership (PPP's) | 1 |
| 10 | Develop internal capacity and capability within municipalities | 1 |
| 11 | Ensure accountability management | 1 |
| 12 | Improve communication | 1 |
| 13 | Develop a high-level smart city strategy | 1 |
| 14 | Leaders to be more open to smart city ideas | 1 |
| 15 | Review and adapt the legal framework to be in line with the fourth industrial revolution | 1 |
| 16 | Implement data management | 1 |
| 17 | Adapt policies to provide free education for skills development | 1 |
| 18 | Ensure alignment of vision between the top and bottom level staff and management | 1 |
| 19 | Create strong project execution teams | 1 |
| 20 | Ensure local technologies are supported | 1 |
| 21 | Create a dedicated R&D budget | 1 |
| 22 | Ensure smart city projects are owned by the city manager's office | 1 |
| 23 | Educate citizens on digital skills | 1 |
| 24 | Ensure leaders are supported by tech-savvy people | 1 |

Source: (author's own)

Corruption was identified as a major barrier, and many participants noted that government needs to apply strict laws to root out corruption as it hinders the success of smart city implementations. The statements below give effect to this recommendation:

> *"let's take Singapore as a smart city – they face the same problems that SA did in terms of corruption, etc, but they have turned it around; Singapore has got everything, from the time that you get off at an airport till you get into the*

*air is very quick, everything works efficiently! And the reason for that is the first thing the president did was stamp out corruption, and the laws are strict and followed! By everyone! So, I think that is the route, if you want to start developing a smart city"* (Participant 1).

*"And then those transgressions, those accountabilities and that ownership of what they did, then they have to be subjected to the might of the law, and the law has to also be stringent enough to take action!"* (Participant 7).

According to some participants, various stakeholders including chief information officers, ICT managers and citizens' lack awareness and understanding about smart city concepts. It is therefore vital to create awareness through education, and other means to overcome the barriers to the development of smart cities in SA. The participants' statements pertaining to this recommendation are listed below:

*"And I think education, education in terms of the systems themselves and how those systems would link with the business, whether it be engaging with the CIO or IT manager, but to have that conversation across technology and what is the priority. That would be addressed through this, because I think a lot of time we talk about technology but not, you know, so that it is clearly visible"* (Participant 4).

*"but I think it is more user education. We have touched on that, the more information that is provided out there, that people are understanding clearly what are these initiatives and smart cities, I think the benefits maybe of using these things will be much better for people to adapt to these changes"* (Participant 11).

Another recommendation by the participants is to employ qualified individuals within the municipalities. A key barrier identified by this research, was the lack of qualified executives and administrative leaders to fulfil their roles and responsibilities. It was also identified that people in these positions were recruited through political recommendations. It is therefore vital to appoint qualified individuals who can move the country forward by implementing futuristic projects. The statements below highlight this recommendation:

*"make sure that qualified people are appointed who are suited to their jobs. Employing people that really are progressive thinkers and innovative. And you*

*know, that are just there to win, nothing else, just to see progression and to work. That certainly will already make a difference"* (Participant 2).

*"I think we need to hire the right people who are qualified to be in these roles, in these leadership roles. Let's make sure that qualified people are appointed into those roles. That's the first thing."* (Participant 3).

## 5.6. Conclusion

This chapter presented the results of the three research questions proposed in chapter three. The rationale for the development of smart cities in SA is primarily focused on service delivery, which is indicated as both a major driver and major benefit. While service delivery is considered as the main rationale, the other key smart city drivers identified were, improving the citizens' quality of life, attracting investment, cost reduction resource savings, ease of use for millennials, better citizen management, infrastructure improvement, spatial planning, economic competitiveness and efficient municipal operations. The other major benefits of smart city developments identified by this study were, the effective and efficient delivery of services, increasing citizens safety and security, improved communication, and improved access to the municipality.

The major barriers to the development of smart cities in SA are arranged into ten categories, namely, organisational, economical, skills and competency, governance, socio-economic, technological, political, socio-cultural, psychological, and legal and ethical. These barriers are, the leadership's lack of understanding and connection to the smart city concept, a lack of funding, a silo municipal structure, the policymakers/leadership's unwillingness to see the intangible benefits of ICT systems, leaders resistance to change, the lack of a smart city vision or mission statement, the high cost associated with smart city technologies and products, and the lack of political buy-in. From the above barriers, it is evident that most of them are related to leadership and management.

The core service delivery departments, such as water, waste management, electricity, safety and security, health, and communication and connectivity infrastructure are listed as key sectors and areas that the SA government needs to prioritise for the implementation of smart city projects. Other general recommendations to overcome the barriers identified for the adoption of the smart city paradigm in SA include, enforcing strict laws to root out corruption, creating an

awareness and education about smart cities, and employing qualified individuals within the municipalities. The following chapter presents a discussion of the findings from this research.

# Chapter 6: Discussion of Results

## 6.1. Introduction

This chapter provides a detailed discussion of the results that were presented in chapter five. The discussion is organised according to the research questions and themes that emerged from the interviews; with insights obtained by analysing the results in conjunction with the literature review.

The discussion surrounding research question one is related to the rationale for the development of smart cities in South Africa. The themes discussed within this research question are factors related to citizens, infrastructure and municipal operations, finance, planning and growth, leadership and external factors.

Research question two addressed the barriers to smart city developments in SA. The themes discussed within this research question are organisational factors, economic factors, skills and competency, governance, socio-economic factors, technological factors, political factors, socio-cultural factors, psychological factors, and legal and ethical factors.

Research question three focused on the recommended sectors and areas where smart city projects are perceived to be of importance, and the recommendations to overcome the barriers identified.

The discussion on research questions one, two and three are provided in sections 6.2, 6.3 and 6.4 respectively, with section 6.5 providing the concluding remarks for this chapter.

## 6.2. Discussion of results for research question one

*What is the rationale for the adoption of the smart city paradigm in SA?*

This research question aimed to understand the rationale for the development of smart cities within the SA context and sought to identify various factors that drive the development of smart cities in SA and the benefits that may accrue. A discussion about various smart city drivers related to citizens, infrastructure and municipal operations, finance and planning and growth is provided in sections 6.2.1, 6.2.2, 6.2.3 and 6.2.4 respectively.

### 6.2.1. Citizens

This study revealed that citizen related factors constitute a significant rationale for smart city developments in SA. Prominent citizen related factors that drive the adoption of the smart city paradigm in SA are service delivery, the quality of life of citizens' and the ease of use for millennials. A few significant benefits that government can derive, after successful implementation of smart city projects, are effective and efficient service delivery, an increase in citizens safety and security, improved communication and improved access to the municipality.

Service delivery is one of the primary responsibilities of local and district municipalities in SA (South African Government, 2019). However, service delivery in SA is a significant concern due to communities and citizens being involved in service delivery protests (Masegare & Ngoepe, 2018; Ndevu, 2019; Young, 2018), which this has resulted in low revenue collection (Chauke & Sebola, 2016).

Although service delivery was not listed as a smart city driver in studies conducted in Brazil, Europe, the USA, Asia, Switzerland and South Africa (Guedes et al., 2018; Oke et al., 2020; Veselitskaya et al., 2019), the results from this study confirm that service delivery is a primary driver for SA. The results also highlighted that citizens are becoming increasingly aware of poor service delivery and have an expectation that the government must provide value for money. With the rapid changes in technology, citizens expect the government to improve the level of service delivery year on year. It is therefore imperative that the SA government adopts the smart city paradigm to fast track service excellence to its citizens and to improve service delivery overall.

SA Municipalities play a crucial role in enhancing the citizens' quality of life through the creation of jobs, providing essential services such as safety and security, health infrastructure and facilities and education (Ndevu, 2019). However, 90 percent of SA municipalities are underperforming due to various reasons (Mello, 2018). Commensurate with the literature review conducted on smart city drivers by Yigitcanlar et al. (2018), and a participative foresight article in Winterthur by Furrer et al. (2017), the results of this research indicate that the SA government needs to utilise smart city technologies to improve its citizens quality of life. This was also affirmed by Vu and Hartley (2017), wherein the authors noted that developing countries need to adopt the smart city paradigm as a strategy to improve their citizens quality of life.

Although SA faces a significant digital divide (Chetty et al., 2018; Lavery et al., 2018; Nyahodza & Higgs, 2017), only 33 percent of households did not find it essential to have internet access at home, thereby implying that 67 percent of SA households believe that internet access is vital. James (2014) noted that the usage of mobile phones in SA has increased and tends to bridge the digital divide. In accordance with the increase in the use of mobile technology in SA, the results of this study highlight the SA government's need to utilise smart city technologies to provide effective and efficient services to the current generation, that is, millennials who expect that they should be able to access services via the click of a button. Dubai has clearly understood these expectations and has provided various mobile apps to deliver services to its citizens (Khan et al., 2017).

Similarly, Bulgaria has also provided 50 online e-government services to its citizens (Kola-Bezka et al., 2016). In SA, the Ekurhuleni municipality is an example of a municipality implementing mobile applications to improve service delivery (Musakwa & Mokoena, 2018). Other SA municipalities, therefore, need to consider Ekurhuleni municipality as a role model and utilise its experience in adopting mobile applications for government services to provide ease of use for adolescents and young adults.

An interesting finding in this section is that service delivery is indicated as a major driver for smart city developments in SA even though it was not listed as a driver in the literature review conducted for this study. This justifies the need for this research as the drivers for smart city developments need to be understood from an SA context and perspective.

The following section discusses the smart city drivers related to infrastructure and municipal operations.

### 6.2.2. Infrastructure and municipal operations

Vu and Hartley (2017) noted that improving the necessary infrastructure and government's proficiency and operations are two of the five topmost priorities that Vietnam must concentrate on to supplant its smart city developments. Another study conducted by Liu and Zhenghong (2014) revealed that the management of resources such as water and electricity, along with various other factors, drive smart city developments in China, whilst another study related to smart city drivers within Brazil also included infrastructure development as one of the key drivers (Guedes et al., 2018). The results of this study are congruent with all the above studies, which

indicate that these factors are some of the most significant drivers for the development of smart cities in SA.

SA municipalities must operate efficiently and effectively to achieve resource savings and improve infrastructure development. The efficient operation of SA municipalities is also linked to other factors such as service delivery, and improving the citizens' quality of life. If municipalities do not operate efficiently and effectively, they will not be able to address service delivery issues which adversely affects revenue generation (Chauke & Sebola, 2016), and ultimately affects resource and infrastructure maintenance and development. Rana et al. (2019) listed resource management and the inadequate and deteriorating infrastructure as some of the main challenges due to urbanisation and that smart cities can be utilised as a means to address these urbanisation challenges. It is therefore evident that these three factors, that is, resource savings, efficient and effective municipal operations and infrastructure development, are critical in driving the development of smart cities in SA.

In summary, this study highlighted that resource savings, efficient municipal operations and infrastructure development are common smart city drivers amongst developing countries such as SA, Vietnam, China, India and Brazil.

The following section discusses the finance related drivers.

### 6.2.3. Finance

Increased operating costs is one of the major challenges faced by governments due to urbanisation (Das & Emuze, 2014; Rana et al., 2019). In addition, the citizen's cost of living has also increased due to urbanisation, and this increased cost of living coupled with high unemployment rates and poverty have resulted in a higher crime rate in SA (Mokoele & Sebola, 2018). It is therefore evident that the SA government needs to focus on reducing its operational costs and provide sustainable solutions to its citizens to reduce their cost of living. Unsurprisingly, this study also indicated that cost reduction, along with economic competitiveness and attracting investment, are the key drivers for smart city developments in SA. Similarly, cost efficiency, along with economic competitiveness, were also listed as vital drivers for smart city developments in Switzerland (Furrer et al., 2017). However, a study conducted by Oke et al. (2020) on smart city drivers in the Gauteng province in SA did not list these factors as major smart city drivers.

Furthermore, these three factors, namely, cost reduction, economic competitiveness and attracting investment have a positive impact on the economic growth of a country (Akinwale & Grobler, 2019; Bekun et al., 2019; Ilesanmi & Tewari, 2017; Mongale et al., 2018). However, SA's economic growth is comparatively lower than other developing countries (The World Bank, 2019). The country, therefore, needs to transcend the economic crisis in order to alleviate various socio-economic issues such as poverty and unemployment as they directly contribute towards an increase in crime. As per the results of this study, the development of smart cities is one way to achieve this goal.

This study also revealed that integration between government departments and entities, and infrastructure improvement can attract both local and foreign investment. The SA government and municipalities need to consider implementing smart city technologies to reduce spending on overtime, reduce costs by improving business processes, and provide cost-effective solutions to their citizens. SA municipalities also need to compete with each other to enhance economic competitiveness. It is therefore imperative for SA to adopt the smart city paradigm to attract both local and foreign direct investment, reduce costs and increase economic competitiveness in order to foster economic growth.

Whilst the literature review conducted for this study does not highlight the above factors as drivers for smart city development in developing countries, one can contend that these factors directly affect the citizens' quality of life, which is listed as a key driver for smart city developments worldwide. However, these factors are not explicitly listed in the literature review, thus validating the need for this research.

Smart city drivers within the planning and growth category are discussed in the following section.

### 6.2.4. Planning and growth

SA's apartheid history created neighbourhoods based on racial segregation, and urban planning was done accordingly which created challenges for the new democratic government (Marais et al., 2019). Given SA's historical context, urban planning plays a vital role in addressing issues related to an increase in urbanisation after democracy. Consistent with the country's context with regards to spatial planning, this study also indicated that urban planning needs to be revisited as it affects infrastructure and resource management optimisation. This study also

highlights the need for spatial planning to include solutions that target infrastructure and resource management, as most of the infrastructure was developed during the apartheid era. As per the results of this study, spatial planning is therefore highlighted as one of the major drivers for smart city developments in SA as it brings people closer together, and can address the challenges of urban migration.

The literature review of this study indicated that urban planning was listed as a primary smart city driver in Brazil by Guedes et al. (2018). In terms of developed countries, urban planning was one of the areas targeted by the “Smart Dubai" initiative (Khan et al., 2017). Whilst the above two studies included spatial planning as one of their major drivers, the literature review conducted for this study indicated that spatial planning was not perceived as a major driver by other developing countries such as India, China and Vietnam. Spatial planning was also not identified as a driver by the study conducted on smart city drivers in the Gauteng province in SA (Oke et al., 2020). It is therefore evident that this study is substantiated by highlighting spatial planning as a major driver in SA, given SA’s apartheid history and current context.

Having discussed the rationale for smart city developments, it is important to understand the barriers that are hindering these developments. The following section presents a discussion of the barriers to the adoption of the smart city paradigm in SA.

### 6.3. Discussion of results for research question two

*What are the barriers that are hindering the adoption of the smart city paradigm in SA?*

This research question was aimed at identifying various barriers that are hindering the adoption of the smart city paradigm in SA and identifies the highest impact barriers. The results of this study revealed that the barriers for the development of smart cities in SA are related to the organisation, especially municipalities, economic related factors, skills and competency related factors, governance issues, socio-economic related factors, technological issues, political barriers, socio-cultural barriers, psychological barriers, and legal and ethical factors. These barriers are discussed in sections 6.3.1 to 6.3.10.

### 6.3.1. Organisational barriers

Organisational related factors are considered to be a major barrier as this study identified 36 barriers in this category. Kleynhans and Coetzee (2019) acknowledged that SA municipalities are decentralised and diverse. In addition, this study's findings further acknowledged that the decentralised nature of municipal departments creates a barrier towards the adoption of the smart city paradigm in SA. This was also affirmed by Rana et al. (2019), wherein the authors noted that the lack of cooperation and coordination between different departments is a critical barrier in the development of smart cities in India.

This study also highlighted that different government departments work in an isolated manner, and that each department has its own agenda and objectives. One reason for this isolation is the structure of government and municipal departments. Another reason is that the staff members within each department have their own power relationships with other departments, and they want to receive the credit and fame for a project's success. Departments, therefore, do not share information with each other resulting in a duplication of systems. However, the findings of this study indicated that significant cost savings, effort minimisation and resource sharing can be achieved if information is shared between departments, and if systems and processes successfully implemented by one department are utilised by another.

It was also identified in this study that municipalities do not plan in an integrated manner due to each department considering its own issues to be of the highest priority, as it needs to achieve its key performance indicators. Municipalities, therefore, do not integrate systems, thereby hindering the implementation of smart city projects which are required to be implemented in an integrated and holistic manner to derive its full benefit. Municipal and government departments need to view the municipality and the country holistically and prioritise tasks and challenges in accordance with the country's priorities.

Another significant barrier within the organisation category is that policymakers/ leaders within the government and municipalities do not see the intangible benefits of technology, especially ICT systems. This was also confirmed by Mawela et al.'s (2017) study on e-Government services in SA, wherein it was revealed that poor leadership and the poor profile of ICT departments in municipalities are the main reasons hindering the successful implementation of smart city projects. Similar to the study noted above, the results of this study also confirmed that most officials and

policymakers within the SA government and municipalities believe that ICT projects do not provide tangible benefits, and they therefore cannot comprehend the value that these projects add to the country. Officials prefer to implement projects that can display tangible progress and demonstrate a financial return on investment. Due to these factors, smart city projects are not implemented by municipalities.

Furthermore, policymakers and leaders do not see the ICT department as a strategic unit and an enabler of service delivery, but rather as a support function. The ICT department is therefore not invited to project meetings prior to sign-off, and only act as a project team member when the service delivery department's project includes an ICT component. In addition, smart city projects are considered as an ICT project, and core service delivery departments therefore do not own these projects as they do not consider ICT to be a high priority.

SA municipalities also do not have a unified and clear smart city vision or mission statement that they can refer to. In contrast, the European Union has a clear vision of achieving a low carbon economy via smart city projects (Veselitskaya et al., 2019). Similarly, Singapore is also creating a smart nation with a clear vision of what it wants to achieve with reference to smartness within a specified timeframe (Hoe, 2016). In a developing country context, Vu and Hartley (2017) find that the lack of a strategic vision is a smart city barrier in Vietnam. An unclear ICT management vision was also noted as a smart city barrier in India by Rana et al. (2019). Congruent with the studies noted above, the results of this study also found that the lack of a smart city vision or mission statement is hindering the adoption of the smart city paradigm in SA as officials do not have concrete objectives that they can refer to.

Other factors such as a municipality's lack of creative thinking to generate revenue, the lack of an effective communication strategy within a municipality, the lack of a high-level smart city strategy, poor participation and input from key municipal staff, the lack of a proper change management strategy, the lack of integrated planning, poor urban planning, the lack of strong and bold leadership, the lack of a dedicated smart city department within SA municipalities, and the non-strategic nature of smart city initiatives were also highlighted as smart city barriers by this study.

In summary, this section highlighted that a silo municipal structure is a major barrier in this category. While it was listed as a smart city barrier in India, this was not listed in other studies that formed part of the literature review conducted for this study.

Similarly, policymakers' unwillingness to consider the intangible benefits of technology is also not identified as a barrier in the literature review. However, the lack of a smart city vision or ICT vision has been identified in other developing countries such as Vietnam and India. It is therefore evident that the barriers for smart city developments, as identified by this research, varies amongst countries and are based on a country's context.

The following section discusses the economic barriers that are hindering the adoption of the smart city paradigm in SA.

### 6.3.2. Economic barriers

According to The World Bank (2019), SA's economic growth is comparatively lower than other developing countries. The poor economic growth has led to poverty and unemployment, whereby poverty in 2015 was at 18.8 percent, and the unemployment level was at 27.6 percent in the first quarter of 2019 (The World Bank, 2019). In addition, there was a 6.6 percent decrease in total employment between June 2019 and June 2020 (stats sa, 2020). Similarly, the results of this study also identified economic factors such as a lack of funding, the high costs associated with smart city technologies and products, and the municipalities lack of revenue generation capability to be major barriers in the adoption of the smart city paradigm in SA.

The lack of funding and economic instability were listed as major barriers in the studies conducted on smart city barriers within India (Chatterjee & Kar, 2018; Rana et al., 2019). This study also revealed that SA municipalities do not have specific ICT grant funding or smart city grant funding. It is therefore difficult for municipalities to approve smart city projects due to budget constraints, and the urgent demand by citizens for the provision of essential services, such as water, electricity and the reduction of the housing backlog.

Municipalities are also not able to generate revenue which is also identified in this study as a major barrier for the development of smart cities in SA. This was also confirmed by Chauke and Sebola (2016), wherein the authors noted that about 26 percent of SA municipalities are in a poor financial position and that SA municipalities are not able to generate revenue because they are mostly serving the poor. Since a municipality's priority is the provision of essential services to the people, smart city projects are therefore relegated to a secondary priority. Musakwa and Mokoena

(2018) also argued that the implementation of smart city projects in SA would be misplaced priorities if they took precedence over the provision of essential services such as water and electricity. It is therefore evident that, unless SA municipalities can generate enough revenue to ensure the adequate provision of basic services, the development of smart cities in SA will be stalled.

In addition, smart city technologies and products are expensive. Rana et al. (2019) noted that the high costs related to smart city technology operations and maintenance are barriers for smart city developments in India. It is therefore evident that a lack of funding for ICT and other smart city specific projects, coupled with the expensive nature of smart city technologies, are significant barriers for the development of smart cities in SA, given the municipalities' inability to generate their own revenue streams. The results of this study also revealed other economic barriers such as a lack of investment, the country's poor economy, the financial viability of smart city projects and the avaricious nature of smart city service providers. The compound effect of these barriers will have a direct impact on other areas such as service delivery, citizens safety and security, improved communication, and improved accessibility which are identified as benefits that smart city developments in SA could derive.

This section highlighted that funding and the expensive nature of smart city technologies are barriers in developing countries such as India and South Africa. However, it was not listed as a barrier in other developing countries such as Vietnam and China. This confirms that a barrier in one country is not necessarily a barrier in another, even though they belong to the same developing countries category.

The following section provides a discussion on smart city barriers related to skills and competency.

### 6.3.3. Skills and Competency barriers

Employee capacity gaps were listed as a major reason for poor service delivery by SA municipalities (Ndevu, 2019). The qualifications of staff play an important role in a municipality's performance (Mello, 2018). In accordance with these studies, the results of this study also revealed that skills and competency related factors, such as the leadership's lack of understanding and connection to the smart city concept, a lack of smart city specific skills within a municipality, a lack of human capital with technology skills within a municipality and the technology readiness of leaders are

smart city barriers. Furthermore, the lack of training and development was identified as a major reason for the lack of skills in a municipality (Luthuli et al., 2019) which was also listed as one of the reasons for the failure of e-government services in SA (Mawela et al., 2017).

The results of this study also revealed that staff who occupy senior positions in municipalities tend to overlook the role of ICT, and therefore do not attempt to understand the smart city concept which results in a lack of connection to the concept itself. In addition, the technology readiness of these officials is poor, which contributes to a lack of interest in the role of ICT. Technology readiness is also related to the age of an individual and most of the officials who are appointed in senior positions are of the older generation and are unprepared for advanced technologies. Together, these factors create a major barrier in the development of smart cities in SA.

Furthermore, the smart city paradigm is an advanced concept, and the skills within the smart city landscape are lagging in SA. The results of this study also revealed that municipalities are lacking in smart city skills, and are unable to compile a proper tender specification to procure smart city specific service providers. Smart city technologies are constantly changing and agile, and staff need to be kept abreast of technology. However, as Luthuli et al. (2019) argue, the municipalities training and development programmes are not current nor effective due to various factors such as the employee's mindset to learn. This is important as many employees participate in training and development to satisfy skills audit requirements rather than their capacitation.

Furthermore, a study conducted by Pezzutto et al. (2016) indicated that the lack of expertise is a barrier for smart city developments within the EU; even though the EU is advanced in smart city developments. Rana et al. (2019) and Chatterjee and Kar's (2015) studies related to smart city barriers in India also affirmed this contention. The results of this study, in conjunction with the studies in the EU and India, identified that a lack of skills is a major barrier in both developed and developing countries. However, the lack of skills was not listed as a barrier in the studies conducted in Barcelona, Charlotte, Shanghai and Tokyo by Veselitskaya et al. (2019). This study also identified other barriers in this category, such as incapable and incompetent leaders, the lack of progressive or future thinking leaders and service providers lack

of skills, competence, and experience. These barriers were not identified in other studies.

Furthermore, it is important to note that Barcelona belongs to the EU; however, a lack of expertise is not listed as a smart city barrier for Barcelona, although it was listed as a barrier for the EU. It is therefore evident that these barriers cannot be generalised in terms of developing and developed countries, and that the barriers to the adoption of smart cities need to be assessed based on the country's context. This study identified that a lack of skills is a major barrier in SA, given the country's context. The lack of skills is also emphasised by Baldry (2016), wherein the author noted that the shortage of skills and mismatch between labour market demand and higher education supply had resulted in high unemployment levels within the country.

The following section provides a discussion on smart city barriers related to governance.

### 6.3.4. Governance barriers

Mello (2018) identified corruption as a critical reason for SA's poor service delivery issues. This is further affirmed by Southall (2014), wherein he noted that state employment is considered to be an opportunity to amass wealth, resulting in maladministration and corruption within government entities, which is highlighted in the audit reports on government entities. According to the author, only 22 percent of government entities received clean audits for the 2011-2012 financial year due to corruption and maladministration. Bruce (2019) argued that SA had witnessed a significant level of corruption, including the 'state capture' saga, which resulted in the loss of R600 billion of the procurement budget for goods and services and with 60 percent of tenders being corrupt. Predictably, the results of this study also confirm that corruption is a major barrier for smart city developments in SA. However, the literature review suggests that corruption is viewed as a smart city barrier in Nigeria only, and not in other developing and developed countries. It is therefore evident that these barriers need to be assessed for each country in order to understand the factors that are hindering the adoption of the smart city paradigm from a country's context. The findings of this research also highlight corruption as a barrier for SA.

According to this study, corruption affects three different aspects of smart city projects. (i) Municipalities are facing severe financial issues due to corruption, thereby resulting in budgets not being allocated to smart city projects as they are

perceived to be of low importance. In section 6.3.1, it was discussed that technology projects are not given priority as they do not provide tangible benefits for leaders and policymakers and are therefore unwilling to prioritise smart city projects. (ii) In many instances, even if smart city projects are approved, service providers are not appointed based on merit as they are appointed by some officials to satisfy their self-interests. This links to three other barriers, namely, mismanagement in municipal supply chain processes, service providers' lack of skills, competency, and experience, and policymakers/leaders' lack of interest in serving citizens. It is therefore evident that one barrier can cause a chain reaction, ultimately resulting in poor service delivery to citizens. (iii) A country's credit rating affects the country's borrowing costs (Trading Economics, 2020a), thereby, affecting the country's economy. Unsurprisingly, rampant corruption has resulted in poor credit ratings for SA by credit rating agencies such as Standard and Poor and Moody and Fitch (Trading Economics, 2020a). This implies that the country's borrowing costs would increase, and that foreign direct investment would be low, thereby affecting funding and budget allocations to municipalities, which ultimately impacts service delivery and infrastructure development. As indicated in section 6.3.2, smart city projects are expensive, and a lack of funding affects the development of smart cities in SA. It is distinctly clear that many of these barriers are interlinked and that they adversely affect the country's economic growth and its ability to drive service delivery effectively and efficiently.

This study also revealed that some leaders, officials, and staff of government entities are not interested in serving citizens, but that they are self-oriented, and focus on self-enrichment while they are in the positions of power by plundering government resources for their own benefit. These issues are often reported by the media and were also highlighted by Munzhedzi (2016). Corruption, therefore, leads to mismanagement of funds and investment in wrong projects which is listed as one of the barriers in this study. The investment in these projects occurs due to officials appointing service providers in exchange for financial benefit. As a result, the expertise and experience of other service providers are not considered when procuring services, resulting in costly, inefficient, or non-delivery of projects.

Corruption also leads to transparency issues within government. According to Winkowska and Szpilko (2020), one of a smart city's dimensions is smart governance which focuses on ensuring transparency. As highlighted by both Munzhedzi (2016)

and Bruce (2019), many officials are involved in corrupt activities. These officials, therefore, do not choose to implement smart city projects as one of the objectives of the smart city paradigm is to provide transparency and accountability. Predictably, the results of this study also indicate that municipal management and officials are unwilling to be transparent about their spending, and this becomes a barrier to the implementation of smart city projects. Rana et al. (2019) also listed the lack of transparency as one of the smart city barriers in India.

Another key governance barrier revealed by this study is the poor alignment between national, provincial, and local governments. Since each government entity has its own mandate in providing services (South African Government, 2019), this study revealed that the silo model of government structures creates many challenges such as the lack of integration between municipalities and other government entities. Gauteng, for example, consists of three metro municipalities, namely, Ekurhuleni, the City of Johannesburg and the City of Tshwane. However, these municipalities do not work together or share systems that are procured by another even though the sharing of information and systems could alleviate many of the problems related to infrastructure, governance, and service delivery in Gauteng. Similarly, local government does not engage with provincial and national government and is also not involved in project meetings that occur at both national and provincial levels. Consequently, the SA government and municipalities are not able to derive the benefits pertaining to economies of scale, which ultimately increases costs due to duplication of effort, systems and infrastructure.

Supply chain processes within a municipality are also noted as one of the barriers as these processes are unable to adapt to agile technologies. Lengthy supply chain processes result in technology projects being delayed and projects that were approved to be implemented become outdated. In addition, municipalities are unable to change the technology as the tender specifications, and its cost once awarded, are fixed. Similarly, the IDP review process also does not cater for fast-changing technologies. The IDP is reviewed annually and any changes to the IDP can only be performed at this juncture. This cycle is perpetuated as the technology is again outdated due to the longer time intervals as budgeting for projects is only conducted when they are listed in the IDP.

In summary, the results of this study indicated that corruption, including mismanagement of supply chain processes, mismanagement of funds and wrong

investments in projects are major barriers for smart city developments in SA. Although corruption is a significant concern worldwide, apart from Nigeria, it was not listed as a barrier in the literature review conducted for this study. This again highlights the fact that smart city barriers vary between countries, and that these barriers need to be assessed from a country's context and perspective; thereby substantiating the rationale for this research.

The socio-economic barriers are discussed in the following section.

### 6.3.5. Socio-economic barriers

Inequality is listed as a major barrier for smart city developments in India (Rana et al., 2019). SA is considered to have a dual economy, as it has a very high rate of inequality, wherein 70 percent of net wealth is held by only 10 percent of the total population, and only seven percent of the wealth is held by 60 percent of the total population (Southall, 2014). The results of this study revealed that high income inequality is a major barrier in the adoption of the smart city paradigm within the SA context as many South Africans are unable to pay for basic services and this directly affects the municipality's ability to generate revenue.

This study also identified SA's apartheid history as one of the main reasons for the inequality. Apartheid's strategy was to segregate people based on racial classifications and to make certain groups rich and others poor. Due to the income gap that was created, smart cities are perceived to be a sophisticated technology for high income people only, thus becoming a major barrier in poorer communities. In addition, the majority of people do not receive essential services such as water and electricity, and smart cities are therefore considered to be a luxury for these citizens, whereas high income people consider smart cities to be a necessity. Due to this income inequality and difference in opinion between citizens, municipalities struggle to make decisions regarding the implementation of smart city projects.

Another key socio-economic barrier is the ageing infrastructure or lack of infrastructure. Once again, SA's apartheid history plays a crucial role in this regard, as urban planning during the apartheid period was conducted based on geographic location and racial segregation. Certain areas were allocated to the elite who had superior infrastructure to other races who lived in townships with little or no infrastructure. However, post-apartheid, the migration from rural to urban areas has caused an increase in the urban population and municipalities are unable to maintain

the existing infrastructure to cater for the corresponding increase in the population. Consequently, the ageing infrastructure, and lack of infrastructure are considered to be daunting problems, as they are also coupled with other issues such as resource theft. This includes the theft of infrastructure as poverty drives people to steal valuable infrastructure such as copper pipes, cables, etc. These issues, therefore, result in unplanned capital and operational expenditure as the government is forced to repair the damaged infrastructure. Smart city projects are therefore shelved or put on hold due to budgetary constraints. As identified in this study, urban areas have a reasonable infrastructure while rural areas and informal settlements still lack basic infrastructure; the provision of which is therefore a priority for all levels of government.

Other key barriers identified within this category are high unemployment levels, the lack of access to basic services and poverty. These issues contribute to resource theft and increase the digital and economic divide of the country. However, a few participants in this study contended that infrastructure projects need to be coupled with smart technologies such as smart water meters to reduce operational costs and to deliver excellent services to their citizens, and that smart city projects should not be seen in isolation. Aghimien et al. (2020) suggested that poor infrastructure is a barrier for smart city developments in Nigeria, whilst Vu and Hartley (2017) noted that improving the basic infrastructure is one of the priorities that Vietnam must consider to succeed in smart city developments. In addition, Rana et al. (2019) also confirmed that a lack of ICT infrastructure is a major smart city barrier in India and the results of this study are congruent with the above assertions from an SA perspective.

In summation of the socio-economic barriers identified by this study, high income inequality is listed as a smart city barrier for developing countries such as India and SA; however it is not listed for other developing countries such as Vietnam, Brazil or China. Similarly poor infrastructure is listed as a barrier for Nigeria and SA only, while the lack of ICT infrastructure is listed as a smart city barrier for India, but not in other countries and therefore substantiates the need for this research.

The technological barriers are discussed in the following section.

### 6.3.6. Technological barriers

Integration and convergence issues across multiple ICT systems and networks is listed as one of the barriers for smart city developments in India (Rana et al., 2019). According to the findings of this study, each municipal department has its own systems to manage its activities, resulting in too many competing systems. One such example is eThekwini municipality which has approximately 50 to 60 different software applications. The majority of systems within a municipality are not integrated which is counterproductive to smart city technologies which require a free flow of information between systems to enable effective and efficient service delivery via a single consolidated view of the city. The results of this study highlight the fact that multiple disparate systems, and the lack of integration between them, are major technological barriers to the adoption of the smart city paradigm in SA.

Any system that fails to provide data to smart city systems negates the entire purpose and objective of smart city projects. Consequently, a lack of access to data arises as another barrier. Poor data availability is also listed as a major barrier in smart city developments within the Indian context (Rana et al., 2019). Other key technological barriers are the slow uptake of technology and inconsistent data. One can argue that this issue arises due to multiple systems, as each system stores data in a format that it requires, which therefore requires data cleansing, and results in inconsistent data. The slow uptake of technology is also listed as a barrier within the Indian context, wherein the authors noted that smart city technologies are still in a pre-commercial stage (Chatterjee & Kar, 2015).

In summary, technological barriers, such as diverse systems, the lack of integration between ICT systems, poor data availability and the slow uptake of technology are listed as smart city barriers in developing countries such as India and SA. However, they are not listed in other studies related to Barcelona, Charlotte, Shanghai, Tokyo, and Nigeria, and therefore justify the need for this research.

The following section discusses the political barriers for smart city developments in SA.

### 6.3.7. Political barriers

Southall (2014) noted that political leaders control members of parliament (MPs) and members of provincial legislatures (MPLs), who are appointed by them. Furthermore, Masuku and Jili (2019, p.2) asserted that the individuals to be appointed as municipal

managers, and to other senior bureaucratic positions are also determined by the politicians. It is therefore evident that political buy-in for the implementation of projects is very important in government. This study revealed that smart city projects need to be approved by political leaders, and the executive management within a municipality, as these parties approve the budgets allocated for projects. However, the results of this study indicate that smart city projects are not supported by SA political leaders. Leaders and executive management tend to approve projects that will produce short-term tangible benefits as opposed to smart city projects which have a longer yield. In addition, this study identified that procurement processes are very difficult if there is no political support for smart city projects. This issue was discussed in section 6.3.1, wherein municipal officials approve short-term projects that provide quick returns as they can showcase these wins for political gain in order to be re-elected or reappointed.

The results of this study also revealed that the unstable political environment is a key barrier for the implementation of smart city projects in SA. In accordance with this study, other studies conducted by Chatterjee and Kar (2015), and Rana et al. (2019) on smart city barriers in India revealed that political instability is a major barrier for smart city projects. As emphasised by Bruce (2019), the unstable political environment in SA is mainly due to state capture that was discussed earlier, which is deemed to have had an enormous effect on various state owned entities. The political instability in the country is also highlighted in the results of the 2016 elections wherein the dominant ANC party lost its voter support in four of the eight metro municipalities (Electoral Commission of South Africa, 2019; The World Bank, 2019). Due to different political parties managing and controlling municipalities, there is a lack of coordination and communication amongst them, and this is identified as a barrier for smart city developments in SA. The power struggles that ensue between political parties affect the approval of, and the implementation of smart city projects. Politicians, therefore, block projects recommended by other politicians as they would prefer to implement these projects to attain political recognition for themselves, which stalls projects and ultimately hinders the development of smart cities in SA.

With reference to the discussion on organisational barriers in section 6.3.1, it was noted that smart city projects are futuristic and do not provide short-term benefits. Since the tenure of the municipality's administration is five years, executive management and politicians prefer to focus on short-term benefits to the citizens in

order to be re-elected. This reverts to the earlier discussion about the self-orientation nature of politicians and senior management who lack the mindset to serve the citizens instead of themselves. In addition, if executive management or political leadership changes after five years, the new management tend to discard most of the projects that were approved by the previous administration, as they prioritise budget allocation towards projects that will serve their political interests and ideas.

In summarising the political barriers in SA, political buy-in, and the constant change of administration (five-year tenure period) tend to be major barriers in this category; which were not listed as barriers in other developing countries. However, political instability has been identified as a key barrier in SA and India.

The following section provides the discussion on socio-cultural barriers for smart city developments in SA.

### 6.3.8. Socio-cultural barriers

Chauke and Sebola (2016) argued that revenue collection remains a continuous challenge for SA municipalities, as they are unable to meet service delivery requirements. The reasons for poor revenue collection, as stated by Kleynhans and Coetzee (2019), include different socio-economic factors such as poverty, unemployment, and the country's low economic growth. However, the results of this study revealed that citizens are unwilling to pay for municipal services as they believe that it is their right to access basic services such as water and electricity, and that government should not be collecting money from citizens to provide these services.

The citizen's unwillingness to pay for municipal services causes financial distress for municipalities in providing and extending their services and infrastructure to them. Young (2018) argued that these service delivery issues, coupled with the citizens' belief about their rights to have free basic services, led to various service delivery protests by SA communities. These service delivery issues caused frustration amongst citizens and communities, resulting in vandalism, and is therefore listed as a key barrier for the adoption of smart cities in SA. The country is prone to vandalism due to the behaviour of irresponsible citizens who vandalise basic infrastructure, resulting in extra pressure on the government, as additional funds are needed to reinstate the damaged infrastructure. While these funds could have been spent on extending the infrastructure, the vicious cycle is perpetuated as the repaired infrastructure is again vandalised during service delivery protests. The SA

government is therefore reluctant to invest in smart city infrastructure due to vandalism, as it is very expensive to repair or replace this infrastructure due to the high costs associated with smart city technologies.

SA citizens are also resistant to change and prefer the status quo, for example, the payment of bills. Although there are many digital platforms to pay for municipal services, most citizens choose to travel to municipal offices to pay for these services. The buy-in of citizens is therefore identified as a key barrier for the adoption of the smart city paradigm in SA. The lack of citizens involvement and low awareness levels of communities are also listed as major barriers for smart city developments in India (Rana et al., 2019).

In summary, the citizen's unwillingness to pay for municipal services, vandalism and citizens' resistance to change were identified as the major socio-economic barriers in SA. In contrast, the citizens' unwillingness to pay for municipal services and vandalism were not listed as barriers in developing and developed countries; however, the lack of citizens' involvement was listed as a smart city barrier in India. One can therefore argue that the citizen's unwillingness to pay for municipal services and vandalism are major barriers in SA due to the country's service delivery issues and consequently necessitates the need for this research.

The section below provides a discussion on the psychological barriers for smart city developments in SA.

### 6.3.9. Psychological barriers

Ndevu (2019) stated that the leadership's collegiality and commitment, and lack of participation are some of the reasons for poor service delivery by SA municipalities. Mawela et al. (2017) also affirmed that poor leadership has resulted in a failure of e-government services in SA. Congruent with these statements, the results of this study also confirmed the leader's resistance to change as a major barrier to the adoption of the smart city paradigm in SA. Since training and development is not effective within municipalities as stated by Luthuli et al. (2019), there is a lack of understanding about advanced concepts such as smart cities, amongst government officials, political leaders, and executive management.

In line with the above, this study also revealed that leaders do not take the necessary steps to familiarise themselves with smart city concepts as they believe that smart cities are ICT related and therefore do not acknowledge this concept from a business

and country perspective. Officials are also hesitant to implement new ideas, such as the smart city concept, because the return on investment is long-term and they are unsure if they can demonstrate tangible benefits. Officials also resist the transformation to a smart city as it will cause dramatic changes, and they do not want to deviate from traditional methods of conducting business. This resistance to change, by leaders and officials, is a key barrier in the development of smart cities in SA.

A few participants also noted that municipal staff are fearful of losing their jobs due to the perception that smart city technologies and products can make their tasks redundant. This also identifies with the training and development issues within the municipality. Luthuli et al. (2019) stated that municipal staff do not participate in training and development programmes for their own capacitation and skills improvement, but rather because of skills audit requirements. Consequently, they do not pay attention to the training programmes. In addition, Wentink and Niekerk (2017) noted that skilled employees are few in local and district municipalities, with only metro municipalities having a significant number of trained employees. It is therefore evident that most municipalities in SA lack qualified individuals, resulting in a higher turnover rate of qualified employees. (Mello, 2018). Based on the reasons highlighted above, municipal staff are threatened by advanced technologies, and therefore do not support smart city projects within the municipality. Another valuable insight obtained through this study is that smart city solutions are not supported by unionised workers as they deem these solutions to be a replacement of their jobs.

In summary, the leader's resistance to change and the municipal staff's fear of losing their jobs are identified as major smart city barriers within this category. However, none of these factors are listed as smart city barriers in other developing or developed countries; as per the literature review conducted for this study.

The following section provides the discussion on legal and ethical barriers for smart city developments in SA.

### 6.3.10. Legal and ethical barriers

A study by Rana et al. (2019) about smart city barriers in India, identified a lack of regulatory norms as a barrier. However, Ndevu (2019) noted that the SA constitution incorporates many legal frameworks such as, the Municipal Structures Act (117 of 1998), the Municipal Systems Act (32 of 2000), the Municipal Planning and

Performance Management Regulations (MPPMR), the Integrated Development Plan (IDP) and the National Development Plan (NDP). Although these frameworks are legislated to ensure that good corporate governance reduces corruption, and promotes the country's growth, it was interesting to discover that the results of this study revealed that the Municipal Finance Management Act (MFMA), which is part of the Municipal Systems Act, is a barrier to the development of smart cities in SA.

As indicated by the findings of this study, the MFMA was considered to be an issue as projects need to be listed in the IDP for budget to be allocated to it. In addition, smart city technologies are agile and must be dynamically adopted into legacy municipal systems. However, for a smart city project to be included in the IDP and budgeted for, it must wait for the IDP's annual review process. Another issue, raised by one participant with respect to the MFMA's legal framework, is that SA municipalities do not implement pilot projects due to there being no provisions in the MFMA for pilot projects to be adopted within the same or other municipalities. This often results in another service provider being appointed for the same project that was successfully implemented during the pilot phase. Consequently, entrepreneurs and SMMEs are demotivated, as their innovative solutions are advertised as a tender even though it was successfully tested as a pilot, resulting in a loss of competitive advantage due to other service providers developing similar systems.

In summary, this study identified the Municipal Finance Management Act (MFMA) as a major smart city barrier in SA; however this was not listed as a smart city barrier in other developing and developed countries. It is also evident that the legislative frameworks are constituted for a country, and hence the need to take cognisance of the drivers and barriers within a country's context when adopting the smart city paradigm.

Having discussed the barriers to the development of smart cities in SA, it is imperative to provide recommendations to overcome these barriers. The following section provides a discussion on the recommended sectors and areas that need to prioritise the smart city projects, and other recommendations.

## 6.4. Discussion of results for research question three

*What are the recommendations to overcome these barriers?*

This research question aimed to understand which sectors or areas in SA need to prioritise the implementation of smart city technologies, and the recommendations to overcome the smart city barriers identified.

### 6.4.1. Recommended sectors

Service delivery has remained a crucial challenge in SA, which is highlighted by various studies conducted in this regard (Bruce, 2019; Chauke & Sebola, 2016; Masegare & Ngoepe, 2018; Ndevu, 2019; Young, 2018). Young (2018) noted that these service delivery issues have resulted in citizens protesting against the government in dispersed geographic locations in SA. According to Ndevu (2019), one reason that SA is facing service delivery challenges is due to a lack of transparency, while Winkowska and Szpilko (2020) stated that smart city technologies are deemed to increase transparency. Based on the study conducted by Ndevu (2019), one can contend that smart city technologies can improve service delivery by increasing transparency. Predictably, the results of this study also indicated that the government needs to focus on implementing smart city technologies, products, and services in core departments to improve service delivery.

According to this study, the areas or sectors where smart city technologies need to be implemented are, water services, waste management and electricity. These core service delivery departments need to integrate smart city technologies into their impending projects so that services are delivered in an efficient and transparent manner. The literature review conducted for this study indicated that the definition of a smart city supports the need for an improvement in service delivery via the use of information and communication technology (Al-Nasrawi et al., 2015; Ismagilova et al., 2019; Rana et al., 2019). Similarly, the definition of a smart city adopted for this study. also noted that ICT will be utilised to provide superior services to citizens. In line with these definitions, the results of this study highlighted the need for core service delivery departments to prioritise smart city projects.

In addition, various successful smart city initiatives around the globe have also focused on service delivery as a priority. An example is the “smart Dubai” initiative which has provided various initiatives to improve service delivery to its citizens (Khan

et al., 2017). Similarly, Bulgaria has provided 50 different online services to its citizens to improve the efficiency of service delivery (Kola-Bezka et al., 2016). The city of Ekurhuleni in SA also started its successful smart city initiatives with core service delivery departments by implementing a mobile application to report issues related to their services (Musakwa & Mokoena, 2018). It is therefore recommended that other SA municipalities integrate smart city technologies, taking due cognisance of their financial, human capital and skills constraints.

The results of this study also revealed that safety and security is another major area that the government needs to prioritise for the implementation of smart city projects. SA's high unemployment and poverty rate have resulted in high crime rates (Mokoele & Sebola, 2018). It is therefore evident that safety and security should be one of the areas that needs to implement smart city technologies, products and services to target crime (Trencher, 2018). This study also noted that a reduction in crime will create a better environment for citizens, which will result in the attraction of investment into the country. As noted by a participant, one way to achieve the attraction of investment into the country is to ensure public safety through efficient emergency rescue and efficient services by metro police through the use of ICT tools. As Musakwa and Mokoena (2018) stated, the city of Ekurhuleni began its smart city initiative by providing citizens with a digital platform to report crimes and vandalism so that it can respond timeously to resolve these issues..

According to the results of this study, health and communication infrastructure are also deemed to be major sectors or areas where government can prioritise the implementation of smart city technologies. As noted by Ndevu (2019), one way that SA municipalities can improve the citizens quality of life is by providing a good health care system. The benefits of smart cities within the health sector has been highlighted in various studies. According to Winkowska and Szpilko (2020), one of the six dimensions of a smart city is smart living which focuses on providing a quality health care system. Nilssen (2019) further affirmed that a smart city consists of various dimensions, including smart healthcare. A study based on successful Chinese smart city pilots conducted by Liu and Zhenghong (2014) indicated that smart cities in China had a positive impact on life enrichment which primarily focused on healthcare and education. In contrast, Jordaan et al. (2019) noted that SA is facing issues within the health sector wherein accessibility to quality health services

remains a crucial challenge. It is therefore evident that the health sector would benefit from adopting smart city technologies and that it needs to be prioritised.

In terms of communication and connectivity infrastructure, a study by Nyahodza and Higgs (2017) indicated that SA is facing a digital divide due to the lack of ICT infrastructure. Another study by Lavery et al. (2018) also confirmed that SA lacks the communication infrastructure such as fibre, and that it needs approximately 160000 kilometres of fibre nationwide to provide connectivity similar to that of developed countries. Congruent with the above studies, the results of this study also concluded that SA needs to focus on improving its communication and connectivity infrastructure so that smart city projects can be successfully implemented. Other sectors and areas where participants believed that smart city projects need to be prioritised are education, operational projects to reduce costs, workforce management within various government sectors, resource management, data management, department of housing, the transport sector, urban planning and governance.

In summary, the results of this study with respect to the recommended sectors and areas are aligned with the literature review of the country analysis conducted for this study. It was also identified that the major sectors and areas that need to prioritise smart city projects are, the core service delivery departments, safety and security, health and communication infrastructure.

### 6.4.2. Recommendations

As highlighted in the governance barrier category, corruption is a major factor in SA that compromises the country's economic growth. Bruce (2019) highlighted the repercussions of corruption and incompetent service providers, wherein he noted that corruption results in a loss of funds which could otherwise have been utilised for improving the wellbeing of citizens, and that the appointment of incompetent service providers resulted in non-delivery or poor-delivery of services. One participant, who provided an example of Singapore, also noted that Singapore faced corruption challenges similar to SA. However, it overcame this challenge through the implementation of strict laws and regulations against corruption. One major recommendation of this study is that the SA government needs to ensure that there are strict laws to root out corruption in the country.

This study recommends that laws against corruption need to be stringent and that it must ensure accountability and ownership of the transgressions by the transgressors. When considering the various acts within the SA legislative framework, as noted by Ndevu (2019), it is evident that the relevant laws and frameworks are available in SA. However, the penalties for transgression by an individual or a group of individuals when defying these laws should be severe enough to deter them from doing so. According to one participant, these laws should be strictly applied irrespective of the roles, designation and status of the individuals who are found guilty.

Studies in India related to smart city barriers by Chatterjee and Kar (2015) and Rana et al. (2019) indicated that India is not able to develop smart cities as planned due to the low awareness of the smart city concept among stakeholders, including citizens. This study also indicated that executive management, including chief information officers and ICT managers are not aware of smart city technologies and that this lack of awareness cascades to junior staff. It is also evident that citizens lack an understanding of smart city concepts and are therefore resistant to change. In line with these findings, this study recommends the need for increased awareness amongst users with respect to the benefits of smart city projects so that they are more willing to embrace these concepts.

In addition, it is recommended that executive and senior management, for example, chief information officers and ICT managers, are educated about various smart city systems available worldwide through training and executive development programmes, and that government also allocates the budget for the executive team to perform site-visits where smart city initiatives have been successful in improving service delivery. Another recommendation, as part of user education, is creating awareness amongst citizens as they are the end users who will derive the benefit. A participant noted that, if citizens are not aware of smart city initiatives implemented by the government, then the smart city initiative will fail, even if it is world-class, Citizens need to be made aware and encouraged to adopt these initiatives by highlighting the benefit to them.

Southall (2014) stated that there are general complaints that most MPs and MPLs in SA are unable to perform their roles effectively. Moreover, Mello (2018) stated that SA municipalities are under performing due to their inability to retain qualified individuals. This study identified that administrative leaders, unlike other developed

countries, for example, the United states of America, are appointed via political influence. This was also confirmed by Masuku and Jili (2019, p.2) wherein the authors stated that senior and general management within a municipality are appointed by the entire municipal council through political influence. Congruent with the arguments above, and based on the results of this study, it is recommended that government and municipal entities in SA need to employ individuals based on their qualifications and expertise. According to this study, senior and executive management need to be innovative and progressive in their thinking. They also need to possess the necessary qualifications that will ensure that they are capable of competently performing their duties. This study also revealed that the hiring process of administrative leaders, and senior and general management, needs to be reviewed and changed where necessary to ensure that applicants are selected on merit, and not due to political influence.

The results of this study also provided a set of recommendations to overcome the barriers listed in section 5.5.2. However these recommendations are not considered to be of significance as they are not emphasised by more than one participant.

In summary, the major recommendations to overcome the smart city barriers identified through this study are, enforcing strict laws to stamp out corruption, creating awareness and education about smart city concepts, and ensuring the appointment of qualified leaders. These three recommendations, if executed properly, will improve corporate governance and the skills and abilities of public sector leadership. It will also increase the awareness of the smart city paradigm amongst various stakeholders, including citizens which will ultimately result in the successful implementation of smart city initiatives in SA. Implementing smart city projects will provide benefits such as, effective and efficient service delivery, an increase in citizens safety and security, improved communication and improved access to the municipality.

## 6.5. Conclusion

This chapter presented a discussion of the findings identified in chapter five.

The objective of research question one was to understand the rationale for the development of smart cities, which was discussed in section 6.2. The major finding of this section was that the drivers of smart city implementations differ based on a country's context. Factors such as service delivery and spatial planning were

perceived to be of the utmost importance in SA, while they were not listed as smart city drivers for other developing countries. Other drivers, such as spatial planning, cost reduction and economic competitiveness, were also factors that were propelling smart city developments in developed countries like Dubai and Switzerland. This implies that smart city drivers do not necessarily need to be categorised based on whether the countries are developed or developing, but is rather based on the country's context. The common drivers in all developing countries, including SA, are resource savings, efficient municipal operations and infrastructure development.

The objective of research question two was to understand the barriers to smart city developments which was discussed in section 6.3. A total of ten categories were identified as barriers that are hindering the adoption of the smart city paradigm in SA. Although many of the barriers are listed in different studies, they are not holistically listed within one single study. A key finding of this section was that the barriers to smart city developments need to be assessed from a country's perspective as they differ from country to country.

The unique smart city barriers identified in SA, and not listed as a barrier in any other country that formed part of this literature review, are policymakers' unwillingness to consider the intangible benefits of technology, mismanagement of supply chain processes, mismanagement of funds and wrong investments, political buy-in and the constant change of administration, citizens' unwillingness to pay for municipal services and vandalism, leader's resistance to change and municipal staff's fear of losing their jobs and the Municipal Finance Management Act (MFMA).

The smart city barriers that were identified to be common amongst SA and India are a silo municipal structure, a lack of funding due to the expensive nature of smart city technologies, high income inequality, the lack of a holistic smart city vision or ICT vision, the lack of ICT infrastructure, multiple disparate ICT systems, the lack of integration between different ICT systems, poor data availability, the slow uptake of technology, political instability, the lack of citizens' involvement, and the lack of technology related skills. The smart city barrier that was identified to be common among SA and Vietnam is the lack of a smart city vision or ICT vision, while the smart city barrier that was identified to be common among SA and the EU was the lack of skills. The common barriers that were identified for SA and Nigeria were poor infrastructure and corruption.

The objective of research question three was to develop recommendations to overcome the smart city barriers identified, and to identify the recommended sectors and areas where smart city projects need to be prioritised. The major sectors and areas that need to prioritise smart city projects are, the core service delivery departments, safety and security, health, and communication infrastructure. The major recommendations to overcome the smart city barriers identified through this study are, enforcing strict laws to root out corruption, creating awareness and education around smart cities, and ensuring the appointment of qualified leaders and management. These three recommendations, if executed properly within the recommended sectors and areas, will provide benefits such as effective and efficient service delivery, an increase in citizens safety and security, improved communication, and improved access to the municipality.

The following chapter presents the concluding remarks, recommendations and limitations of this study.

# Chapter 7: Conclusions and Recommendations

## 7.1. Introduction

This study set out to identify the rationale and barriers for the development of smart cities in developing countries with a particular emphasis on SA. The ensuing discussion in chapters one, two and six evaluated studies related to smart cities globally. However, there was a gap in the literature pertaining to the drivers and barriers of smart cities in SA. While a specific study of the drivers for smart city developments was conducted in SA, this study had limitations as it was conducted in one city in SA only, with the majority of its participants belonging to the construction industry (Oke et al., 2020). As it was a quantitative study, the authors included a list of drivers identified from their literature review, and did not allow for the identification of any new drivers.

Another study only focused on the barriers of a smart city initiative in Modderfontein, and not on SA as a whole (Brill & Reboredo, 2019). The literature review of this research revealed that there are no studies that investigated a comprehensive set of drivers and barriers holistically within the SA context, which therefore substantiated the need for this study. This study also endeavoured to identify the sectors and areas in SA that should prioritise smart city projects, and to develop recommendations to overcome the smart city barriers identified accordingly.

This chapter outlines the findings of this research in terms of the three research questions discussed in chapters three, five and six. A framework interconnecting the drivers, barriers, recommendations and benefits has been developed based on this research and proposed in this chapter. This chapter further discusses the implications of this research from an academic and business point of view. The limitations of this research and suggestions for future research follows thereafter.

## 7.2. Research findings

This section presents the research findings with respect to the rationale and barriers for the adoption of the smart city paradigm in SA, the recommended sectors and areas where smart city projects should be prioritised, and the recommendations to overcome the smart city barriers identified.

### 7.2.1. Rationale for smart city developments

The rationale for the development of smart cities in SA was studied in terms of drivers and benefits. This study identified 13 major drivers for the adoption of the smart city paradigm in SA which are listed in **Figure 8** below:

**Figure 8:** *Major smart city drivers*

**Smart City Drivers**

1. Efficient service delivery
2. Improved citizens quality of life
3. Cost reduction
4. Sustainability
5. Attract foreign investment
6. Resource savings
7. Ease of use for millennials
8. Efficient citizen management
9. Infrastructure improvement
10. Spatial planning
11. Need for municipal departments interconnectedness
12. Economic competitiveness
13. Efficient municipal operations

Source: (author's own)

The benefits that SA can achieve from smart city projects implementation are, effective and efficient service delivery, an increase in citizens safety and security, improved communication between government and citizens, and citizens improved access to the municipality and its services.

The section below presents the barriers that are hindering the development of smart cities in SA.

### 7.2.2. Barriers for smart city developments

The factors hindering smart city developments in SA are classified into ten categories, namely, organisational barriers, economical barriers, skills and competency barriers, governance barriers, socio-economic barriers, technological barriers, political barriers, socio-cultural barriers, psychological barriers and legal and ethical barriers. The major barriers under each category are listed in **Table 20**.

**Table 20:** *Major smart city barriers*

| **Organisational barriers** | **Economic barriers** |
|---|---|
| 1. Municipal departments work in silos<br>2. Policy makers / leadership's unwillingness to see the intangible benefits of IT systems<br>3. The lack of a smart city vision or mission statement<br>4. Smart city projects are identified as lower priority<br>5. ICT department is not seen as an enabler of service delivery | 1. The lack of funding<br>2. High costs associated with smart city technologies / products<br>3. Municipalities poor revenue generation capability / inability of municipalities to generate revenue |
| **Skills and Competency barriers** | **Governance barriers** |
| 1. Leadership's lack of understanding and connection to the smart city concept<br>2. Lack of smart city specific skills within the municipality<br>3. Lack of human capital with technology skills within the municipality<br>4. Technology readiness of senior management and executives | 1. Corruption<br>2. Poor alignment between national, provincial, and local governments<br>3. Municipal management / officials' unwillingness to be transparent about spending<br>4. Lengthy supply chain processes for agile (fast moving) technologies<br>5. Mismanagement in municipal supply chain processes |
| **Socio-economic barriers** | **Technological barriers** |
| 1. Lack of infrastructure / ageing infrastructure<br>2. High income inequality<br>3. Theft of resources<br>4. High unemployment levels<br>5. Lack of access to basic services<br>6. Poverty | 1. Lack of integration between systems<br>2. Multiple competing systems<br>3. Lack of access to data<br>4. Slow uptake of technology<br>5. Inconsistent data |
| **Political barriers** | **Socio-cultural barriers** |
| 1. Lack of political buy-in<br>2. Lack of continuity due to constant change of administration and the five year tenure of officials | 1. Citizens unwillingness to pay for municipal services<br>2. Vandalism<br>3. Citizens resistance to change |
| **Psychological barriers** | **Legal and ethical barriers** |
| 1. Leaders resistance to change<br>2. Municipal staff's fear of losing their job | 1. Municipal Finance Management Act (MFMA) regulations and legislations |

Source: (author's own)

The following section recommends the sectors and areas in SA where smart city projects need to be prioritised.

### 7.2.3. Recommended sectors and areas to prioritise smart city projects

This research identified the major sectors and areas that need to prioritise smart city projects to derive the benefits identified as part of the rationale for smart city developments in SA. The major sectors identified by this research are the core service delivery departments such as water, waste management and electricity, the health department, safety and security, and infrastructure development departments focused on improving the communication infrastructure.

The recommendations to overcome the smart city barriers identified by this research are presented below.

### 7.2.4. Recommendations to overcome the smart city barriers

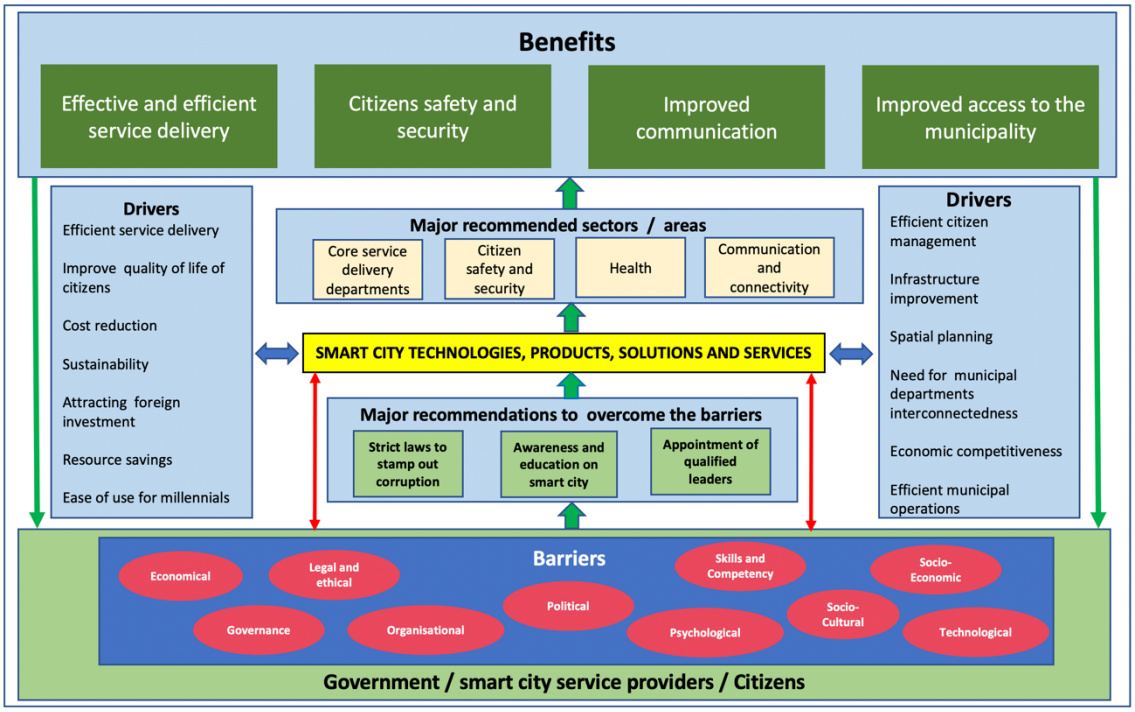
The major recommendations to overcome the smart city barriers identified in this research include ensuring strict laws to root out corruption, creating awareness and education about smart city concepts amongst various stakeholders and citizens, and ensuring the appointment of qualified leaders.

A framework consolidating all the findings of this research is proposed in the following section.

## 7.3. A proposed framework

This section proposes a framework that academic literature and businesses can utilise to understand the drivers and barriers for the adoption of the smart city paradigm in SA. The Drivers, Barriers, Recommendations, and Benefits framework, also referred to as the DBRB framework, demonstrates the interconnectivity and consolidates the discussion between the smart city drivers, barriers, recommendations and benefits. The DBRB framework is depicted in **Figure 9** below:

**Figure 9:** *The DBRB framework for smart cities in SA*



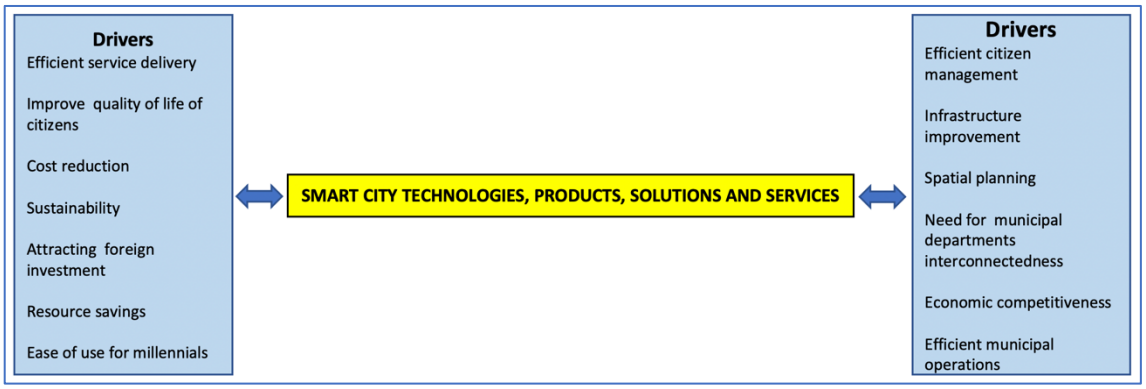

Source: (author's own)

Sections 7.3.1 to 7.3.4 provide a detailed overview of the evolution of the DBRB framework. Each section augments the previous one thereby constructing a holistic framework presented in section 7.3.4.

### 7.3.1. The 'D's of DBRB framework

The most significant smart city drivers identified by this research are listed in **Figure 8** and form the basis of the 'D's for this framework. These factors directly affect the growth, efficiency and the financial sustainability of the municipality and the country, and are therefore considered to be major catalysts for the implementation of smart city projects in SA. Consequently, **Figure 10** below, illustrates the symbiotic relationship between smart city drivers and smart city technologies, products, solutions and services. It is therefore recommended that service providers and vendors take due cognisance of these factors when developing solutions to address smart city challenges in SA.

**Figure 10:** *The 'D's of DBRB framework*

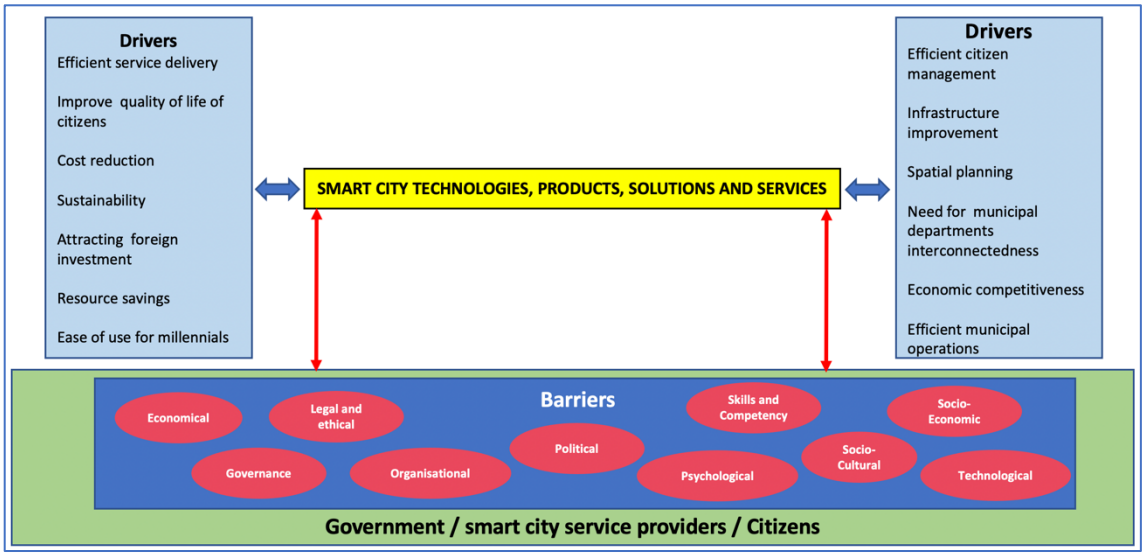



Source: (author's own)

### 7.3.2. The 'D+B's of DBRB framework

This research revealed that it is equally important to understand the barriers for the development of smart cities in SA as it is for drivers, as these barriers hinder the approval and implementation of smart city projects. These barriers, listed in **Table 20**, delink the effective implementation of smart city technologies, products, solutions and services which ultimately affects the successful implementation of smart city projects, as illustrated in **Figure 11** below:

**Figure 11:** *The 'DB's of DBRB framework*

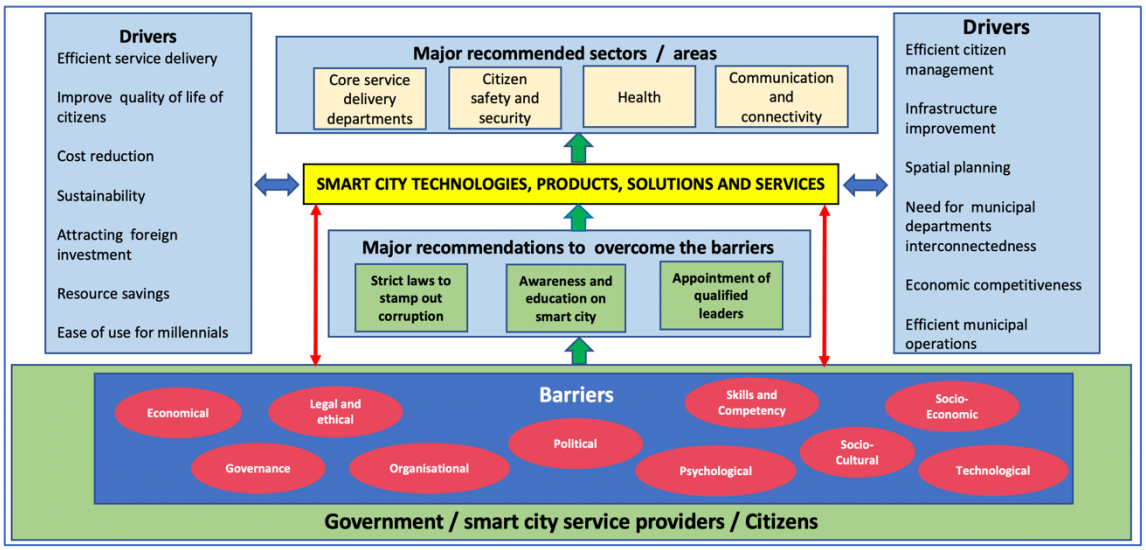



Source: (author's own)

### 7.3.3. The ‘DB+R’s of DBRB framework

The major recommendations as depicted in **Figure 12** are required to be applied in order to overcome the barriers identified by this research. Applying these recommendations will reconnect the smart city technologies, products, solutions and services to the recommended sectors and areas that have been identified, in order to ensure the successful implementation of smart city projects. These recommendations and recommended sectors and areas form the ‘R’s of the framework.

**Figure 12:** *The ‘DBR’s of DBRB framework*




Source: (author’s own)

### 7.3.4. The DBRB framework

When smart city technologies, products, solutions and services are implemented in the recommended sectors and areas, after overcoming the barriers identified by this research, government, smart city service providers and citizens will derive the benefits as listed in the DBRB framework (see **Figure 9**). These benefits include effective and efficient service delivery, an increase in citizens safety and security, improved communication between government and citizens, and citizens improved access to the municipality and its services.

The section below outlines the theoretical contributions of this research.

## 7.4. Theoretical contributions of this study

As outlined in chapter one, rapid urbanisation has caused numerous challenges worldwide, affecting various factors such as the citizens quality of life, environmental sustainability, the depletion of natural resources, high pollution levels, increased traffic, infrastructure challenges, digitisation and data privacy and security ( Das & Emuze, 2014; Rana et al., 2019). In SA, urbanisation has also caused many socio-economic challenges such as poverty, crime, unemployment and a lack of access to basic services (Mokoele & Sebola, 2018). Smart cities are deemed to address the urbanisation challenges outlined above, through the use of the ICT (Albino et al., 2015; Pezzutto et al., 2016; Rana et al., 2019; Veselitskaya et al., 2019). In line with the above contention, developed countries such as Dubai and Singapore have implemented many successful smart city initiatives (Hoe, 2016; Khan et al., 2017). However, developing countries such as India, SA and Vietnam are lagging in the development of smart cities (Musakwa & Mokoena, 2018; Rana et al., 2019; Vu & Hartley, 2017).

As highlighted in chapter one and in section 7.1, there is a gap in the academic literature pertaining to the drivers and barriers to smart city developments in SA. This study, therefore, aimed to address this gap by holistically exploring the rationale and barriers that are hindering smart city developments in SA. This study also developed recommendations to overcome the smart city barriers identified, and recommended sectors and areas where smart city projects need to be prioritised. A theoretical framework was constructed and proposed in this study to illustrate the interconnectivity between the drivers, barriers and recommendations, and the subsequent benefits to be derived by government, citizens and smart city service providers.

The section below outlines the practical implications of this research.

## 7.5. Practical implications of this study

### 7.5.1. Government

City and municipal managers, city planners, policymakers, and senior and executive management within municipalities can utilise the insights and the DBRB framework to understand the rationale and overcome the barriers for the development of smart cities in SA. The recommendations suggested by this study can be utilised to strategically formulate changes in both policies and procedures to address the smart

city barriers identified by this research. Government can also focus on the recommended sectors and areas where smart city projects need to be implemented, and prioritise accordingly.

### 7.5.2. Smart city service providers

Smart city service providers can utilise the DBRB framework to understand the rationale for the implementation of smart cities in terms of the drivers and benefits identified by this research. This will enable them to customise or develop smart city technologies, products, solutions and services, congruent with the South African context. These smart city service providers could be global companies who would like to expand their market share in SA, or local ICT companies who would like to extend their services in the smart city sector.

### 7.5.3. Citizens

An understanding of the smart city barriers by citizens, especially the socio-cultural barriers identified by this research, will enable them to become more responsible, and to extend their co-operation to government. This will allow citizens to therefore derive various benefits that smart cities could provide to them.

Given the theoretical contributions and practical implications discussed earlier, it is vital to understand the limitations of this study, as outlined below.

## 7.6. Limitations

Due to the exploratory nature of this study, the results may not be appropriate for other developing countries that do not portray similar characteristics as SA. Given the subjective nature of qualitative research, the findings of this study may also be affected by the researcher's bias. Furthermore, due to the purposive non-probability sampling technique utilised by this research, the selected participants may not be an equal representation of the population, and the cross-sectional data of this study may not always be appropriate due to the dynamic nature of the country. As noted by Jebb et al. (2017), qualitative studies may lead to an inability to make strong scientific claims.

The following section provides the suggestions for future research.

## 7.7. Suggestions for future research

The following suggestions are provided for researchers who intend to expand on this research. These suggestions are provided based on the knowledge derived from this study:

- As utilised by Rana et al. (2019), the fuzzy AHP (analytical hierarchical process) method can be utilised to understand which drivers, barriers and recommendations revealed by this study provide the highest impact to SA.
- Similarly, a duplication of this study utilising a quantitative approach can be performed to understand the highest impact drivers and barriers.
- A duplication of this study can be conducted within the African continent to determine if other African countries have the same rationale and barriers for the development of smart cities.
- The applicability of the DBRB framework proposed in this study can be further explored in other developing countries.
- The validation of the DBRB framework can be substantiated by studying a particular municipality in SA.

## 7.8. Conclusion

Urbanisation has created numerous challenges worldwide, and a smart city is considered to be one way of addressing these challenges. Although many developed countries have implemented successful smart city initiatives, developing countries including SA, are delayed in the adoption of the smart city paradigm. This qualitative study has therefore provided new insights on the rationale and barriers for smart city developments in SA. Rich insights from this study were obtained and added to the existing body of smart city literature, via semi-structured interviews which included 13 public and private entity participants. This study further developed recommendations to overcome the smart city barriers identified by this research, and recommended the sectors and areas in SA that need to prioritise the implementation of smart city projects to derive its benefits. This study also proposed a framework (DBRB framework) by taking cognisance of all key insights obtained which may prove useful for smart city researchers, the SA government, smart city service providers and citizens.

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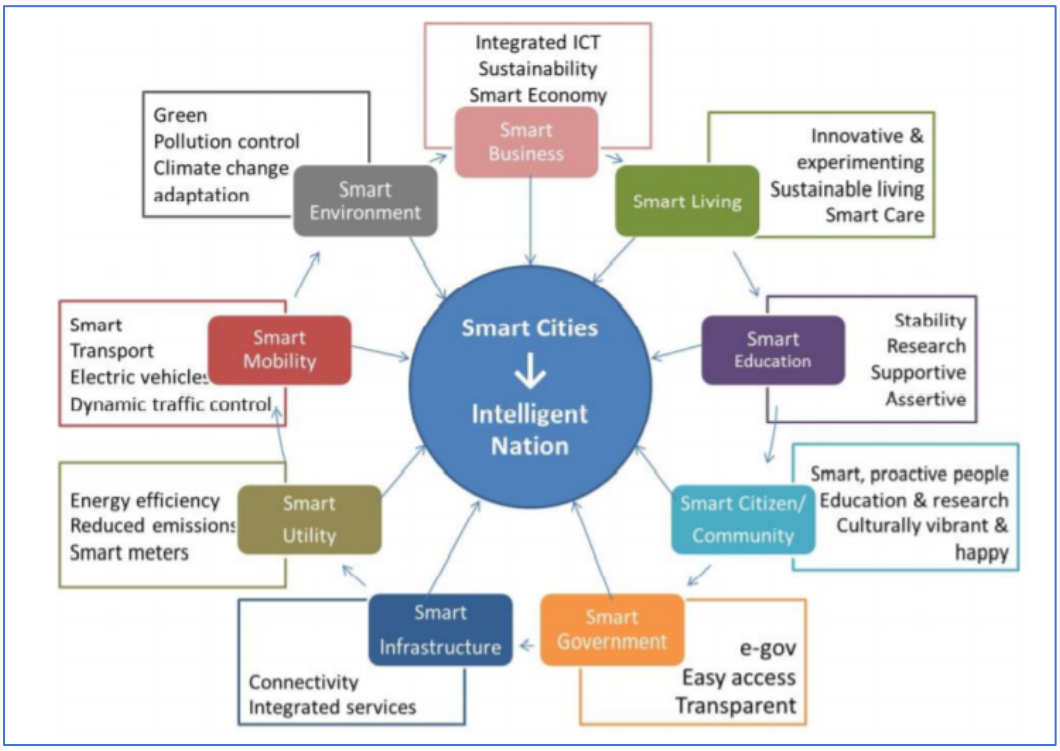
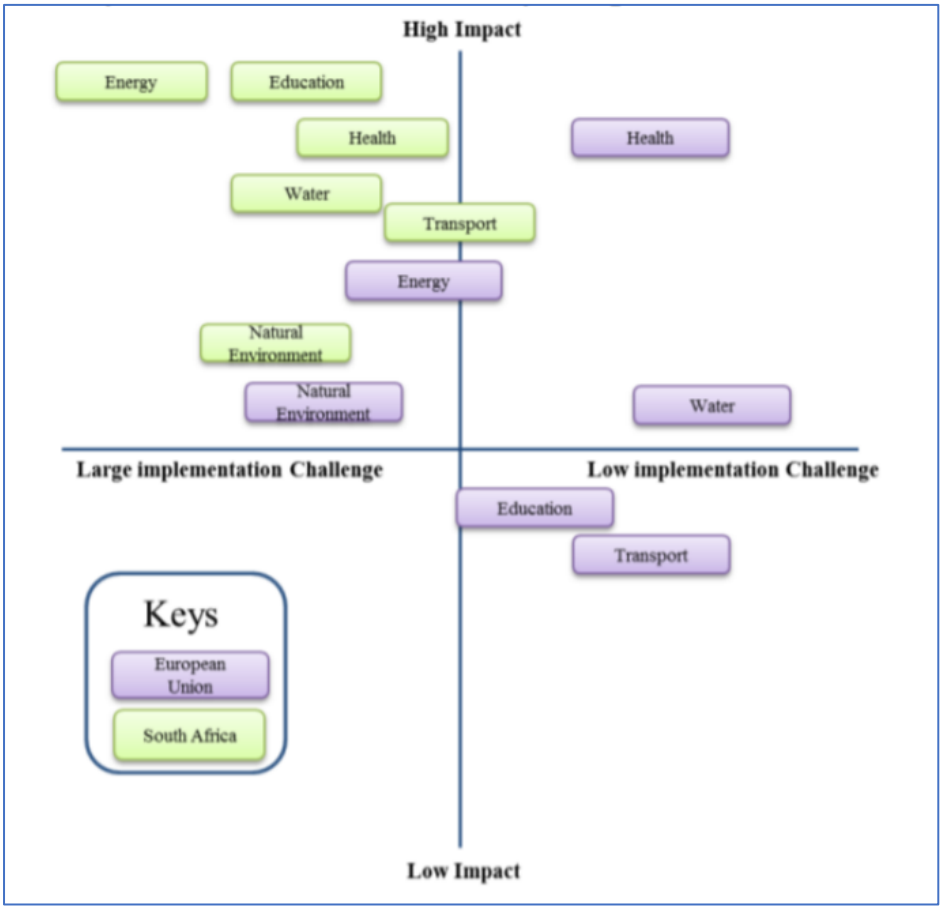
## Appendices

**Appendix 1:** *Smart city framework*




Source: (Vishnivetskaya & Alexandrova, 2019, p. 2)

**Appendix 2:** *EU Vs SA – Smart city implementation challenges vs Impact*




Source: (Coetzee et al., 2015, p. 4)

**Appendix 3:** *Interview guide*

**RESEARCH TITLE**: Drivers and barriers to the adoption of smart city paradigm in developing countries: A South African perspective

**RESEARCHER**: Gayathri Kolandaisami, MBA student: Gordon Institute of Business Science, University of Pretoria.

Dear sir / Madam,

Thank you kindly for allowing me to interview you with regards to my research. I sincerely appreciate your time and effort.

The purpose of this research is to establish the drivers and barriers in adopting a smart city paradigm in developing countries, with specific emphasis on South Africa. The research, therefore, aims to identify the following:

1) What is the rationale for the adoption of the smart city paradigm in SA?
2) What are the barriers for the adoption of the smart city paradigm in SA?
3) What are the recommendations to overcome these barriers?

This research will adopt the following as the definition of a smart city: "A smart city is an innovative city that utilises ICT to address social, economic and environmental aspects that will improve citizen's quality of life, improve the efficiency of urban operations, improve competitiveness, provide sustainable management of resources, develop superior infrastructure and provide superior services to citizens"

The nature of this research and interview is exploratory. I would therefore like to encourage you to speak freely as the information shared in the interview is confidential and your input will remain anonymous.

In order for me to reflect on your answers later, I will record the interview utilising an audio recording device placed in front of us. Before we commence with the interview, please may I ask you to sign the consent form confirming your approval accordingly and a copy of the recording will be given to you if required.

**Interview questions:**

1) Please indicate the number of years of experience in city planning.
2) Which sector does your company/your municipality/city deem to be most important to implement a smart city project?
3) What smart city projects has your company/your city/municipality embarked on or is planning to embark on?
4) What is/was/will be your roles and responsibilities with respect to the smart city projects that your company/your city/municipality has implemented/will be implementing?
5) What do you think are the main drivers for your smart city project?
6) What benefits will you derive/did you derive from implementing the smart city project?
7) What barriers, if any, did you encounter for the approval of the project? (More emphasis will be given to this question and follow up questions will be based on the responses received)
8) What barriers did you encounter/are you encountering/may encounter with respect to the implementation of these projects? (More emphasis will be given to this question and follow up questions will be based on the responses received)
9) Which barriers, as discussed above, do you deem to be most significant?
10) What are your recommendations to address these barriers?

**Appendix 4:** *Consistency matrix*

| **Research questions** | **Sections in literature review** | **Data collection tool** | **Analysis** |
|---|---|---|---|
| Research question one: What is the rationale for the adoption of the smart city paradigm in SA? | Country analysis of South Africa (Section 2.2),<br>Smart city drivers (section 2.6.1) | Interview supported by a semi-structured guide | Thematic analysis utilising Atlas.ti software |
| Research question two: What are the barriers for the adoption of the smart city paradigm in SA? | Country analysis of South Africa (section 2.2),<br>Smart city barriers (section 2.6.2) | | |
| Research question three: What are the recommendations to overcome these barriers? | Country analysis of South Africa (Section 2.2),<br>Smart cities in developed countries (section 2.4.1),<br>Smart cities in developing countries (Section 2.4.2),<br>Smart cities in South Africa (Section 2.4.3) | | |

Source: (Gordon Institute of Business Science, 2020, p. 60)

**Appendix 5**: *Possible strategies to ensure trustworthiness*

| *Quality criterion* | *Possible provision made by researcher* |
|---|---|
| Credibility | Adoption of appropriate, well recognised research methods |
| | Development of early familiarity with culture of participating organisations |
| | Random sampling of individuals serving as informants |
| | Triangulation via use of different methods, different types of informants and different sites |
| | Tactics to help ensure honesty in informants |
| | Iterative questioning in data collection dialogues |
| | Negative case analysis |
| | Debriefing sessions between researcher and superiors |
| | Peer scrutiny of project |
| | Use of "reflective commentary" |
| | Description of background, qualifications and experience of the researcher |
| | Member checks of data collected and interpretations/theories formed |
| | Thick description of phenomenon under scrutiny |
| | Examination of previous research to frame findings |
| Transferability | Provision of background data to establish context of study and detailed description of phenomenon in question to allow comparisons to be made |
| Dependability | Employment of "overlapping methods" |
| | In-depth methodological description to allow study to be repeated |
| Confirmability | Triangulation to reduce effect of investigator bias |
| | Admission of researcher's beliefs and assumptions |
| | Recognition of shortcomings in study's methods and their potential effects |
| | In-depth methodological description to allow integrity of research results to be scrutinised |
| | Use of diagrams to demonstrate "audit trail" |

Source: (Shenton, 2004, p. 73)

**Appendix 6**: *Informed consent form*

**RESEARCH TITLE**: Barriers to the adoption of smart city paradigm in developing countries: A South African perspective

**RESEARCHER**: Gayathri Kolandaisami, MBA student: Gordon Institute of Business Science, University of Pretoria.

I am conducting research on the barriers in adopting the smart city paradigm in developing countries, with emphasis on South Africa. I am trying to understand in-depth information related to these barriers.

The interview is expected to last between 45 minutes and 1 hour. The information and insight gained through the interview will assist me in understanding the various barriers in adopting the smart city paradigm within South Africa and will help to determine which barriers have the most significant influence amongst others.

Your participation is voluntary, and you can withdraw at any point of time without penalty. The audio recording of the interview is also optional, and you may choose not to be recorded. All data will be kept confidential, and any quotations used will be anonymised. Please contact my supervisor or me if you have any concerns or questions. Our details are provided below:

| **Researcher** | | **Supervisor** | |
|---|---|---|---|
| Name | : Gayathri Kolandaisami | Name | : Marianne Matthee |
| Contact No | : | Contact No. | : |
| Email | : 19388234@mygibs.co.za | Email | : mattheem@gibs.co.za |

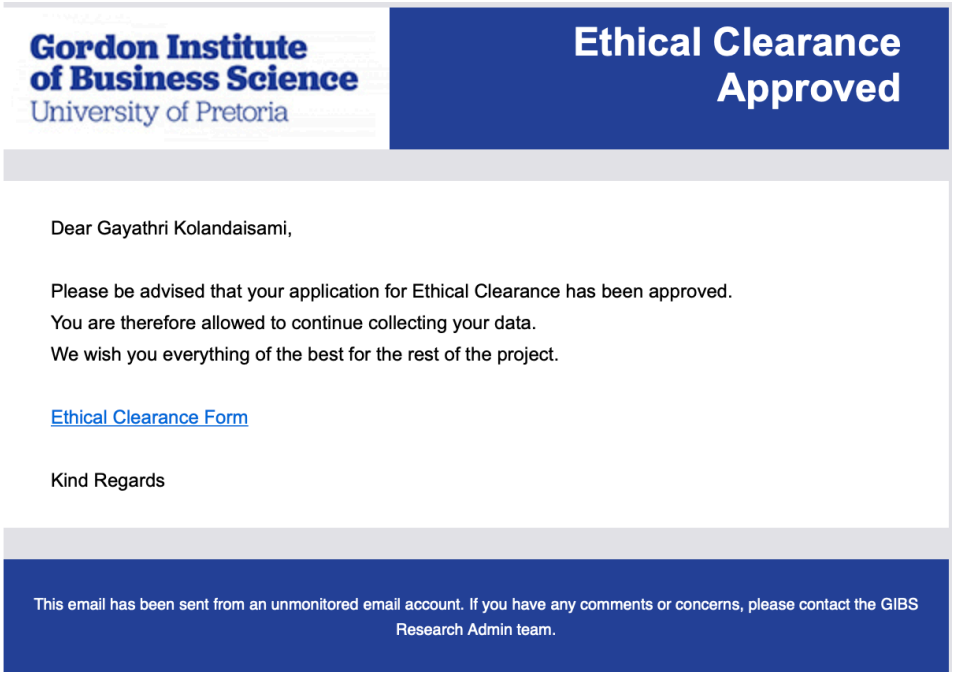
Participant's name: _____ Date: _____

Signature: _____

Researcher's name: _____ Date: _____

Signature: _____

**Appendix 7**: *Ethical clearance approval*



Gordon Institute of Business Science
University of Pretoria

**Ethical Clearance Approved**

Dear Gayathri Kolandaisami,

Please be advised that your application for Ethical Clearance has been approved.
You are therefore allowed to continue collecting your data.
We wish you everything of the best for the rest of the project.

Ethical Clearance Form

Kind Regards

This email has been sent from an unmonitored email account. If you have any comments or concerns, please contact the GIBS Research Admin team.