Smart City .ZA

Discussion Paper on a South African Approach to Smart, Sustainable Cities and Settlements

Towards a SA Cities Network response to the COGTA national Smart City Framework

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South African CitiesNetwork

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Introduction

According to the Oxford English Dictionary, the word “smart” has a number of meanings. On the one hand, smart has to do with appearances. We call a person smart when they are “clean, tidy and well-dressed”, smart clothing is “attractively neat and stylish”, objects are smart when they are “bright and fresh in appearance” and a smart place is “fashionable and upmarket”. On the other hand, smart has to do with intelligence and efficiency. We call a person smart when they display “quick-witted intelligence” and a smart device is one that can be “programmed so as to be capable of independent action” while also being able to “connect to other devices and networks” to work interactively. A person moving smartly is walking “quickly or briskly”. These everyday understandings of the word smart influence our understanding of the idea of smart cities and settlements and lead to different understandings and approaches.

This paper provides a contextualised reflection about what smart means, and what it could mean, for cities and settlements in South Africa. It is written in response to the national “Smart city framework” being proposed by COGTA (February 2020), offering a position from the perspective of cities. It seeks to contribute to the ongoing national conversation about smart cities in the South African context. Although we refer, for brevity, to “smart cities”, we take the view that the full space continuum from the smallest of settlements to the largest metros can all benefit from becoming smarter.

The paper is in three parts. The first part, on meaning, examines the different ways of understanding the idea of a smart city and identifies a number of common smart city discourses, or ways in which people talk about smart cities and how these influence the eventual selection of smart city strategies and initiatives. We argue for a careful consideration of which discourses best support the interests of South African citizens, cities and national interests. In particular, we think that the strong values- and rights-based approach to the developmental state in South Africa needs to be carried through into the evolution of smart agendas.

The second part of the paper looks at the consequences of this position. If smart cities and settlements are to reflect important national values, then we need a South African approach to creating smart cities and settlements. We argue that this approach should support innovation by encouraging diversity in strategies and priorities to address the specific needs of different cities and settlements, which necessitates different roles for national and local actors.

The final part of the paper looks at what cities and settlements can do, now, to become smarter. This section proposes a broad agenda of the types of problems that can be addressed smartly, without prescribing solutions. We also provide a framework for how cities and settlements can align their smart approaches with local and national goals and values. Finally, the paper concludes with some thoughts about how this discussion should be taken forward and how cities and settlements can be supported in becoming smarter.

The authors take the position that smart cities and settlements means more than implementing technology-based solutions to make cities easier to manage, better to do business in, or more exciting to live in. South Africa has pressing issues to address such as housing, inequality, the climate crisis and the economy. Making cities smart should not be prioritised over these. Rather, smart technologies offer new ways for cities and settlements to contribute to addressing these issues. Being smart, we argue, is the best way to tackle these fundamental issues, rather than a sexy alternative that will draw resources away from them.

This paper has been compiled during the global shutdown in response to the COVID19 crisis. This crisis makes clear the urgent need to reduce inequality, to strengthen the resilience of cities in times of crises, to improve social cohesion and to strengthen the economy. Smart technologies are one of the

most promising tools available for achieving these ends, but should be explicitly directed towards such developmental goals, and should be used judiciously.

Section one: Meaning

What might a smart city or settlement be in the South African context?

1.1. Smart city discourses

There are many definitions and understandings of a smart city. For example, the definition used by the International Standards Organisation (ISO) is:

> *A smart city is a city that increases the pace at which it provides social, economic and environmental sustainability outcomes and responds to challenges such as climate change, rapid population growth, and political and economic instability by fundamentally improving how it engages society, applies collaborative leadership methods, works across disciplines and city systems, and uses data information and modern technologies to deliver better services and quality of life to those in the city (residents, businesses, visitors), now and for the foreseeable future, without unfair disadvantage of others or degradation of the natural environment.* (ISO 37122, 2019-05)

While this definition is quite comprehensive, others are less so and focus on one or other aspect of smart cities. For example, Silva et al. (2019) focus on specific technologies when they say that "smart city is an application of Internet of Things (IoT)".

The diversity of definitions prompted the International Telecommunications Union (ITU) to come up with a common, global definition. They set up a group of experts who surveyed the definitions in use, analysed them to extract the most common elements, and crafted this definition:

> *"A smart sustainable city is 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."* (ITU-T, 2014)

This is a good working definition to adopt because it is relatively simple and has wide acceptance. It is also a technical definition, developed with the aim of being objective and so it attempts, as far as possible, to be value-neutral.

Researchers have identified several different "discourses" related to smart cities (Hollands, 2008; Praharaj & Han, 2019). While the word discourse can just mean conversation, in this case we are talking about discourse in the sense of how we think and communicate about something. A discourse includes the words we use and the ideas and beliefs we have about the topic. Discourse is important because how we speak about something frames and limits how we can think about it. Smart city definitions are one part of these larger discourses about smart cities.

Some people understand smart cities as being about **economic growth**, which can include using technology to improve business, increasing privatization, supporting innovation to create new businesses and developing high-tech and creative industries. In this discourse the benefits of smart cities are economic competitiveness, job creation, and increased wealth. The concerns are for supporting enterprises with infrastructure, regulations that make it easy to do business, and how to attract highly-skilled knowledge workers into cities. One aspect of this discourse is the idea that **greenfield or satellite cities**, built from the ground-up to be smart, will attract businesses and knowledge-workers to cities.

Another very strong smart city discourse focuses on **technology** and the creation of a high-tech urban space that makes use of information and communication technologies (ICTs) to automate and control the city. It includes looking for ways to use emerging technologies such as the internet of things (IoT) to collect big data and automate decision-making using artificial intelligence (AI). One extreme of this discourse is the idea of a **city brain** that collects all the **data** in a city and automates decisions on managing the city. The technology discourse is about making cities manageable, even as they grow, but it also suggests that we can change how people experience the city, including through augmented or virtual reality. It positions technology as exciting, modern and able to make life in cities easier and more fun. The technology discourse is supported by the idea of the **fourth industrial revolution** (4IR) which argues that developments in technology are fundamentally changing how societies are structured and creates a sense of urgency, that it is important to respond to these technological changes.

There is also a discourse of **service delivery**, that focuses on how technology can help cities to understand the needs of businesses, residents and visitors and provide for them in seamless ways. In this discourse tools and methods are sought to increase engagement with citizens and provide ways for more city stakeholders to participate in creating a smart city, while technology serves to improve services through e-government or increase the transparency of decisions using blockchain. This discourse focuses on improving traditional city services to businesses and residents, such as the provision of housing, energy, water, sanitation, safety and transportation in partnership with other city stakeholders.

Alongside this discourse is often one of **human development**, the creation of better quality of life for people in cities, including social upliftment and improving social cohesion. This discourse focuses on creating cities that are good to live in with services that work and pleasant residential, working and leisure spaces that are green and connected. The focus of this discourse is on the needs and experiences of all city residents, rather than those of knowledge workers and includes greater consultation and involvement of residents in the design and development of the city.

Another strong discourse is that of the **environment**, the protection of natural resources, mitigating the impacts of climate change and long-term sustainability. The smart city concerns in this discourse are for improving the quality of air and water, improving the way that waste is handled, using more clean energy sources and understanding the climate impacts of infrastructure choices in cities.

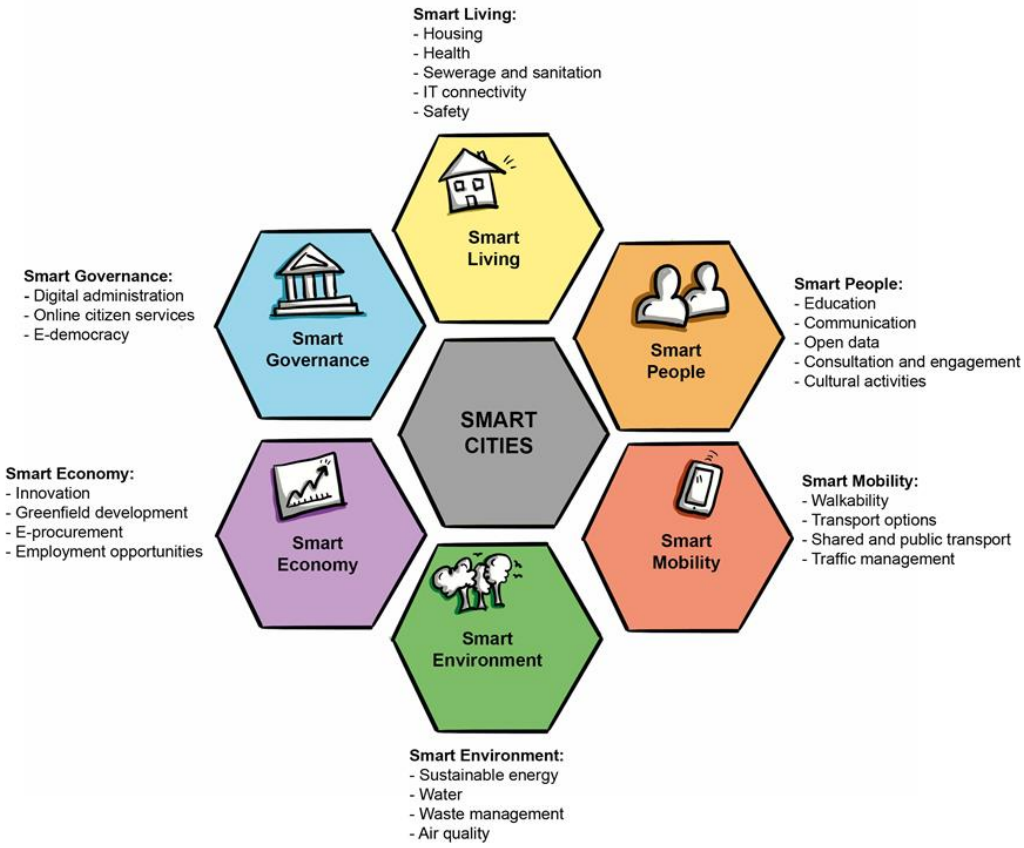
These discourses do, of course, overlap. It is possible to argue that technology supports economic growth and economic growth supports human development. However, the differences between them are evident in the values that underpin them. For example, the economic growth discourse tends to be exclusive, valuing knowledge workers more highly than other people, while the human development and service delivery discourses tend to be more inclusive. The environmental discourse is driven by a concern for the planet, while the technology and economic growth discourses value innovation over long-term sustainability. As a result, they tend to lead to different kinds of smart interventions, and they tend to measure different kinds of outcomes.

1.2. Smart city initiatives and their benefits

In the excitement that surrounds smart cities, there is an assumption that smarter is better. After all, the word “smart” generally has positive connotations. However, it is worth stopping to ask if smarter is actually better. What results can (and can’t) be expected from smart city initiatives? Smart cities have been under development for at least a decade, so we are able to look back and see what kinds of benefits can be expected from being smart. In this section we examine the benefits that can and have been achieved by smart cities, as well as the challenges that have emerged.

There is no doubt that smart technologies are able to improve life in and the management of cities. In particular, they make it possible to keep good records and provide services at a large scale. Technologies can enforce consistent and transparent processes which helps to provide services equitably and reliably. In addition, new technologies enable the collection and analysis of data that can be used to better understand a situation or environment and hence to make better decisions. Finally, smart technologies provide new ways for city stakeholders to communicate.

FIGURE 1: COMPONENTS OF THE SMART CITY.ZA (GENERIC FRAMEWORK ADAPTED BY SACN)



Smart initiatives include projects to make use of a range of smart technologies as well as broader initiatives to expand industries or develop new processes and mechanisms for interactions between city stakeholders. Table 1 provides an overview of common kinds of smart initiatives, examples of where they have been implemented, and their intended (although not always realised) benefits, as well as the discourses that they align with. The examples were selected as examples of all six of the main components of a smart city (Giffinger & Gudrun, 2010).

TABLE 1: COMMON SMART INITIATIVES AND THE DISCOURSES THEY REFLECT

Initiative	Intended benefits	Example	Discourses
SMART ECONOMY			
Incubators and hubs for new tech and creative businesses, including skills development	Economic growth through establishing new businesses and job creation	Innovate Durban, Tshimologong and; The Innovation Hub are examples of innovation hubs in South Africa Economic development has been facilitated through job creation and the creation of new businesses (Bakici et al, 2013).	Economic growth, Human development

Initiative	Intended benefits	Example	Discourses
Building **new cities** designed from the ground up to be smart	Smarter cities, increased city competitiveness, attracts businesses and knowledge workers, reduces crowding and congestion in current cities.	A new smart city is proposed in Gauteng, the Lanseria Junction In Lagos, Eko Atlantic City is a massive development on land reclaimed from the ocean (Backhouse, 2015).	Economic growth, Human development
Online and automated **procurement** processes	Fair process for businesses leads to greater trust in government procurement	The Gauteng Open Tender system has saved the Province money by reducing irregular expenditure. In Malaysia, suppliers have supported the implementation of e-procurement systems (Ramantoko & Irawan, 2017).	Economic growth, Service delivery
SMART MOBILITY			
Traffic monitoring and management using sensors and machine learning	Improved traffic flows, better emergency response times, improved driving behaviour	South African researchers proposed a traffic management model that sends information about congestion and alternative routes to drivers (Mbodila et al., 2015) In China cities are using a City Brain to manage traffic flow in cities.	Technology, Service delivery
Improved **public transport**, new alternatives, increased capacity and convenience	Reduced emissions, better air quality, lower transit times, less congestion from private vehicles, greater convenience for commuters	GoMetro Public Transport app integrates bus and rail information from five transport providers in South African cities. In Curitiba, Brazil, the bus rapid transport (BRT) system provides frequent, reliable buses with convenient and comfortable stations. The system is heavily used, reducing congestion and pollution.	Service delivery, Human development, Environment
Shared transport solutions including cars, bikes, scooters	Fewer vehicles and optimal use of vehicles, ease of use, lower transport costs, fun and excitement	Tshwane tested a shared bike pilot project with the University of Pretoria in 2018, but found that the dense traffic and lack of bicycle lanes in the area limited uptake. In Hangzhou, China shared bikes are available from over 1000 points around the city with access provided by a smart transport card.	Environment, Human development
SMART ENVIRONMENT			
Smart meters to monitor power usage and design energy systems	Better data for decision-making, reduced costs	Joburg City Power implemented smart electricity meters to improve revenue collection and distribution management (Xulu S, 2013). Data from smart meters was used to design district energy systems that reduce capital and running costs (Wang et al., 2020).	Technology, Service delivery
Sensor networks to monitor **water use,** repair leaks and plan for future needs	Faster, more accurate response for maintenance, lower costs, better planning for improved public service.	Smart water meter data was used to analyse the responses of households during the 2017 Cape Town water crisis, to learn more about effective crisis communication (Booysen et al., 2019) In India, smart monitoring of water provision has made it possible to reduce leakages (Sajhau, 2017).	Technology, Environment
Waste management using apps and sensors to improve the informal waste recycling chain	Higher volumes of recycling, improved livelihoods for information waste collectors	eThekwini has implemented a waste-to-energy project to use landfill sites as a source of green energy and reduce emissions. Kabadiwallah Connect (India) apps encourage recycling and assist informal waste collectors in Indian cities to improve their working conditions and profitability.	Environment, Economic growth
Policy measures combined with using sensors to monitor and report on **air quality**	Better data for managing air quality, policy making and decision-making by cities and individuals	The South African Air Quality Information System (SAAQIS) monitors air quality across the country. London has worked to improve air quality through policy measures and monitoring to observe the results.	Environment, Technology, Human development
Retrofitting buildings for energy efficiency and energy generation	Lower energy use, additional energy source, lower cost, environmental benefits	The Vodacom Innovation Centre in Midrand won awards for energy efficiency, using solar panels, natural lighting, blinds that track the sun and specialised heating and cooling technology. The Eastgate Centre in Harare, Zimbabwe uses natural ventilation based on biomimicry to control temperature without air-conditioning or heating, using only 10% of the energy of similar buildings.	Environment, Economic growth

Initiative	Intended benefits	Example	Discourses
SMART PEOPLE			
Using **social media** to communicate with city stakeholders, analysing social media data	Faster communication, better responsiveness to concerns, better understanding of stakeholder views	Joburg Water and City Power use Twitter, a social media platform, to provide citizens with information and updates on services in the different city regions. In the US, a town called Mobile used Instagram to document derelict properties, automatically collecting location data from photographs, in order to understand the extent of the property problem	Service delivery, Technology
Consultation processes to engage with city stakeholders and collaborate on decisions	Better understanding of city issues, greater engagement, policies and solutions benefit from collaborative design, greater buy-in and trust	The My Ekurhuleni app enables communication between residents and the municipality of Ekurhuleni. Amandla.mobi is an independent, community advocacy organisation. New York city runs a participatory budgeting process where residents vote on how they want a portion of the city's budget spent.	Human development, Service delivery
Collection and provision of **open data** with tools and training for its use	Transparent data can assist understanding, encourage evidence-based decision-making, be a basis for engagement and enable citizens to hold cities accountable	Durban EDGE is an open data platform sharing data about Durban. Open data and participatory service design have enhanced citizen involvement in Seoul and San Francisco (Lee, Hancock, & Hu, 2014).	Service delivery, Human development
SMART LIVING			
Public **internet access** through wi-fi, network rollouts, shared devices, with skills development	Increase skills, improve access, address inequality leading to better quality of life	Joburg free public wi-fi enabled residents to improve their economic status (Backhouse and Chauke, 2020). Viasat, a private company, is providing low cost, high speed community Wi-Fi in São Paulo, Brazil, using technology that requires little infrastructure, installed at local businesses.	Human development
Camera and personal **surveillance** with machine learning techniques to evaluate data and reduce crime	People feel safer, better understanding of criminal behaviour, may reduce crime	Public Emergency Communication Centre (which also has a twitter account) is a City of Cape Town initiative aimed at making the city safer by providing emergency services through a single emergency toll-free number. The Glasgow Operations Centre uses closed-circuit TV cameras in public spaces and video analytics to provide coordinated, real-time responses to events across the city.	Technology, Human development
Developing **green spaces** in cities, improving walkability, providing leisure facilities	Environmental benefits, better quality of life for residents, cities attract knowledge workers	Joburg City Parks has set up outdoor green gyms to encourage healthy lifestyles. Smart infrastructure and services improve quality of life and enhance the overall satisfaction of city residents (Anthopoulos, 2017).	Human development, Environment, Economic growth
SMART GOVERNANCE			
Government data processing using established **information systems** like ERP, CRM and financial systems	Efficient processing of large volumes of data, consistent processes, and accuracy. Improved ease of doing business	The City of Cape Town's digital strategy builds on the ERP system that was implemented in the early 2000s. This system integrates all of the city's business processes and underpins the digital transformation plans (Boyle and Staines, 2019) The city of Ronda in Spain uses a cloud-based electronic document and records management system that allows the city to digitalize all documents and use online procedures with digital signatures for all city processes.	Service delivery
City **web sites** for information and online service provision	Increased access to city services, greater efficiency, improved ease of doing business	The Cities of Tshwane and Ekurhuleni have websites which provide access to city services and updates on the municipality. e-Tshwane makes a wide range of services available electronically. The United Nations University analysed the web sites of 100 cities using the Local Online Service Index (LOSI) to evaluate the extent to which they provide services online and their effectiveness (UN e-government survey, 2020)	Service delivery, Economic growth

Initiative	Intended benefits	Example	Discourses
Using **emerging technologies** to improve record-keeping and city processes	Secure transactions, greater transparency, increased trust in city government	Converting housing stock into smaller parcels through tokenisation to enable part ownership of property is being explored in Nigeria. In Moscow, a blockchain-based solution is used to fairly allocate stalls at municipal markets (U4SSC, 2020).	Service delivery Technology
Electronic voting and polling systems	Frequent polls on more issues, greater accuracy, increased voter turnout, improved trust in outcomes.	The IEC manages fair elections at all levels of government in South Africa. VoteSmart is an American web site that gives voters information about how to register to vote as well as issues and candidates in US elections.	Human Development, Technology
Smart tools for **crisis management**	Smart tools offer opportunities to monitor and share information during crises, enabling better informed, faster and coordinated responses.	National government created the COVID-19 Online Resources and News Portal with regularly updated information to keep residents informed about COVID-19 in South Africa. This platform includes a WhatsApp chatbot for individualised information. The Australian government launched the Covidsafe app for people to record their Coronavirus status in order to help curb the spread of the virus.	Service delivery

While many smart initiatives have been undertaken in the last decade, with the promise of a wide range of benefits, the aggregate and longer-term results of these initiatives are not well studied. Indeed, researchers have found that many of the benefits of smart city interventions are hypothetical (Lim et al., 2019). Hypothetical benefits are those that are intended, planned or hoped-for, while observed benefits are those that have actually happened. In their study of 55 smart initiatives, Lim et al. (2019) found that only 19 (35%) provided evidence of the results that they claimed.

What is worrying is that many of the benefits that are most desirable for South Africa are the ones that have been less often observed. For example, **social benefits** such as facilitating social development, increasing social capital and enhancing citizen involvement have been claimed, but not observed (Lim et al, 2019). The benefits of protecting the **environment and facilitating sustainable development** also appear to be hypothetical. In particular, being smart does not necessarily mean lower CO2 emissions (Garcia-Fuentes et al., 2017; Yigitcanlar & Kamruzzaman, 2018). There is also limited evidence that smart cities foster **innovation** (Lim et al., 2019).

In addition, smart interventions can also have negative results. Concerns have been raised about decreasing privacy and security (Elmaghraby & Losavio, 2009; Hollands, 2015) as well as diminished freedom of speech and democracy (Galdon-Clavell, 2013; Vanolo, 2016), although these have not yet been observed. Smart initiatives have however been observed to **aggravate or hide existing urban problems** (Grossi & Pianezzi, 2017). Most concerning for the South African context is a growing list of smart initiatives that have led to **polarization and increased inequality**. A crime prevention system that characterised one area as dangerous led to reduced property prices and decreased economic activity (Brannon, 2017); low literacy and low skilled residents were excluded from a smart learning program (Sajhau, 2017) and marginalised groups have been left out of smart city planning consultation processes (Datta, 2015).

The other challenge with smart city initiatives is that the change can be sudden while the benefits are unpredictable and not uniformly distributed. So, for example, the rapid and unregulated growth of the on-demand, app-based, taxi industry (Uber, Bolt, Taxify) negatively impacted the metered taxi industry and exploited drivers, while benefiting users who valued the convenience and lower fares. Deciding on the long-term societal benefit of such disruptive change and the appropriate short-term response, is complex.

1.3. A values-driven response

In deciding what a smart city or settlement might be in the South African context, it is important to understand and consciously choose discourses, and then initiatives, that support well-established national values. The public sector in South Africa takes as a starting point the "Batho Pele" or "People First" principles which base excellence in service delivery on good communication with and fair treatment of citizens (DPSA, 1997). Local government in South Africa has a critical role to play in undoing the damage caused by apartheid to "the spatial, social and economic environments in which people live, work, raise families, and seek to fulfil their aspirations" (COGTA, 1998). This role is fleshed out in the idea of Developmental Local Government which is characterised by "working with local communities to find sustainable ways to meet their needs and improve the quality of their lives" and includes maximising social development and economic growth, aligning investment, democratising development and building social capital (COGTA, 1998).

The Integrated Urban Development Framework (COGTA, 2016) sets out a vision of cities and settlements that are "liveable, safe, resource-efficient" as well as "socially integrated, economically inclusive and globally competitive, where residents actively participate in urban life". There is no reason for smart city agendas to deviate from this vision for urban development. What is important in a national framework is that the overarching national values and the discourses to be supported be identified so that local governments can make choices that are aligned.

From these national priorities and commitments, it is clear that the national values of equity, inclusion, fairness, redress and social cohesion predominate with economic development as a secondary (but also important) concern. The smart city discourses of human development and service delivery align most closely with these values. Smart city initiatives can (and should) also be used to support economic development, but not at the expense of fundamental societal concerns. Other values that need to be taken into account include the responsible use of limited resources and a long-term perspective. Smart solutions are those that address significant problems (not peripheral), address them in a manner that is sustainable in the long term, and are thoughtfully selected and implemented, looking for efficiencies of scale and co-ordinated responses where appropriate. What emerges is thus a hierarchy of values that our smart city agendas need to respect.

From this we can deduce several things that a South African smart city should **not** encompass.

- Proliferation of policies, strategies and words about being smart cities, but with little in the way of action or results that evidence it
- Undertaking smart initiatives for cosmetic and marketing purposes, merely for appearances
- Copycat buying of systems or solutions in response to technology hype or vendor marketing
- Randomly implementing smart technologies in discrete parts of the city without any integration
- "Smart" projects that exacerbate current problems, for example increasing inequality
- Smart projects that are peripheral in focus, distracting attention and resources from pressing, bigger needs and priorities
- Smart solutions that bring short-term gains for long-term losses (such as maintenance costs or generational burdens)

In conclusion, what smart means in South Africa can, and should mean what makes sense locally. Technology is a very useful **enabler**, but it should not be directing our decision-making. Technological change will continue to happen, so smart South African cities and settlements should be developing their aptitude for dealing effectively with such continual change by **building capabilities for anticipation, response, adaptation, and resourcefulness**. Smart responses might mean the development and use of proven, low-tech solutions to achieve the best results, or experimenting with new technologies that have the potential to transform government and life in our cities. The smart

initiatives to be undertaken in each city and settlement need to be selected and pursued based on local priorities, conditions and resources while respecting the broader shared societal or national values. Diversity in interpretations of smartness are to be welcomed as this will lead to innovation, with locally feasible and effective interventions.

Section two: Roles

What is the role of government in developing smart cities and settlements?

2.1 Cities and innovation

The idea of a smart city presupposes that innovation in technologies, services, processes and models will lead to improvements in cities. Innovation is important for this process because the goal is not simply to do things better, but to find ways to transform cities with new ways of operating. The COGTA Framework document supports the need for, and highlights the poor state of, innovation in South African municipalities (COGTA, 2020, p9).

Steven Johnson, an expert in innovation, identifies the importance of variety to support innovation. He argues that innovation does not emerge in situations of control and regulation. Rather, innovation flourishes in situations where many different actors try different strategies and share information, adapting and refining their own strategies towards being more successful. If there are many different experiments taking place at any one time, some will fail but some will succeed (Johnson, 2011).

Johnson uses the examples of coral reefs and the tangled banks of rivers as environments that best support innovation. These complex, messy environments support a variety of intertwined life forms, and display the unique properties that lead to a rich, fertile and flourishing state. Likewise, for smart cities to deliver on the promise of rich innovation, they need to draw on the rich endowment of cities – ideas, skills and resources of a wide range of actors including public bodies, universities, private companies, non-profits and citizen organisations (Dameri et al., 2016), allowing them space to experiment, to try different strategies and then to share what they have learned.

In South Africa, the National System of Innovation (NSI) is a well-structured and thoughtful approach to influencing innovation, particularly at the level of formal research and development and large-scale national projects. However, in many countries, much of the innovation in smart cities started out as “bottom-up” projects initiated and driven by researchers, entrepreneurs and citizens (Dameri & Benevolo, 2016). This level of innovation can make an important complementary contribution to the NSI and aligns with the broader conceptualisation of innovation adopted by the Department of Science and Technology (DST, 2018).

There are three forces driving greater government involvement in smart city developments. First, there are obvious **benefits for governments** to embrace smart technologies themselves, to enable more effective and efficient service delivery. Second, it is necessary for government to **protect the public interest** and implement controls where the profit motive may work against socially desirable goals. Third, government has an important **facilitating and coordinating** role to play in creating alignment between the other stakeholders.

On the other hand, government cannot operate alone in creating smart environments, but needs to work with other stakeholders, including business, academia, non-profit and cultural organisations and individual residents. Such stakeholders provide resources, skills, ideas and energy that play an important role in conceptualising and implementing smart initiatives. Indeed, the COGTA Smart Cities Framework recognises the need to “promote constructive interaction among state, private sector and civil society” (COGTA, 2020).

The challenge for government is how to play a constructive role in the smart city space, balancing the competing demands of building internal capacity, protecting the public interests and working with

other stakeholders, without compromising the conditions for innovation. In addressing this challenge, we examine here how governments have intervened in smart cities globally, what has worked and what hasn't. We also consider the different roles for government at the local and national levels.

2.2. The roles of local government

Much of the research into smart city governance has focussed on the role of local government in smart cities. Researchers have identified three important roles that local government has played in leading smart cities (Dameri & Benevolo, 2016):

Political vision and visibility: The political role involves establishing a vision of the city that goes beyond service-provision, proactively supporting innovation. This vision needs to be championed at a high-level by someone who is able to represent the city effectively. Research shows that someone in a senior role, and not within a specific domain, can do this most effectively. Where smart city initiatives are located within one city function (such as information technology or transport) the vision is limited and cross-functional innovation unlikely. Formal involvement of the municipal government allows multi-level and multi-domain interventions and a more comprehensive smart city strategy (Dameri & Benevolo, 2016). In locations where funding is provided nationally or supra-nationally, political influence is also important in accessing such funding (Dameri & Benevolo, 2016; Nam & Pardo, 2011).

Safeguarding public interests: The second role of local government is to protect and drive urban policies towards the common good, rather than the interests of specific vendors (Dameri & Benevolo, 2016). Many smart city initiatives are driven by companies involved in infrastructure development or selling technologies and these same companies, despite an obvious conflict of interests, are advising cities on their smart strategies.

One of the fundamental challenges that faces South African cities is the divide between rich and poor and the need to create integrated cities that reverse existing apartheid geographies in order to achieve the goals of SDG11 (COGTA, 2016). However, research shows that smart city initiatives can also increase polarization and inequality (Brannon, 2017; Datta, 2015; Lim et al, 2019; Sajhau, 2017). The Indian Smart Cities Mission has been ingloriously credited with strengthening an exclusionary vision of urbanization, contributing to forced evictions, homelessness, inequality and impoverishment (HLRN, 2018).

Many of the smart city initiatives that emerge from the economic growth and technology discourses promote the idea of modern, urban spaces that attract business and an elite class of knowledge workers. These developments in particular, work against the goals of integrated sustainable human settlements and inclusive economic development contained in the IUDF (COGTA, 2016). Local government plays a role here in ensuring that developments align with the long-term public interests through the use of planning and development strategies and regulations, but also through building constructive partnerships with the private sector. Indeed, the IUDF notes that while the private sector has a role to play, the overall pattern of spatial development should be shaped by the long-term public interest and there is a need to improve the capacity of government to partner with the private sector (COGTA, 2016).

Coordinating the activities of other city stakeholders: This leads to the third role of local government, that of coordinating the efforts of diverse city stakeholders. Leading smart cities have addressed this need by creating dedicated organisations to oversee the city's engagement with citizens, businesses, trade associations, non-profits, researchers and other stakeholders. Cities like Amsterdam, Barcelona, Vienna and Genova have created bodies that coordinate and promote smart city activities (Camboim et al., 2019; Dameri & Benevolo, 2016). The cities play a key role in defining the nature and functioning of such organisations as well as their scope of work, with the city mayor often playing a leading role.

Of course, some structures are better suited to larger cities and are not necessary in every city. Other boundary spanning organisations such as living labs, innovation districts and sector-specific networks have also been used to bring different city stakeholders together and leverage their different strengths (Acuto et al., 2019). Directing efforts in line with city development plans can also be done through existing city structures using processes like stakeholder management (Chigona et al., 2010) as well as engaging stakeholders through online platforms and using smart tools such as customised mobile apps and social media (Joss, 2018; Malhotra et al., 2019; Panagiotopoulos et al., 2017; Zanello & Maassen, 2011).

How well local government are able to play these three roles, depends on developing an understanding of what smart means to them and how it might be useful in addressing local challenges. It also means understanding which discourses are being promoted by the different stakeholders that they engage with and how to recognise and direct these appropriately. Further discussion of these capabilities is included in Section 3.

COGTA Framework

The COGTA Framework proposes seeing a smart city as a governance model that adheres to six principles (COGTA, 2020, p20)

1. Promotes open source
2. Collaboration and participation
3. Protection of privacy and personal information
4. Bottom-up crowdsourced innovation through open government
5. Promoting open data
6. Creates new business models with shared risks

These principles appear to position local government as a balancing force between the needs and interests of private companies and the needs and interests of citizens (or, more broadly, city residents). On the one hand, the principles suggest that government will work with private companies to solve problems and deliver services. This will be done through new business models, that share risks between the public and private spheres (principle 6). At the same time local government will promote open source software to limit the power of private companies (principle 1), and act to protect the privacy and rights of individuals to their data (principle 3), countering the desire of the private sector to use such data for their own ends. On the other hand, the principles suggest that government will maintain an open relationship with city residents through the provision of open data and encouraging its use (principle 5), through closer collaboration and participation (principle 2), and through harnessing the innovative power of individuals and communities to solve problems for city government (principle 4).

The COGTA Framework thus recognises the roles of government as coordinator between city stakeholders and, to some extent, the Framework identifies the need for government to protect public interests, but it does not recognise the need for government to take the lead, be actively involved in evaluating the potential impacts of smart city initiatives and to steer the choice of initiatives undertaken. Also absent from the Framework is any mention of local government's political role in championing and creating visibility for a shared smart city vision.

2.3 The role of national government

The discussion in section one already points to an important distinction between the roles of central and local government. While the values and overall goals for developing human settlements are appropriately decided at a national level, the choices about implementation and the local "flavour" of what makes a particular city or settlement smart, needs to be decided locally. Local conditions are too variable for one set of smart solutions to work for every city and settlement. At the same time, smart

city plans and initiatives "cannot work in local isolation, but must be embedded in wider regional, national and global settings" (Fromhold-Eisebith, 2017). Here we examine the role of central government which, in South Africa would normally mean national government, but might also be at the provincial level and, sometimes, at the regional level.

In the smart city literature, less attention has been paid to the role of national government since, in most countries, smart city initiatives have been led by cities. Notable exceptions are those countries where a single large city dominates the national landscape and national government is inevitably closely tied to the government of that one city, and some countries where national governments have undertaken to actively direct the development of smart cities. Examples of the former include Singapore (a city-state), Egypt (Cairo), and Qatar (Doha). Examples of the latter include India's 100 Smart Cities project and China's smart initiative led by the Ministry of Housing and Urban and Rural Development (MOHURD) that is funding 193 official smart city project sites (Fromhold-Eisebith and Eisebith, 2019; Johnson 2014; Praharaj and Han, 2019).

However, some work has been done and has identified the following roles for national government: the provision of **high-level infrastructure**, **appropriate legislation and regulations**, **supportive procurement processes** and, in some cases, **targeted funding**. National government also ensures a **supportive political environment**, and defines **national priorities and standards** for measuring city performance.

For smart cities to operate at all, there is a need for **national-level infrastructure** including services such as electricity supply and internet connectivity (Fromhold-Eisebith, 2017; Manda & Backhouse, 2016). Where such services require significant infrastructure and planning or negotiation with international suppliers and regulators, high-level policy support and leadership, national government is often best placed to ensure their provision. National government is also responsible for ensuring supportive legislation for smart initiatives that includes data and privacy protection, intellectual property protection, business regulations, and the regulation of telecommunications, among others.

National government is also responsible for at least part of city finances through fiscal transfers. Government support and influence towards smart cities could be exercised through these allocations, as well as through specific funding instruments for smart city initiatives, as in the cases of the Indian and Chinese projects mentioned above (Fromhold-Eisebith and Eisebith, 2019; Manda & Backhouse, 2016). Central government also often dictates procurement processes and standards and the needs to ensure that these do not create barriers to innovation.

Finally, central government can provide a conducive political environment through explicit support for smart city development, as well as clear direction of the type of smart city development that is desirable and the values that should underpin smart city choices, as discussed in section 1. National government can also play a role in monitoring and ensuring that cities adhere to these guidelines by defining standards and measures for evaluating city progress and success (Shen et al, 2018).

Learning from India's 100 Smart Cities Project

In particular, South Africa can learn from the experience of India's 100 Smart Cities project, the benefits and drawbacks of a nationally mandated smart city agenda. This project, initiated in 2015, defined what an Indian smart city would look like, including defined solutions that addressed priority areas such as water supply, electricity supply, sanitation and solid waste management, efficient urban mobility and public transport, affordable housing, network connectivity and digitalization, good governance, especially citizen participation, environmental sustainability, safety and security, health and education (Das, 2017; HLRN, 2018). Some have argued that the selection of priority areas was heavily influenced by technology companies seeking new markets (Das, 2017; Datta, 2015). Cities were nominated by states to compete for funding based on proposals which had to include both a

project to develop or re-develop a specific area (area-based projects) as well as a pan-city project. State funding was intended to be matched and exceeded by other sources of funding and cities were required to set up a Special Purpose Vehicle to manage their smart city mission.

While a wide range of projects were proposed under this scheme, the emphasis that has emerged is on area-based projects with an overall 80% of funding going to such projects. The pan-city projects have been awarded only 20% of the funding although these are the projects that will benefit the city more widely. The area-based projects focus on small areas of the city (1% to 3% in some cities) and benefit a similarly small and elite portion of the populace. In addition, the proposals do not address the concerns of marginalized sections of society including women, children, domestic workers, Scheduled Castes, Scheduled Tribes, migrant labourers and the homeless (HLRN, 2018). This approach has been criticised for treating "urbanization as a business model rather than a model of social justice" (Datta, 2015).

The projects initiated under the India 100 Smart Cities program have run into difficulties in several respects. Implementation was hampered by knowledge gaps which resulted in poor budgeting, and the division of competencies between departments and traditional hierarchies hampered contributions by tech-savvy but junior staff. The strong direction of national government restricted local engagement encouraged local staff to not take responsibility for outcomes (Fromhold-Eisebith & Eisebith, 2019). In addition, despite the intention that projects should become self-sustaining, the reliance on targeted national funding for these projects resulted in little concern for cost recovery and long-term revenue streams, leading to unsustainable projects that are failing as the central funding comes to an end (Fromhold-Eisebith & Eisebith, 2019). The program has also been hampered by resistance from the informal economy sectors and from subsistence farmers whose land has been appropriated for the construction of greenfield smart city projects (HLRN, 2018).

The limited scope of the program and pre-defined solutions created dependence on tech companies and consultants as well as competition for suppliers as several cities tried to implement the same systems and infrastructure. This has led to similar solutions being replicated across all cities, defeating the smart city ideal of greater innovation (HLRN, 2018).

On the other hand, the program has had some unintended benefits for local governments (Fromhold-Eisebith & Eisebith, 2019). City officials involved in compiling proposals benefitted from the experience with an exposure to procedural rigour and an increased sense of place resulting from mapping exercises, awareness of local potential, selling points and development opportunities. This experience produced a sense of pride and motivation among officials (Harris, 2015; Fromhold-Eisebith & Eisebith, 2019). The process also raised awareness of urban environmental problems (Butsch et al, 2017) and allowed cities to develop online and offline tools for citizen participation. Cities formed new networks and the demand for services led to India's world-class ICT industry providing more local services (Fromhold-Eisebith & Eisebith, 2019). One particularly interesting result is that national oversight of the program led to discipline.

The lessons that South Africa could learn from the Indian case include:

1. Funding for smart city agendas is best channelled through the existing mechanisms for funding. Smart should be built into the planning and development of each city and not viewed as an "add-on".

2. A stronger value-driven approach is needed to ensure that smart city agendas address the needs of marginalised sectors of society, rather than the needs of an elite few.

3. Defining the areas to be addressed undermines the ability of cities to respond to local needs and priorities and ultimately reduces innovation.

4. National oversight in terms of defined goals and measures can be beneficial in ensuring that cities show results.

5. There were unintended capacity development benefits from the Indian national program and it would be useful to find ways to recreate these in the South African context.

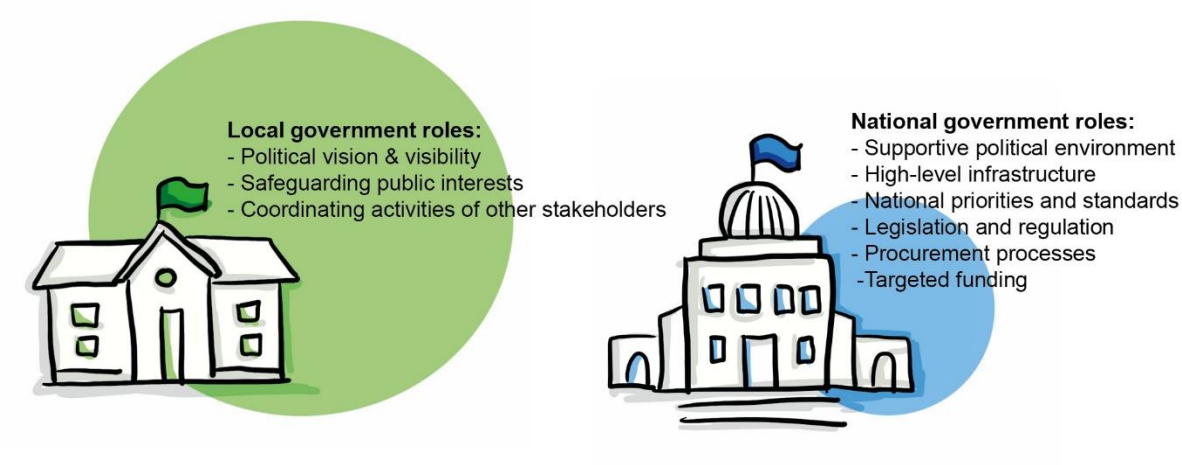
COGTA Framework

The COGTA Framework recognises the role of national government in providing a "conducive political and legal environment" and proposes "working at a systems level" in order to address the complex problems of municipal governance (COGTA, 2020, p8). However, in keeping with COGTA's position as a national entity, "working at a systems level" then focuses on the decisions and support structures that can be implemented at a national level. This is contrary to systemic ways of thinking which would also recognise the autonomy of the other actors in the system, such as city government, businesses, non-profit organisations and residents. These actors all have different goals and aspirations as well as different contributions to making cities smarter. A systemic approach would seek to accommodate different goals and to guide activities in a desirable direction, leaving space for cities to address their own needs and priorities.

The COGTA smart city framework discusses in some detail four areas of smart delivery: decentralised energy and smart grids, decentralised water systems, urban mobility and autonomous vehicles, and online learning and a "learning revolution" in education. These are interesting as examples of how smart solutions can change cities and will serve as useful starting points to debates about how to address the provision of energy, water, transport and education in cities. However, these needs should be subjected to fuller systemic analyses, considering multiple alternatives as well as local conditions, to understand if the solutions proposed in the Framework are indeed appropriate for each context. The danger of suggesting, for example, shared transport, is that this will not be the best solution for every South African city. Indeed, suggesting that all South African cities should take the same approach to providing transport works against local innovation. The identified smart interventions shift the autonomy of local government in responding to smart city needs because they insinuate that smart city initiatives must respond to national government priorities in all contexts to achieve alignment. This leaves little room for flexibility and for municipalities to drive a locally informed smart city process. So, proposing these smart interventions as part of a national Framework is not an appropriate, systemic response.

One of the goals of the Framework is to "build innovation capacity" and "do away with compliance driven cultures" in local government (COGTA, 2020, p20). This is a difficult task and requires direct engagement with the DST's long-established work on the National System of Innovation (DST, 2018), and with the ongoing issue of how to build strong local systems of innovation (LSIs) that can respond locally while leveraging national systems. Building capacity for "radical and bold 'big thinking, big ideas, big projects' that achieve 'radical economic and social transformation' in local government" (COGTA, 2020, p20) needs to start with developing the capacity for small-scale innovation. South African cities have already implemented a great number of smart interventions. Encouraging a broad set of local innovations will have a greater impact on developing local capacity than promoting specific national smart initiatives.

FIGURE 2: SMART CITY.ZA ROLES – LOCAL AND NATIONAL GOVERNMENT LEVELS (SACN)



Section three: Agenda

So, what should a South African approach to smart cities and settlements be?

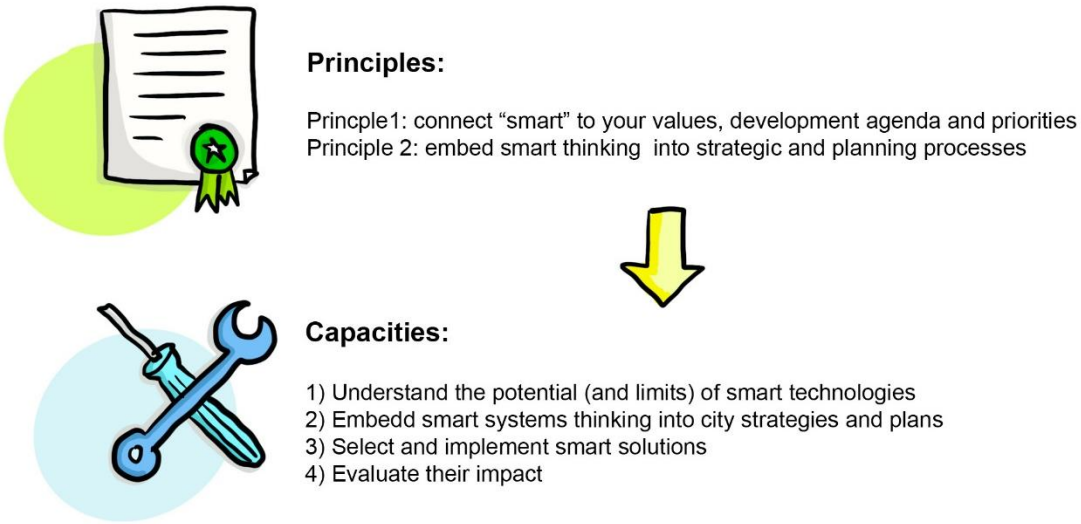
3.1 Principles for smart, and the capabilities needed

This document does not propose an agenda for smart cities in South Africa, since that agenda should look different for every city. Consequently, this section of the report is not prescriptive, but rather outlines principles that South Africa should adopt in developing smart agendas. It includes a process for cities to follow and discusses how this can be supported nationally.

The **first principle** is to clearly connect the idea of smart to the development agenda and to the pressing concerns that need to be addressed, such as housing, inequality, climate change and the economy. Smart technologies should be viewed as tools to be used in addressing these concerns. This requires raising awareness of the different smart discourses and clearly emphasising the need to connect these with national and local needs and concerns. It also requires a clear understanding of the values which should be driving decision-making at all levels.

The **second principle** is to establish smart thinking as an inherent, embedded part of existing strategic and planning processes. This means that those responsible for planning city development should turn naturally towards smart technologies to explore their potential for addressing challenges. It means being innovative in how such technologies might be used in their current form or with adaptations. It also means being able to reject smart solutions where they do not contribute, with the understanding that it might be smarter to focus efforts elsewhere for now.

FIGURE 3: SMART CITY.ZA PRINCIPLES AND CAPABILITIES (SACN)



With these two principles established, **developing the capabilities to (1) understand the potential (and limits) of smart technologies, (2) embed smart systems thinking into city strategies and plans, (3) select and implement smart solutions, and (4) evaluate their impact** is the first priority of cities that wish to be smart, as well as a national priority. Some of the capabilities that cities will need are outlined here.

- Understanding smart thinking and technologies
- Awareness of the different discourses surrounding smart cities and settlements
- Understand how national values relate to these discourses
- Understanding the potential of technologies
- Keeping up with new developments in technologies
- Anticipating the impacts of technology change

Embedding smart systems thinking into planning

- Understanding the socio-technical nature of city systems and how to influence them
- Evaluating and balancing different system goals
- Applying systems analyses to understand what changes will have the desired effects
- Innovating with technology
- Critically evaluating potential smart interventions

Selecting and implementing smart initiatives

- Engaging constructively with stakeholders
- Managing and drawing on partner organisation's expertise
- Financing smart initiatives
- Transforming skills (high and low) to accommodate change within municipalities
- Dealing with unintended consequences of systemic change

Evaluating the impact

- Knowledge of evaluation principles
- Knowledge of existing evaluation mechanisms
- Selection of relevant indicators and data sources
- Data collection, quality and curation
- Data analysis and reporting

These capabilities can be built through formal education of individuals and through carefully designed on-the-job training interventions, but primarily they are developed as a result of engaging in these activities – i.e. learning by doing. Such engagement might need to be under the guidance of experienced staff, consultants or mentors. Internal capacity development needs to be supported by a strong knowledge management function to ensure the retention and diffusion of knowledge throughout the organisation through defined knowledge management processes. Regional and national government also plays a role in ensuring that education and training opportunities exist and are accessible.

City networks have also been found to play an important role in facilitating smart city development. A study of the Spanish Network of Smart Cities (RECI) concluded that such networks facilitate knowledge sharing and learning between cities, improve the success rate of smart city projects and lead to cost savings. To succeed, such networks need to sustain and manage relationships between cities, as well as with other stakeholders, including national government and standards bodies (Palomo-Navarro & Navío-Marco, 2018).

South Africa already has a number of institutions that play a networking role. These could provide useful developmental mechanisms in the South African context. Table 2 below lists some of these institutions and the roles they are already playing, but is not comprehensive. Further work to identify these organisations and to understand their roles and strengths would be a useful contribution to developing smarter cities.

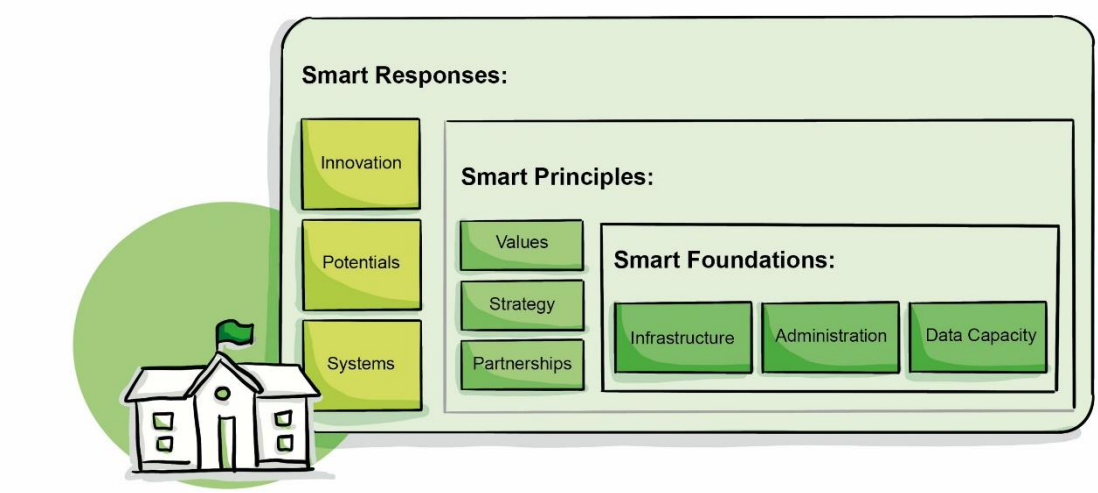
TABLE2: SOUTH AFRICAN INSTITUTIONS THAT COULD PLAY A NETWORKING ROLE

Name	Current activities
South African Local Government Association (SALGA)	Operates national and provincial working groups, provides guidelines for municipalities and supports a knowledge hub.
South African Cities Network (SACN)	A network of South African cities and partners concerned with urban development and city management, works across a number of thematic areas and produces knowledge products for cities based on local and international experience, lessons and ideas.
Development Agencies	Examples include the Johannesburg Development Agency (JDA) and Mandela Bay Development Agency (MBDA) – these special purpose development entities augment and support city programmes for renewal, transformation and development. They are important innovators, knowledge-holders, and laboratory spaces for cities.
Centre for Public Service Innovation (CPSI)	Tasked with the creation and implementation of new service delivery solutions, the CPSI runs an innovation conference, annual innovation awards for the public sector, conducts research and hosts a knowledge platform
Department of Co-operative Governance and Traditional Affairs (COGTA)	Initiated and owns the Integrated Urban Development Framework, runs programs including the back to basics campaign, municipal infrastructure grants, serves as a knowledge repository on matters of policy and regulation
Department of Science and Innovation (DSI)	Seeks socio-economic development in South Africa through research and innovation, providing leadership, an enabling environment and resources for science, technology and innovation. Reporting entities include the National Advisory Council on Innovation (NACI) and the Technology Innovation Agency (TIA)

3.2 Responses needed at the level of local government

At the local government level, we envisage three stages of development for cities, with the idea that cities should proceed from the first (lowest) stage to the third (highest) stage. These stages anticipate increasing levels of sophistication in the use of technologies and a corresponding increase in capacity as they progress. The stages of development are summarised in Figure 2.

FIGURE 4: STAGES OF DEVELOPMENT TOWARDS BEING SMART CITIES.ZA (SACN)



This development process envisages that establishing the use of basic technologies in the management of a city is an important fundamental stage for city development. Putting this first allows for capacity development and develops an understanding within the city of the potential for smart solutions. At level 2 a city can start planning to become smart by establishing values, strategies and partnerships. The selection of smart projects is left until level 3 when cities have a better understanding of the potentials of technology and are better able to innovate. More information about these processes is given below.

Level 1: Smart Foundations

Every city needs to achieve a base level of smart administration to ensure efficiency, good governance and service delivery, to support the ease of doing business and provide a positive experience for residents (SDB, 2018). These include using information technology constructively for internal communication and office automation, for electronic record-keeping and transaction processing and for communication (examples are given in Table 3). In addition, each city needs the infrastructure and an adequate ICT support function to ensure that such services run smoothly. Achieving this will prepare cities to become smarter by ensuring basic infrastructure is in place and developing capabilities and understandings of the potential of ICTs.

TABLE 3: SMART ADMINISTRATION THAT EVERY CITY SHOULD HAVE

Function	Examples
Office automation	E-mail and electronic filing systems
ICT support	IT help-desk and technical skills to support networks, printers, computers, servers as necessary
Transaction processing and record-keeping	Information systems for functions such as revenue collection, procurement, accounting and payroll
Communication and engagement	Municipal website, social media and other channels appropriate to context
Data storage and reporting	A data repository that accumulates data and the capacity to interrogate this data for reporting and decision-making

At the same time that smart administration is being implemented, the capacity to manage and use data needs to be developed. All cities have obligations to keep records and report on their operations and progress towards goals and most have some degree of structure dedicated to these processes. This function needs to be strengthened and developed. Municipalities should start by streamlining their reporting functions and develop skills and tools to be able to report accurately and quickly on a variety of measures.

Data management includes the collection, storage, protection, analysis and disposal of data. Municipalities will need to follow regulations on data privacy and provision, decide on what to collect and how, implement secure storage, ensure the quality of their data, and take decisions about how it is to be used. Data is also needed to be able to monitor and demonstrate the effectiveness of the city's systems and to identify ways to improve. Data also underpins the power and success of most smart interventions, so if cities can develop this capacity early on, they will be well placed to properly evaluate the need for and impact of any smart interventions.

Level 2: Smart Principles

In order to avoid smart agendas that are driven by fashion, or private sector interests, cities need to establish the values that will underpin their development. Some of the values that have been identified in this paper as aligned with the South African development agenda include equity, inclusion and social cohesion, economic development, having a long-term perspective, and the responsible use of limited resources. Cities need to establish which values they will embrace so that these can be used to evaluate the strategies and directions in which they progress.

Local government has the task of understanding local priorities and concerns and aligning those with national goals as well as local resources and expectations. Smart cities begin with a strategic vision for the city, which should be driven by the city management. The vision for the city should drive developments in the city. Being smart is not about implementing technology solutions as much as it is about using technology appropriately, when it enables cities to approach their goals or to work differently towards them.

Thinking through smart alternatives should therefore be an integral part of the established city planning processes and be incorporated, where there are clear benefits, into a city's Integrated Development Plan (IDP), including the city's spatial development plans, sectoral plans and plans for service delivery. By examining the role of smart alternatives at the planning stage, cities will be able to find common concerns across the various city functions and identify opportunities for smart solutions. For example, smart street lighting might be able to address concerns with crime while lowering the city's power consumption and providing public Wi-Fi at the same time.

It is also important for cities to set up, or identify existing channels to work with partner institutions including universities, non-profit organisations, businesses, innovation hubs, entrepreneurs, cultural organisations and city residents. These partners can be important sources of ideas and will be needed to collaboratively build solutions for the city. Cities should plan structured, ongoing engagements with key stakeholders and open a conversation about what being smart means. Cities should be aware that different stakeholders will bring their different priorities to these conversations and be prepared to assert their own role as leader and protector of the public interest.

Having a dedicated office for smart city development, or housing a smart city function within another department (like Information Technology services) is generally not thought to be useful if they develop add-on projects that are not integrated into the work of other functional areas. A dedicated office for smart city development can, however, serve a useful function in championing smarter approaches, educating colleagues in other functional areas about the potential of smart city initiatives and

supporting them in investigating and implementing possible solutions. Such an office can also help to overcome barriers between functional "silos" which may pose obstacles to smart interventions.

Level 3: Smart Responses

Cities that have proven capabilities in smart administration, and have a clear strategy, can start to look towards more expansive smart interventions, including those that might significantly transform how a city operates.

In thinking through how smart technologies might contribute to city strategies, it is worth thinking in terms of the **potentials** of smart technologies for cities. These potentials are identified in Table 4 and can be used to identify points within the city plans where smart solutions might be worth exploring.

TABLE 4: SMART POTENTIALS AND RELATED INITIATIVES

Potential	Smart idea / solution / process / technology
Efficient administration (including for high-volumes)	Process mapping and definition, consultative processes, stakeholder mapping and profiling, ERP systems
Consistency of service delivery processes	Process mapping and definition, ERP systems, feedback mechanisms
Increased transparency and reducing corruption	Process mapping and definition, ERP systems, open data, blockchain, improved communication, consultative processes, participative budgeting, participative policy-making
Better understanding needs and priorities	Stakeholder mapping and profiling, consultative processes, surveys, importance/performance mapping, social media interactions
Understanding conditions in cities	IoT devices, monitoring sensors, apps to collect data from residents, machine learning applied to large data sets
Changing resident's behaviour	Smart metering devices, IoT devices with feedback, consultative processes, social media interactions
Improving decision-making	Big data, open-data, data visualisation tools, machine learning, artificial intelligence
Automating decision-making	Artificial intelligence, automated traffic controls, "city brain", autonomous vehicles

Table 1 gave examples of how cities and settlements are becoming smarter and the intended benefits of these initiatives. The temptation might be for city managers to identify initiatives that have been implemented elsewhere and replicate them. However, such an approach is dangerous because city contexts are so different. While smart meters have helped cities in Britain to reduce capital and running costs (Wang et al., 2020), that might not work in Polokwane, where winter heating is less of a concern. And while smart meters have changed consumption patterns in Tshwane, it does not follow that they will have a similar effect in Mahikeng.

Investigating and identifying smart solutions needs to be problem-driven and not technology-driven. This means that city departments need to start with their most pressing problems and, from those, identify potential smart strategies and interventions that might be able to improve the situation. This process needs to be supported by a good understanding of the systemic nature of change and capabilities in cities, so that there should be a clearly articulated logic for why a particular intervention might i) solve a problem, and ii) be feasible and sustainable. Such logics should then inform the measurement of the success of each intervention.

It is important to note that when it comes to smart city interventions, there are no "best practice" solutions because of the underlying variability in city contexts. This means that becoming smart is not

as simple as selecting a set of solutions from a list. The best smart solutions are those that are developed by cities, and are specific to their context. In particular, cities need to work out how to leverage local innovation capacity and existing pockets of excellence to support the municipality's smart city vision. Very often the most appropriate and successful interventions originate in the immediate communities, including universities, businesses and residents, as these typically respond to existing civil society needs and are already aligned to local, developmental values. Municipalities should look out for innovative solutions already identified and developed within communities that could benefit from upscaling.

Cities will also need to develop capabilities to evaluate smart innovations for their feasibility. There is little research that looks at the impacts and changes that have resulted from smart interventions more broadly to answer questions such as:

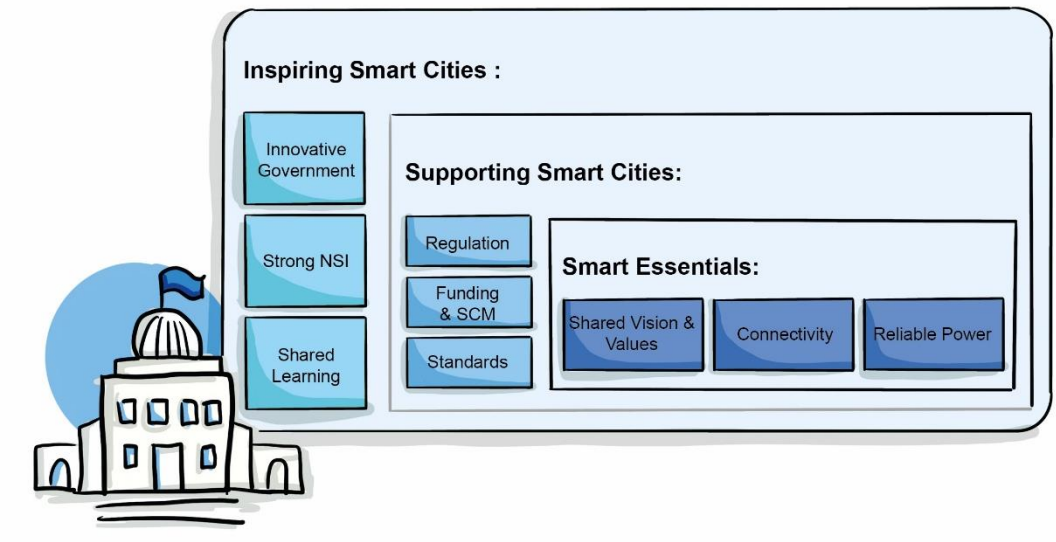
- Will this work in my city or region?
- Will this always have the same effect (are the results guaranteed)?
- What conditions are necessary for this to work?
- What are the risks and unintended consequences?
- Who can assist me in applying this solution?
- What is the best way to work with partner organisations?

The complexity of navigating the smart city space means that South African cities will have to develop locally appropriate tools to assist with decision-making.

3.3 Responses needed at national / provincial levels

National and provincial governments also have important roles to play in supporting the development of smart cities, but these are distinct from the roles of local government. Here three levels of contribution from central government have been identified, that can support smart cities.

FIGURE 5:THE ROLE OF NATIONAL GOVERNMENT IN SMART CITIES.ZA (SACN)



Level 1: Necessary Conditions

Arguably the most important contribution that national government can make to developing smart cities in South Africa is to address the two most pressing **base infrastructure** challenges. That is, to secure and render accessible a reliable electricity supply for cities and affordable connectivity to the global internet. How these challenges might be addressed is beyond the scope of this paper, but

certainly the comments in the COGTA Framework on increasing the use of localised energy supplies should be taken into account.

As discussed in the introduction to this paper, national government already contributes a national vision and values for the public sector that is embodied in numerous papers, frameworks, processes and programs. These provide a vision and the core values which any smart city development needs to build on. This, together with the necessary infrastructure, forms the necessary base for the country to proceed to develop smart cities.

Level 2: Supporting

Secondly, there are measures that need to be in place to support smart city development. They include having **laws and regulations** that operate at a national level need to support the efforts of cities. This means having in place, and supporting the effective implementation of laws concerning data use and protection, privacy and intellectual property, and the regulation of telecommunications. Legal frameworks are needed to support the functions of business, including taxation, labour laws and the regulation of specific industries. There is also a need to regulate environmental protection, including how to ensure that manufacturers and retailers take on more of the costs of the whole product life cycle. National government needs to develop the capabilities to monitor, anticipate and respond rapidly to regulatory changes that may be needed in response to rapid technology development and the impact of the 4IR.

National and regional structures need to examine **funding mechanisms** as well as **procurement regimes** to ensure that they optimally support cities. We would caution against targeted smart city funding mechanisms as these serve to encourage disconnected and cosmetic smart city projects. Rather funding needs to be channelled to city challenges so that smart projects are initiated in the context of addressing these.

The Department of Planning, Monitoring and Evaluation and SABS can contribute to the development of Smart Cities by developing clear standards and measures for Smart Cities that speak to the international standards, but are relevant to the local context. Such measures should be sensitive to the values-focus that has been proposed, and focus on the nature and extent of the benefits of smart initiatives, ensuring that the values hierarchy presented above is being respected. Regular measures of how local government is becoming smarter and lessons thereof should be included in existing processes for monitoring cities as envisaged for the various bodies responsible for the Government-Wide Monitoring and Evaluation Policy Framework and could be made public using web sites such as YES Media's municipalities.co.za.

Level 3: Inspiring

With the first two levels in place, national government should be inspiring the development of smart cities by setting an example of innovative government, showing how innovation can take place and leading a culture change in government that supports innovation. National government needs to continue the important work of developing and strengthening the NSI so that it works to support innovation more broadly across the country. Smart cities are going to depend on innovation at both the small and large scales and coming from multiple players including public, private and non-profit sectors.

National government has an important role to play in developing the capacities across the public sector to transition to smarter cities. In this respect it can play an important role, not only in the provision of training and learning opportunities, but also in coordination and developing the networks for knowledge sharing and in communicating across the public sector.

In order to make these proposals more concrete, Table 5 suggests ways in which specific institutions might be involved in this agenda.

TABLE 5: SOUTH AFRICAN NATIONAL INSTITUTIONAL ROLES - EXAMPLES

Name	Potential Roles
COGTA	• Coordinating (in consultation with cities) shared national smart vision, values and priorities • Innovative government strategies (with DPSA and DSI) • Establish Smart City evaluation and learning practices (with DPME and national agencies) • Advocate for enabling SMART systems (e.g. for procurement) and targeted funding (with National Treasury)
DPME	• Coordination to critical government Outcome Areas that ensure base infrastructure • Smart City standards (with COGTA, DHS and SABS)
DOC	• Planning and regulation of national connectivity • Coordinating with local Smart infrastructure plans and needs
DSI	• Guiding the national progression towards a strong NSI and supporting the building / strengthening LSI ecosystems • Leveraging of national knowledge infrastructure to enable Smart Cities (with NRF)
DTI	• Coordination between local Smart City / economic strategies, and economic / industrial growth & investment strategies (with IDC, development agencies, etc.)
National and regional innovation agencies	• Contribute to innovative programming and practices through research, experimentation, knowledge sharing, analysis, capacity building, etc. (Agencies include e.g. CSIR, TIA, Universities, The Innovation Hub, SAASTA)

Finally, there is a role for regional and national government in providing political support for smart city agendas including the recognition and reward of innovation in cities and the promotion of smart solutions that address real city challenges effectively. Key to this is a coherent message that smart in the South African context must first and foremost respect and espouse our values. The vision and implementation of smart cities lies in local government, but national government has a key role to play in coordinating and guiding municipalities towards a single vision of Smart South African cities that encompass the different scales and contexts, from metropolitan municipalities, intermediary cites to rural municipalities. It is thus important for regional and national government to align with existing policy interventions. The COGTA framework for smart cities must align with the principles of the District Development Model One Plan.

Conclusion and next steps

This position paper was compiled in response to the COGTA Smart Cities Framework. As such it sought to critique and expand on the ideas that were put forward by COGTA. In particular it sought to distinguish clear roles for local and central government and to present a theoretically sound argument for these distinct roles.

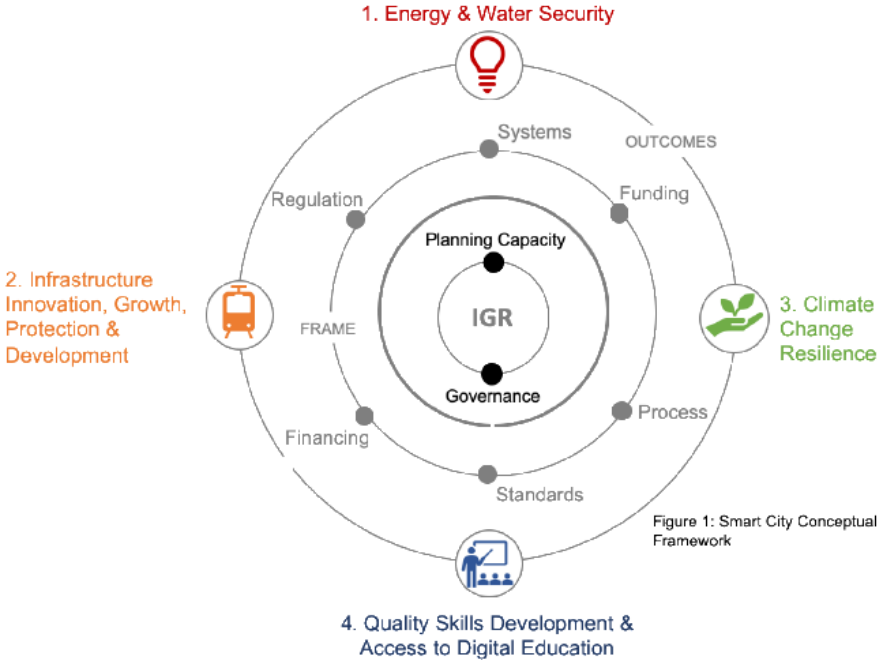
This paper has argued that there are a number of smart city discourses that reflect different value system and priorities. In moving towards smarter cities, South Africa needs to ensure that the national values are respected. This means countering discourses that position smart as technology-driven and focussing instead on how smart technologies can address pressing social, environmental and economic problems.

Local and central government both have roles to play in developing smart cities, but they are different roles. The kind of innovation that will best support the emergence of locally relevant smart solutions requires smart agendas to be locally driven, in partnership with universities, entrepreneurs, architects, engineers, residents and non-profit organisations. South Africa can learn from the experience in India where the centrally-driven Smart City program encouraged unsustainable solutions that benefitted the wealthy at the expense of the poor.

The role of central government in developing smart cities is to focus on the provision of large-scale infrastructure and connectivity, a supportive regulatory environment, and a strong national system of innovation. Funding of smart cities should not be distinct, but should rather take place through existing mechanisms but smart agendas can be supported with appropriate procurement practices. Central government can also develop national standards for technology, city services and measures for city performance.

COGTA proposed a Framework for Smart Cities in South Africa that they describe as a “mechanism to coordinate IGR activities around smart city initiatives across the country”.

FIGURE 6: COGTA’S SMART CITY CONCEPTUAL FRAMEWORK (COGTA, 2020)

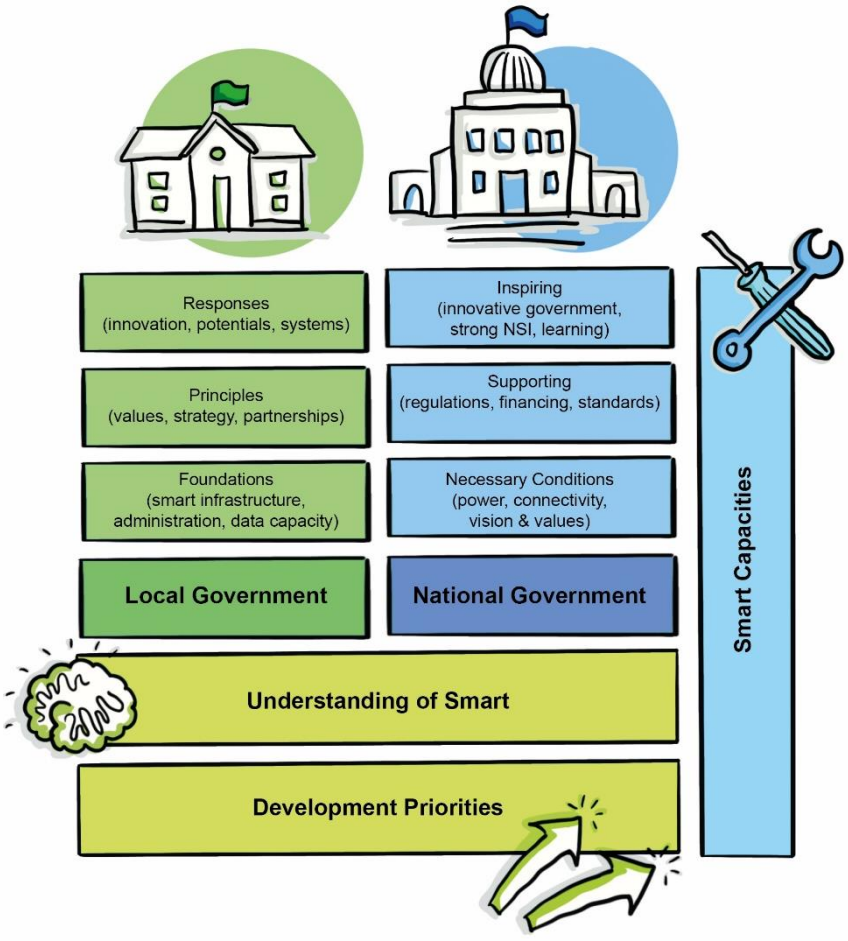


The COGTA focus is to be able to “fast-track the implementation of quality smart city solutions” (COGTA, 2020, p 23). In this paper we have argued against both central coordination of smart city activities and against a focus just on picking and choosing smart city domains and solutions. Rather,

we propose that more diverse city-driven approaches to becoming smarter will support innovation and lead to solutions that are more closely aligned with city's development priorities and more sustainable in the long run. In particular, we are concerned that a nationally coordinated approach will have a similar outcome to that observed in India where the national Smart City project has increased inequality, supporting the needs of the wealthy over those of the poor and has led to unsustainable smart city projects that depend on central funding.

Putting together the elements that this paper has presented, we propose instead the following framework for smart city development in South Africa.

FIGURE 7: ALTERNATIVE FRAMEWORK PROPOSED FOR SMART CITY.ZA DEVELOPMENT IN SOUTH AFRICA (SACN)



The framework is underpinned by the national development priorities already identified for cities, and is based on an understanding of smart as an opportunity to harness the power of technology in the service of those development goals. This understanding ensures that smart cities benefit all their residents and do not increase the existing divides in South African cities.

We envisage capacity development as being something that happens at every level of this framework. The framework is developmental by design. In particular, with regards to city development the intention is to ensure that cities grow their understanding of technologies and their potential in the process of developing their basic systems and in preparing for smarter solutions. At the same time, capacity development is needed within central government to be able to adequately support and inspire cities. Multiple interventions will be needed to develop this capacity.

Arising from the points put forward in this paper a number of steps can be identified that could take this conversation forward. These steps are beyond the scope of this paper to address in depth, but are recorded to suggest ways in which this agenda can be developed.

1) The requirement that **cities include smart strategies where appropriate in the IDP**, aligned with all relevant existing development plans. Developing a smart city should include the smart application of frameworks that align with existing policy developments, rather than negating these.

2) It might be useful to **consider how the Smart City Framework relates to the Khawuleza District Development Model (DDM One Plan)** under development by the Department of Planning Monitoring and Evaluation. This intergovernmental relations initiative seeks to coordinate national, provincial and local priorities to assist municipalities to address challenges in implementing local plans.

3) A more detailed **analysis of capacity development needs and mechanisms** to providing for these is needed.

4) A comprehensive **catalogue of smart city solutions tested and implemented in South Africa** would be a useful resource. Such case studies would enable cities to drive the narrative and relationship with the private sector and to seek out relevant service providers in line with their goals and targets. Additionally, this resource could suggest how cities can harness local talent and organisations that are already responding to needs in society.

5) Investigate existing **knowledge sharing and learning mechanisms for cities to network and share** plans, achievements and lessons and understand the roles that they can play. Innovation in South Africa needs to shift from a siloed approach to an environment of collaboration and engagement. Initiatives such as SCODA, Open Data South Africa, InTact, VulekaMali, and CTIN can be leveraged to encourage openness and create platforms for cities to share, thus informing the national smart city agenda from within municipalities.

6) While international standards exist for measuring cities (such as ISO, ITU), they do not always speak to national priorities. It would be useful to develop a **flexible set of national indicators for smart cities** that is locally relevant while aligning with international standards

7) The stages of development suggested for cities could be developed into a **smart city maturity model** to guide and measure progress by cities towards being smarter

END

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