

A SOUTH AFRICAN SMART CITIES FRAMEWORK

A decision-making framework to guide the development of smart cities in South Africa



cooperative governance

Department:
Cooperative Governance
REPUBLIC OF SOUTH AFRICA

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Preamble

The world is becoming more and more urbanised, and across the globe people are moving to cities in large numbers. If cities are to overcome the challenges that accompany rapid urbanisation, rural-urban migration, climate change and general resource constraints, they have to become centres of innovation and creativity. Responding to challenges such as congestion, rising crime, growing urban poverty and the need for more efficient service delivery practices, an increasing number of cities have made the choice to use smart technologies and encourage innovative practices as part of their efforts to become more resilient and liveable.

In his State of the Nation Address (SONA) in June 2019, the President of South Africa, Mr. Cyril Ramaphosa, expressed his dream of building a South African smart city. In the February 2020 SONA, the President announced more concrete plans to develop a smart city in the country. These statements provoked discussion around the notion of Smart Cities within the South African context.

A “smart city” could be described as a settlement where investments in human and social capital as well as traditional and modern communication infrastructure fuel sustainable economic development, a better quality of life and prudent management of natural resources.

The Department of Cooperative Governance (DCoG) provides leadership in the development of cities and towns in South Africa. The department drafted this Smart Cities Framework (SCF) to support all those involved in the planning and implementation of smart city initiatives with impartial, factual information about smart cities in South Africa. The SCF supports DCoG in its efforts to guide and coordinate smart city initiatives implemented at municipal level throughout the country.

The SCF shares learning on the potential contribution of smart cities as well as the perceived limitations of these types of interventions. It further emphasises the critical characteristics of South African cities and towns that need to be considered when planning and implementing smart city initiatives. The unique South African context calls for local and tailor-made interventions to develop settlements that are not only smart but also inclusive. Any smart city initiative should contribute to the well-being of ordinary city dwellers and support the broad national vision for human settlements outlined in, among others, the National Development Plan (NDP) and the Integrated Urban Development Framework (IUDF).

The SCF further assists in establishing a common understanding of smart cities in the South African context and outlines a set of principles to guide decision-making for smart cities. The document concludes with highlighting critical issues to consider and outlining initial steps to be taken when identifying, planning and implementing smart city initiatives.

The three spheres of government are continuously looking for ways to improve service delivery, effectiveness and efficiency and to create a better future for all. People-focused smart cities could potentially become inclusive centres of innovation, creativity and prosperity.

Abbreviations

4IR	Fourth Industrial Revolution
AGSA	Auditor-General of South Africa
AI	Artificial Intelligence
CBO	Community-Based Organisation
CCTV	Closed Circuit Television
DCoG	Department of Cooperative Governance
CPTED	Crime Prevention through Environmental Design
CSIR	Council for Scientific and Industrial Research
DDM	District Development Model
DTPS	Department of Telecommunications and Postal Services
ICT	Information and Communication Technologies
IDP	Integrated Development Plan
IoT	Internet of Things
ISO	International Standards Organization
IUDF	Integrated Urban Development Framework
NDP	National Development Plan
NGO	Non-Governmental Organisation
SACN	South African Cities Network
SALGA	South African Local Government Association
SCF	Smart Cities Framework
SDG	Sustainable Development Goal
SONA	State of the Nation Address
UNDP	United Nations Development Programme
UNU-WIDER	United Nations University World Institute for Development Economics Research

A South African Smart Cities Framework

A decision-making framework to guide the development of smart cities in South Africa

1 Introduction

1.1 Purpose of the Smart Cities Framework

South African cities and towns are increasingly pressured to become smarter. However, the lack of a common understanding of the concept makes it difficult for some to identify appropriate interventions. Uncertainties regarding the benefits and pitfalls related to smart cities also hamper progress in implementing smart city initiatives. Furthermore, there are many misunderstandings regarding the interpretation of smart cities that is appropriate to the South African context.

This South African Smart Cities Framework (SCF) was developed by the Department of Cooperative Governance (DCoG) to provide municipalities, national and provincial government, the private sector, civil society and other role players with impartial, factual information about smart cities in South Africa. The SCF supports DCoG in its efforts to guide and coordinate smart city initiatives planned and implemented throughout the country.

The purpose of the SCF is to guide decision-making and provide all role players with a structured approach to identifying, planning and implementing smart city initiatives that are appropriate to the local context.

Because smart cities must be informed by, and respond to, local conditions, the SCF does not contain instructions or specifications. For the same reason, the framework does not prescribe minimum standards or requirements for smart cities, initiatives or technologies. The framework rather guides and informs decision-making to ensure smart city initiatives are appropriate to the particular context.

The objectives of the SCF include the following:

- To share local and international learning to provide all role players with factual information on the benefits and advantages as well as the challenges and disadvantages that need to be taken into account when planning and implementing smart city initiatives.
- To highlight the South African realities that need to be considered when planning and implementing smart city initiatives to ensure that such initiatives are appropriate to the local context.
- To assist in developing a common understanding of the concept of a smart city and propose a South African interpretation of various aspects related to smart city initiatives.
- To outline a set of principles to provide guidance when decisions have to be made regarding the identification, planning and implementation of smart initiatives and technologies.
- To outline the factors to consider, and the steps to be taken, when identifying, planning and implementing smart city initiatives.

1.2 How to use this framework

The SCF guides role players through a decision-making process that would ultimately result in the identification of smart initiatives and technologies that are appropriate to the local context and contribute to the development of an inclusive smart city. The framework includes six guiding principles to create inclusive smart cities as outlined in **Section 4**. When identifying, planning and implementing a smart city initiative, these six principles should direct and inform decisions. In addition, the perceived benefits and limitations of smart cities (**Section 2**) and the macro context (**Section 3**) should be carefully considered. Local (cross-cutting) factors that also need to inform decisions are described in **Section 5**. In **Section 6**, the steps to be taken to initiate a smart city initiative are summarised, specifically focussing on assessing a city's smart-readiness.

The principle-based nature of this framework means that it could be applied in cities and towns in urban as well as rural settings (see **Section 2.2**). The structure of the framework allows users to follow a coherent logic and it guides them in the process of making decisions regardless of the context.

2 Background

2.1 Smart city origins

The concept of smart cities originated in the early 1990s with cities starting to label themselves as "smart" upon introducing Information and Communication Technology (ICT) infrastructure, embracing e-governance and attempting to attract high-tech industries to encourage economic growth. The origins of the smart city concept have been linked to North American "smart growth" theories of the 1990s – a community-driven reaction to address traffic congestion, air pollution, etc. through improved development practices¹. A link has also been established between the uptake of smart cities and the ratification of the Kyoto Protocol in 2005², which was a global commitment by world leaders to limit and reduce greenhouse gas emissions in accordance with agreed targets.

The World Forum on Smart Cities estimated in 1997 that within a decade approximately 50 000 cities around the world would be launching smart city initiatives³. Well-known and celebrated examples from the first two decades of the century include Barcelona, Amsterdam, Chicago, Seoul, Vienna, Shanghai, Shenzhen, Birmingham, Copenhagen, Bangalore and Hong Kong. However, some concerns were raised about the broad uptake of the smart cities concept. For instance, Hollands⁴ accused the movement around smart cities of "definitional impreciseness", having "numerous unspoken assumptions" and being "self-congratulatory". The global conversation on smart cities changed somewhat around 2005 with the large-scale entrance of major IT companies into the field⁵. Government, and specifically municipalities, were identified in the early 2000s as an untapped market for companies selling so-called "urban technologies"⁶. Large multi-national companies launched campaigns, published guidance documentsⁱ and formed councils and coalitionsⁱⁱ to drive the smart city agenda, often in support of their market expansion strategies.

In recent years, many literature reviews were conducted on smart cities. Key themes which emerged explored smart cities as cities using smart technologies (a technological focus), smart cities as cities with smart people (a human resource focus) and smart cities as cities with smart collaboration (a governance focus)⁷. Further research identified three dominant discourses, namely one focusing on infrastructure-based services, particularly using ICTs; the second discourse concerning business-led urban development – focusing on creating conditions conducive to business development; and a

ⁱ For instance, since launching their mission to create smarter cities in 2009, IBM's Institute for Business Value published a range of documents to provide "strategic insights for senior executives". Cisco is another multinational that published, among others, a range of "white papers" on issues related to smart cities.

ⁱⁱ For instance, the Smart Cities Council is an industry coalition formed to accelerate the move to smart, sustainable cities. So-called global lead partners include AT&T, Microsoft, Cisco, and Dow. In June 2019 the World Economic Forum launched the G20 Global Smart Cities Alliance which promises to unite municipal, regional and national governments, private-sector partners and cities' residents around a shared set of principles for the responsible and ethical use of smart city technologies.

third discourse where social inclusion, learning and development are central to better meeting community needs⁸.

While the uptake of smart cities in the Global South has been steady, with countries such as Brazil, India, Rwanda and South Korea launching national initiatives, the literature and research on smart cities have been dominated by Global North examples and initiatives. Research in the Global South has only recently turned to the theme of smart cities⁹.

2.2 Defining smart cities

A wide range of definitions of the term “smart city” has been developed by various people and organisations. However, there does not seem to be a universally accepted definition or a common understanding of the concept of a smart city. While early definitions of smart cities tended to emphasise the technologies to be used, there seems to be a growing realisation that “smart” technologies should not be prioritised at the expense of issues such as social inclusion and sustainability. Recent definitions of smart cities tend to highlight the need for smart cities to improve people's quality of life. Examples of some international definitions are presented below.

The United Nations specialised agency for information and communication technologies (ITU) analysed nearly 100 definitions of smart cities to develop the following 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.

The British Standards Institute (BSI) defines smart cities as follows:

The effective integration of physical, digital and human systems in the built environment to deliver a sustainable, prosperous and inclusive future for its citizens¹⁰.

The Smart Cities Strategic Advisory Group of the International Standards Organization (ISO) formulated the following definition of a smart city:

A “smart city” is one that increases the pace at which it improves social, economic and environmental sustainability outcomes, responding to challenges such as climate change, rapid population growth and political and economic instability by improving how it engages with society, how it applies collaborative leadership methods, how it works across disciplines and city systems, and how it uses data, information and modern technologies in order to provide better services and quality of life to those in, and involved with, the city, now and for the foreseeable future, without unfair disadvantage to others or degradation of the natural environment.

Various descriptions have been used as alternatives to the term “smart cities”, for instance “digital cities”, “intelligent cities”, “future cities”, “smart communities” and “intelligent communities”. There is not always a clear distinction between the different terms as they often share certain assumptions and, in some cases, are conflated¹¹. The terms are sometimes used interchangeably, and this could lead to confusion. The term “smart city” has become significantly more popular than the other alternative terms¹². To avoid unnecessary debates about terminology and semantics, the term “smart cities” will be used in this SCF, with the understanding that it could be interpreted in a variety of (often complementary) ways.

There is a distinct lack of understanding of the meaning of both components of the term “smart city”. The idea of “smart” can be interpreted in many ways, while the use of the word “city” is often seen to exclude other types of settlements such as towns and villages. However, based on international literature, it is clear that both terms should not be defined in a narrow sense. For the purposes of this SCF, they should be interpreted fairly broadly in the spirit of inclusivity.

Inclusive interpretations of the terms “smart” and “city”

Smart

The term “smart” is generally associated with a range of technological and digital concepts and interventions, especially ICT. There also seems to be a particular focus on 4IR (Fourth Industrial Revolution) technologies.

However, in addition to this technology-intensive interpretation, smart could also mean “intelligent”, or “knowledge-intensive”. The understanding of the term “technology” could be expanded to also include innovative approaches, techniques and processes, as well as non-conventional interventions and scientific innovation.

City

The word “city” has multiple meanings in the smart city conversation. It is a catch-all phrase that includes various types of settlements, or parts of settlements. It could refer to any of the following:

- Cities, towns and villages of any size, including those in rural locations.
- Municipalities (metropolitan, district, local).
- A custom-built greenfield development (“city”) which may or may not be linked to an existing city.
- Large new precinct developments linked to an existing city (e.g. business parks).
- Upgrading or retrofitting aspects (e.g. transportation or connectivity) or parts (e.g. an educational precinct) of an existing city or town.
- New residential, commercial or mixed-use developments, such as privately developed gated communities.

2.3 Smart city promises and opportunities

The benefits of smart cities are extensively promoted on the websites of smart city vendors and smart cities coalitions and councils. It is useful to have a broad understanding of the opportunities that can be created by an integrated, digitally-enabled and data-driven city. Although a smart city can mean different things to different cities, the concept is ultimately based on the promise of addressing some of the most critical issues that cities have to deal with, including climate change, urbanisation, citizen engagement and resource efficiency¹³. The potential ways in which smart cities could create and spread public value are described below.

- **More effective, data-driven decision-making**

Smart cities promise to change the way cities are planned and managed. Continuous reflection in the short term could potentially enable cities to become smarter over the long term¹⁴. The Internet of Things (IoT), in particular, enables real-time, uninterrupted communication between humans and objects (both static and mobile). This allows municipal officials to comprehensively manage and monitor critical assets. The workings of existing infrastructure can be optimised by using sensors that monitor the functioning of the infrastructure and feed real-time data into a central system. This constant stream of high-quality and relevant information on the operations and condition of, for example, a water and wastewater system can potentially improve the management of the entire system, especially by more focused maintenance and planning practices. Maintenance can be planned because failures can be predicted and technical problems could be addressed in time through early detection. Planning for extensions and new infrastructure can also be improved, as a better understanding of resource flows and consumption can assist with anticipating future needs.

- **Reduced environmental footprint/impact**

The environmental challenges associated with climate change and rapid urbanisation are well-known: carbon emissions resulting from traffic congestion, limited and vulnerable water resources, threats of extreme weather events and escalating solid waste. Smart cities promise to address these challenges at various scales. For instance, improved planning and improved analytics could result in consumption reduction and more efficient resource management. Smart city efficiency can also support the implementation of alternative approaches to infrastructure design and management. A better understanding of water flows and consumption can, for instance, inform and support the implementation of Water Sensitive Urban Design initiatives and Sustainable Urban Drainage Systems. Furthermore, through information-sharing and awareness raising, data created by the system can be utilised to engage residents and encourage more ecologically friendly behaviours.

- **New economic development opportunities**

Another proposed benefit of smart cities is that they tend to attract more businesses, thereby boosting city economies and reducing unemployment. Techno parks and start-up hubs are popular manifestations of the smart city idea, but the attractiveness of smart cities is not limited to high-tech businesses. Ordinary businesses may be attracted to cities with well-functioning smarter infrastructure because it lowers their operating costs, thereby improving their profit margins and opportunities for growth. Smart buildings, for example, may save businesses costs on electricity for cooling and lighting. Smart interventions may also have positive economic impacts through innovative practices such as energy-efficient or water-efficient practices or by means of industrial symbiosis – finding ways to use the waste from one company as raw material for another.

- **Improved quality of life**

Smart cities can impact on people's quality of life when, for instance, commuters spend less time sitting in traffic, when emergency-response times are cut or when residents have 24/7 access to potable water. Some smart city technologies directly improve citizens' convenience. For instance, digitised government services make transacting far easier and allow citizens to report incidents and issues in their local area to the municipality through smartphones and other devices. Initiatives such as public Wi-Fi, street furniture with charging points and queue management systems have a direct positive impact on people's quality of life.

- **Safer communities**

Smart city technologies that are often promoted to curb criminal behaviour include Closed Circuit Television (CCTV) cameras, face and license plate recognition and various forms of access control. In addition to crime prevention and detection, community safety can also be improved by smart systems that assist with mitigating risks and reducing damages in case of a disaster. Early hazard detection is central to this approach. Rainfall can, for instance, be monitored and flooding can be predicted with a higher level of accuracy. Smart city technologies can also be used to install automated flood control measures.

- **Enhanced engagement between municipalities and residents**

Through collaboration tools, modern and intuitive websites, mobile applications, self-service portals and online accounts, smart cities improve the communication between municipalities and residents. Residents become a source of information (e.g. through accident reporting) to the municipality and at the same time residents are empowered with gaining access to municipal data, interactive maps and government performance dashboards. Residents can then also make informed decisions regarding their own consumption of resources and the trade-offs that are available to them. The continual interaction between the physical and digital worlds

enables the decision-making processes to be more open and inclusive, so that citizens, policy makers and businesses can work together effectively to manage the life of the city for the benefit of all.

- **Cost savings**

Although there are initial investment costs associated with smart cities, long-term cost saving is one of the prime "selling points" of smart cities. The city could be automated to enable appropriate city functions to be delivered reliably and effectively without the need for direct human intervention. With Artificial Intelligence (AI) and IoT technologies automating certain functions, water and electricity service delivery could become more efficient, particularly concerning energy-usage and resource-management, thereby saving time and money. Through eliminating redundancies, finding ways to save money and streamlining workers' responsibilities, municipalities can provide higher-quality services at lower costs, while targeting the specific needs of individual groups. Mitigating risks and reducing damages in case of a disaster is another way in which a smart city can cut down expenses, as well as increase safety. For South African cities one of the most important possibilities of cost saving would be through leapfrogging traditional trajectories of technological advancement. Boyle¹⁵ explains that South African cities can possibly "...invest in cutting-edge telecommunications and bypass investments in older technologies." Bypassing investment in obsolete technology such as landlines mean that resources can be allocated to more recent and appropriate technology.

2.4 Smart city concerns and limitations

Plans for more digitised, networked and connected urban areas face challenges if they fail to account for existing, local, and mostly non-digital elements such as governance, socio-economic conditions, politics and finances. Researchers studying the phenomenon of smart cities have raised several concerns. Issues that have been raised are briefly described below.

- **Interventions are not appropriate to the context**

While smart city initiatives may share many commonalities, the settings where these ideas are to be implemented more often than not differ considerably. Many of the assumptions about smart cities seem to be based on Global North perspectives on what cities consist of. In the cities of the South, the existence of, for instance, municipal engineering infrastructure should not be taken for granted. The functioning of existing systems may also differ from cities in other regions. Engineering infrastructure in cities of the South is often only provided to formal parts of the city. Bakker¹⁶ explains the pitfalls of making certain assumptions about cities of the South by presenting the following example: "The term 'network' and the interconnectedness it evokes is a poor descriptor of water supply systems in many cities. Rather, the metaphor of the archipelago - spatially separated but linked 'islands' of networked supply in the urban fabric - is more accurate than the term 'network'." In addition, the most basic infrastructure is often lacking, or existing infrastructure has not been maintained for many years, make use of outdated technologies and may even be beyond repair. The functioning of the existing infrastructure may be severely slowed or may have become hazardous due to multiple illegal connections.

In addition, cities are places with complex organisational and investment arrangements where politics are often volatile. Concerns are raised that smart city ideas are implemented without due consideration of local contexts and priorities. The city is not a blank canvas where sophisticated and expensive technologies can simply be overlain¹⁷. The smart city presented on websites is often "deeply decontextualised and strangely 'placeless'"¹⁸. Although the smart city rhetoric is one of resource efficiency and inclusion, the images generally do not portray, for instance, mixed-income neighbourhoods, social housing or informal markets and networks. According to Aurigi and Odendaal¹⁹ "the smart city is too often framed as a general construct responding to generalized challenges and conditions – and often offering generalized products as 'solutions' to these." If a smart city innovation has been applied and piloted in one city, it does

not necessarily mean that it can be rolled out universally. The challenges that cities face, and will continue to face in the future, are complex and diverse. These challenges are also very context-specific since no two cities are the same.

- **Vested corporate interests**

With smart city initiatives comes a significant amount of decision-making related to questions like: What will be done? Who will be doing it? When will it be done? Who will pay for it? Who will cover upfront costs and who will pay for continued operations? The answers to these questions are not straight-forward and decisions can have serious and long-term implications. Although the importance of the private and public sector as partners in smart city development cannot be over-emphasised, certain challenges should be highlighted. The impact that vested corporate interests have had on the global smart city dialogue has been discussed extensively²⁰. The global market for smart city solutions and services are growing. Being a lucrative industry, the competition among large multi-national Information Technology (IT) companies have been fierce and concerns have been raised that these companies are positioning themselves to create skewed financial dependencies. These companies are also sometimes allowed (maybe unwittingly) to set agendas in the urban debate and to influence urban experiments, leaving little room for ordinary people to participate in the smart city²¹. The challenges associated with vested interests are already evident when cities or projects are labelled as "smart". The label is, for instance, used to describe a number of cities in the Global North and it is used for high-end property developments in Africa. "This labelling is problematic and is often misused, thus it is important to interrogate claims and labels of 'smartness' as they are often appropriated to serve other agendas"²².

- **Technology as a starting point and not an enabler**

Smart cities promote the potential of technology to address urban challenges. Governments have been accused²³ of being more focused on the smart city technologies of the future than on present development challenges. In addition, the role of technology is sometimes emphasised at the expense of other essential elements in the drive to address complex urban challenges. Although technology is a core aspect of a smart city, technology alone is not enough to create and spread public value for residents²⁴. Changing behaviour - the way we live, work and play - will be critical for cities if they are to become smart. By applying the smart city as a "technological fix" or a "technical solution to political and environmental issues"²⁵ the digital divide that exists in many cities of the Global South may even be widened (also see **Section 4.2.2**). This excessive emphasis on the latest technology may have additional unintended consequences. Boyle²⁶ warns that although there are evident benefits of bypassing older technologies, cities may unwittingly limit their ability to build their own technological capabilities. While the leapfrogging of technologies may be useful and save costs over the short term, the leapfrogging of skills is far more complex and the latest technology as a starting point may yet again widen the digital divide. Another unintended consequence of the use of technology (including 4IR technologies) could be job losses, particularly amongst those who earn the lowest wages and are the least able to be reskilled.

- **Understanding and defining a city**

Although smart cities will be digitally-enabled and data-driven, they remain cities. Proposing smart solutions for urban problems, smart city literature has to make sense of what the city is. Smart city approaches often tend to frame all urban questions as essentially engineering problems, with the accompanying solving through empirical, often quantitative, methods²⁷. Urban management seems to be portrayed as a technocratic function that can be addressed simply through better data and appropriate software to analyse the data. The reason for this over-simplification of urban problems may have its origins in the definitions that are provided for the "city" in smart cities. For instance, IBM's smart cities approach rests on two main assumptions. First, the city is based on three main pillars: planning and management services; infrastructure

services; and human services. Each of these pillars is sub-divided into three sub-pillars: "Planning and management services" into public safety, smarter buildings and urban planning, government and agency administration; "Infrastructure services" into energy and water, environment and transportation; "Human services" into social programmes, health care and education. The sum of these nine pillars makes "the city". This systems approach to cities is not new to urban planning and may be useful in designing the "architecture" of a smart cities system, but these systems may not fully grasp the complexity of even small cities and towns.

- **Ethical concerns**

The mass proliferation of connected devices, systems and services in the smart city inevitably raises ethical questions. Top of mind is the erosion of privacy through continuous mass surveillance, but there are other issues as well, including procurement of expensive smart city systems - who decides which technologies are selected? Systems that are automated and are dependent on algorithms often lack transparency and may complicate oversight and ownership. Smart city narratives often tell of places where people will thrive. However, without efforts to implement projects in inclusive ways, existing institutionalised privileges and protections can be reinforced. Furthermore, smart cities run the risk of relying only on data collected from tech-savvy users and this could lead to the exclusion of certain groups. The system itself may also treat groups differently or exclude some as a result of automated decisions based on predictive profiling.

3 The South African context

3.1 Does South Africa need smart cities?

In view of the country's seemingly overwhelming socio-economic challenges (unemployment, poverty, inequality, crime, violence etc.), the question could be asked whether the development of smart cities should be a priority for South Africa. Given limited financial resources, some could argue that the provision of basic services such as water, sanitation, electricity, waste removal, health-care and housing are more important than smart interventions that may not address the most critical needs of many communities. Furthermore, the country is facing overwhelming challenges related to the provision of electricity, and a reliable supply of power is a critical prerequisite for the successful implementation of smart city initiatives.

Therefore, to make a meaningful contribution to improving the quality of life of all citizens, smart initiatives and interventions should address the key problems faced by South African cities and towns. Smart cities need to respond appropriately to local challenges rather than being based on generic models that may not be suitable to South African conditions.

In the next section, some of the South African realities are briefly outlined to provide the context within which smart cities have to be developed. In response, a South African interpretation of the concept of a smart city is provided in **Section 4**.

3.2 Socio-economic characteristics of South African society

Three critical socio-economic characteristics that need to be taken into consideration when making decisions about smart city interventions, are briefly discussed below. The so-called triple threat of poverty, inequality and unemployment has a far-reaching impact on the prospects of South African society as these issues affect (and are affected by) the way in which basic infrastructure, healthcare and education services are delivered.

- **Poverty**

The challenges created by the extreme levels of poverty in South Africa could not be underestimated. More than 30 million people (56% of the population) live below the upper bound poverty line (less than R1 268/month). Approximately one quarter of South Africa's population (almost 14 million people) live below the food poverty line (less than R585/month)²⁸. In a working paper prepared for the United Nations University World Institute for Development Economics Research (UNU-WIDER)²⁹, the distinction between the chronic poor and the transient poor and vulnerable, rather than between the poor and non-poor, is highlighted. The chronic poor are trapped in poverty, while the transient poor and vulnerable are more likely to experience poverty as a temporary state. While social grants play a key role in the survival of the chronic poor, they do not address the structural barriers to upward mobility. In the UNU-WIDER paper it is also stated that a large share of the population remains locked in persistent poverty with very low chances of being fruitfully integrated into the labour market. Furthermore, social grants will remain an indispensable source of income for many of the chronic poor. Certain technologies may not appropriately address the priority needs of the poor, particularly the chronic poor, due to the additional financial burden they may place on them.

- **Inequality**

South Africa is often portrayed as the most economically unequal society in the world. Usually such statements are based on the Gini coefficient or indexⁱⁱⁱ, developed by the World Bank. It should be noted that the Gini coefficient has numerous limitations, for instance, it does not nearly include all the countries in the world, it is not completely comparable across all countries, and it does not incorporate all information about inequality³⁰. Despite these shortcomings, the Gini coefficient does provide some indication of relative economic inequality. Recent research indicates that one of the main reasons for the high level of inequality in South Africa is that top income earners have thrived, while everyone else has not³¹. Between 2003 and 2015/2016, the real incomes of SA's top 1% of income earners almost doubled. By contrast, the incomes of 95% of the population stagnated, or for those at the bottom showed only slight growth, in their case mainly because of social grants. Nearly 60% of the population earned no taxable income at all during this period. This means that the wealthiest South Africans are doing well, while the middle class and the poor are struggling more and more. According to Prof Murray Leibbrandt, of the Southern Africa Labour and Development Research Unit (Saldru) at the University of Cape Town, "such high levels of inequality threaten the social fabric, increase the risks of political and economic upheaval and prevent the majority from living up to their full potential. All of these are likely to harm the country's long-term developmental prospects."³²

- **Unemployment**

The unemployment rate for the third quarter of 2020 was 30.8%. This means that 6.5 million people were unemployed, while almost 14.7 million were employed. For the same period, the expanded unemployment rate, which includes people who have stopped looking for work, is 43.1%³³. Of particular concern is the youth unemployment rate of 58.2%. More than 60% of all young unemployed South Africans have never worked before³⁴. Furthermore, more than 13% of South Africans have not been employed at all over the past ten years, and a significant portion of the unemployed are practically unemployable³⁵. These unemployment figures underline the immense challenges the country is facing with respect to job creation. Against this backdrop, it could be argued that smart cities, ICT and other technologies (including 4IR technologies) may not create job opportunities for a large proportion of the unemployed population. Reasons include the lack of appropriate knowledge and experience, and skills gaps that render upskilling of many a major challenge. The 4IR may very well provide new employment opportunities and

ⁱⁱⁱ The Gini coefficient attempts to measure income inequality. In essence, it can range from 0 to 1, where 0 reflects an equal distribution of income (where everyone has the same income) and 1 reflects absolute inequality (where one person has all the income and no-one else has anything)

create jobs that do not even exist at the moment, but it may also result in the destruction of certain job types and could add to the numbers regarded as unemployable.

3.3 The nature of South African cities and towns

Many parts of South African cities and towns – particularly those developed specifically for poor communities – are still characterised by a lack of adequate infrastructure, facilities and amenities, low levels of service delivery and few or undesirable public spaces. These areas are often located on the periphery of cities and towns, and therefore residents generally have to travel long distances to and from their places of employment, shops and social, recreational, healthcare or other facilities. This negatively affects the quality of life of those living in these areas and has significant personal financial implications. It also results in the inefficient utilisation of resources.

“Although the Apartheid urban planning system began to crumble in the late 1980s with urbanisation and economic pressures and resistance, its legacy is still evident today. South Africa’s urban areas, after 22 years of democracy, are still characterised by spatial inequality: jobs and economic activity are generally concentrated around ‘urban cores’, a disproportionately white elite residing in well-located city cores, with proximity to economic activity and social amenities and a disproportionate black South African population living on the urban peripheries in dense and poorly serviced settlements, far from economic opportunities.”

- High Level Panel on the Assessment of Key Legislation and the Acceleration of Fundamental Change, 2017³⁶

South African human settlements are inextricably linked to the country's socio-economic context. This means that poverty, unemployment, inequality, crime and violence and other challenges have an impact on the sustainability of cities and towns. Digital access of urban residents also tends to follow current patterns of spatial fragmentation (informed by both public and private investment patterns), reinforcing social and economic inequalities³⁷.

Informality as it relates to settlement form, housing structures, the way income is generated and how people live in and interact with cities and towns is a worldwide phenomenon that is becoming more and more prevalent in the Global South. Informality is often associated with illegitimate behaviour and with marginalised people and communities, but arguments have been made for it to be acknowledged and accommodated in the planning and design of cities. Informal settlements are a common feature of most South African towns and cities. In many cases they provide new migrants and the urban poor an affordable point of access into towns and cities. However, they are also associated with high degrees of physical and social vulnerability, which add to the challenges faced by residents and authorities. The upgrading of these settlements is often a contentious and challenging issue.

In some cases, the country's urban landscape has been influenced by the prevalence of crime. The unacceptably high levels of violent crime, as well as the fear of crime, have contributed to the implementation of built environment interventions to address these concerns. Middle- to high-income neighbourhoods in particular are often characterised by high fences and walls, often supplemented by electric fences. In addition, public access to some neighbourhoods is restricted by means of street closures and access control mechanisms. Various other forms of privately developed gated communities are becoming increasingly popular, varying in size from small townhouse complexes to expansive lifestyle or security estates. In some cases, these developments have a substantial impact on the structure and functioning of cities and towns, and it could be argued that they do not support current planning policies and strategies aimed at promoting integration.

3.4 Municipal realities

A substantial number of municipalities can be regarded as dysfunctional or distressed. Reasons for this could include management, political instability or interference, corruption and incompetence. The Auditor-General of South Africa (AGSA) has also highlighted severe shortcomings. During the 2018/19 financial year, only 20 out of 257 municipalities produced financial statements and performance reports of acceptable quality, and complied with all key legislation, thereby receiving a clean audit³⁸.

Various challenges exist with respect to municipal engineering infrastructure. In the 2017 SAICE scorecard, public infrastructure received an overall grade of D+³⁹.

3.5 The regulatory environment

The Smart Cities Framework should be considered against the background of a range of acts, policies, frameworks and strategies that impact on human settlements in South Africa.

3.5.1 International imperatives

International goals and agendas inform the actions taken to improve South African human settlements. Three critical documents are presented below.

Since 2015, member states of the United Nations have been expected to frame their agendas and political policies for a period of 15 years according to *Transforming our World: the 2030 Agenda for Sustainable Development*. Commonly referred to as the 17 Sustainable Development Goals (SDG), it is a “plan of action for people, planet and prosperity.” Many of the goals are relevant to human settlements, but SDG 11 deals specifically with sustainable cities and communities: “Make cities and human settlements inclusive, safe, resilient and sustainable.”

At the United Nations Conference on Housing and Sustainable Urban Development (Habitat III) held in Quito, Ecuador, in October 2016, a document known as the *New Urban Agenda* was adopted. The purpose of this agenda is to guide national and local policies on the growth and development of cities up to 2036. It shares “...a vision of cities for all, referring to the equal use and enjoyment of cities and human settlements, seeking to promote inclusivity and ensure that all inhabitants, of present and future generations, without discrimination of any kind, are able to inhabit and produce just, safe, healthy, accessible, affordable, resilient and sustainable cities and human settlements to foster prosperity and quality of life for all.”

From an African perspective, a strategic framework for the socio-economic transformation of the continent was developed by the African Union Commission. *Agenda 2063 – The Africa we want* outlines a number of aspirations. It includes an Africa where “[c]ities and other settlements are hubs of cultural and economic activities, with modernized infrastructure, and people have access to affordable and decent housing including housing finance together with all the basic necessities of life such as, water, sanitation, energy, public transport and ICT”.⁴⁰

3.5.2 National policies and initiatives

There are a host of national acts (e.g. the Municipal Systems Act, the Housing Act, the Spatial Planning and Land Use Management Act), policies (e.g. Breaking New Ground, the Housing Code) and frameworks/plans (e.g. the National Spatial Development Framework) that impact on human settlement planning and by implication on their transformation into smart cities and towns.

It is clear that any smart city intervention in a municipality should be incorporated into the Integrated Development Plan (IDP) process, as the IDP remains the overall framework for development at a local level. In addition, such interventions should also be guided by, or support

the intentions of, the *National Development Plan 2030 (NDP)*, the *Integrated Urban Development Framework (IUDF)* and the *District Development Model (DDM)*. The IUDF and the DDM, in particular, reflect a cross-government concern with improving the effectiveness of the management of cities and towns⁴¹.

- **The National Development Plan**

The *National Development Plan 2030 (NDP)* provides a long-term vision for the country and defines a desired destination, specifically aiming to eliminate poverty and reduce inequality by 2030. In Chapter 8 it explicitly addresses the transformation of human settlements and the national space economy. The NDP foresees that planning will be "...guided by a set of normative principles to create spaces that are liveable, equitable, sustainable, resilient and efficient, and support economic opportunities and social cohesion"⁴². It also expects there to be meaningful and measurable progress in creating functionally integrated, balanced and vibrant urban settlements by 2030⁴³. Although the NDP does not specifically promote the concept of smart cities, the plan identifies ICT as a critical enabler of economic activity and envisage an amplified role for ICT.

"By 2030, ICT will underpin the development of a dynamic and connected information society and a vibrant knowledge economy that is inclusive and prosperous. A seamless information infrastructure will be universally accessible and will meet the needs of citizens, business and the public sector." "This ecosystem of digital networks, services, applications, content and devices, firmly integrated in the economic and social fabric, will connect public administration and active citizens; promote economic growth, development and competitiveness; drive the creation of decent work; underpin nation building and strengthen social cohesion; and support local, national and regional integration."

- National Development Plan, 2012, page 190

- **The Integrated Urban Development Framework**

The *Integrated Urban Development Framework (IUDF)* is the South African government's policy framework that guides the future growth and management of urban areas. Its purpose is to steer urban growth towards a sustainable growth model of compact, connected and coordinated cities and towns so as to achieve the intended outcome of spatial transformation. The IUDF aims to create a shared understanding across government and society regarding the creation of inclusive, resilient, resource-efficient and liveable urban settlements, given the unique conditions and challenges facing South Africa's cities and towns. It is crucial that all smart city initiatives are not only aligned to the aim and goals of the IUDF, but that these initiatives are incorporated into the integrated urban planning of all municipalities. The SCF complements the IUDF, and therefore smart city initiatives that are guided by the SCF directly contribute to achieving the IUDF goals of spatial integration, inclusion, access, growth and governance.

The urban growth and management model⁴⁴ of the IUDF focuses on achieving compact urban growth, providing connected infrastructure and coordinating governance and investments in cities and towns. It argues that "innovative urban infrastructure and technology can enable the economic benefits of more compact urban forms to be captured". While all nine IUDF policy levers could be supported by smart city initiatives, ICT as a supporting technology is highlighted specifically in at least three of levers:

- Policy Lever 2: Integrated Transport and Mobility flags the investment in ICT as important to strengthen and integrate public transport modes⁴⁵.

- Policy Lever 4: Integrated Urban Infrastructure, identifies an intervention to invest in ICT infrastructure and literacy⁴⁶: “Successful ICT investments should result in effective governance systems, the availability of infrastructure and technical platforms, and the bridging of digital divides”. The IUDF further promotes better access to ICT infrastructure (e.g. through fast broadband and mobile coverage) as a means to improve rural-urban linkages⁴⁷.
- Policy Lever 8: Effective Urban Governance calls for the strengthening of communication and use of technology. “Government, and local government in particular, needs to make greater use of technology to inform, empower and include citizens in its activities.”⁴⁸

- **The District Development Model**

The *District Development Model* (DDM) was adopted by government in 2019 and is an operational model for improving the coherence and impact of government service delivery and economic development. Aligned to the NDP and the IUDF, the model aims to facilitate collaborative planning among the three spheres of government and state entities to work in unison and in an impact-oriented way. According to the Minister of Cooperative Governance and Traditional Affairs, Dr Nkosazana Dlamini-Zuma, “[t]he DDM seeks to strengthen the local sphere of governance, moving us away from silo planning, budgeting and implementation”⁴⁹. The 44 districts and 8 metropolitan municipal spaces have been identified as the impact areas of joint planning, budgeting and implementation.

Among others, the DDM will be implemented through a collaborative process to develop One Plans for all District and Metropolitan Municipalities which will be further synchronised with Integrated Development Plans (IDPs) of municipalities. Each district and metro plan will develop a long-term government agenda in these spaces and unpack at least the following developmental issues⁵⁰:

- Managing urbanisation, growth and development.
- Supporting local economic drivers.
- Accelerating land release and land development.
- Investing in infrastructure for integrated human settlement, economic activity and the provision of basic services.
- Addressing service delivery in municipalities.
- Mainstreaming disaster risk reduction and climate change adaptation within sustainable development.

The Smart Cities Framework is aligned with the principles of the DDM. A critical point of alignment is in building and nurturing partnerships. Partnerships are essential to the successful implementation of any smart city initiative. Partnerships are also central to the DDM: “The ‘one plan’, ‘one budget’ and ‘one space’ for each district or metropolitan space will serve as a fulcrum for drawing contributions from all government institutions, the private sector and civil society organisations in the implementation of developmental programmes”⁵¹. The DDM further aims to be a practical mechanism for enhancing cooperative governance⁵². This approach to be practical complements the SCF’s perspective that any smart city initiative should be initiated by first establishing an understanding of what is already available and happening in a municipality (see **Section 6**), before action is taken. Any smart city intervention should therefore be in line with the content of the One Plan that has been developed for the relevant district or metropolitan municipality.

3.5.3 Smart-specific policies, guidelines and initiatives

The International Organization for Standards (ISO) identified a need for standardisation after a significant increase in smart city activities across the globe. *ISO 37106:2018, Sustainable cities and communities – Guidance on establishing smart city operating models for sustainable communities* was published in August 2018, following a five-year process of research and

engagement with city leaders globally. The standard was finalised in the first quarter of 2020. This standard provides guidance on enabling processes for using technology and data with organisational change “to develop an open, collaborative, citizen-centric and digitally-enabled operating model” for a city for a sustainable future.

In addition to the ISO, there are a number of international bodies contributing to or formulating smart city standards, including the European Committee for Standardization (CEN), the European Committee for Electrotechnical Standardization (CENELEC), the British Standards Institute (BSI), the European Telecommunications Standards Institute (ETSI), the United Nations specialised agency for information and communication technologies (ITU) and the International Electrotechnical Commission (IEC)⁵³.

Locally, different national sector departments and other entities have engaged the topic of smart cities. The Department of Telecommunications and Postal Services (DTPS) published a *National Smart Communities Framework* in 2020. The DTPS framework aims to prepare municipalities to become data-driven for efficient and effective service delivery. The framework focuses on “data as a guiding principle and central element of smart cities development”⁵⁴, implying that having an overview of the data value chain in cities can facilitate a better understanding of “the digital world in ways that enable us to transform the physical space”. The framework envisions the breakdown of silos, finding “synergies between different domains and stakeholders, creating new opportunities and transforming data into value”⁵⁵.

Recent research on smart cities have also been conducted by, among others, the South African Cities Network (SACN), the Council for Scientific and Industrial Research (CSIR) and the South African Local Government Association (SALGA).

4 A South African interpretation of smart cities

4.1 The inclusive South African smart city

Informed by the aspects highlighted in the preceding sections, an interpretation of smart cities that are appropriate to the South African context is outlined in this section. At the core of this SCF is the belief that the South African understanding of a smart city should be based on the notion of inclusivity. In essence, this means that a smart city initiative should ultimately benefit all people and all communities in the city and improve the well-being of the entire city.

4.2 Guiding principles to create inclusive smart cities

For a smart South African city to be inclusive, it should adhere to six interdependent principles. These principles provide guidance when decisions have to be made regarding the identification, planning and implementation of smart initiatives and technologies.

Each principle is expressed in the form of an objective that should be achieved to enhance the inclusiveness of a smart city initiative. Decisions regarding the nature and purpose of a smart initiative or technology should be guided by the following principles:

- It should be smart for all.
- It should use technology as an enabler rather than a driver.
- It should be shaped by, and respond to, the local context.
- It should be informed by the real needs of the community.
- It should embrace innovation, partnerships and collaboration.
- It should be sustainable, resilient and safe.

In the following sections, practical guidance is provided on how those responsible for planning and implementing smart city initiatives should give effect to the principles. The factors to consider when making decisions are also highlighted.

4.2.1 An inclusive smart city is smart for all

An inclusive smart city should incorporate a portfolio of smart technologies and initiatives that would collectively contribute to improving the well-being of the city as a whole. Smart city initiatives should not be implemented at the expense of, or to the detriment of, certain parts of the city or certain sectors of society. This means that a smart city should ultimately benefit all those residing in the city, not only those with sufficient financial and other resources and enough of an understanding of technology to allow them to make use of smart initiatives. Those responsible for planning and implementing smart city initiatives should be innovative to ensure that smart initiatives are identified that are specifically aimed at underdeveloped areas and the more deprived sectors of society.

When planning and implementing smart initiatives that would benefit all, many factors need to be considered, including the following:

- Ensure that all sectors of society are able to share in the benefits of smart initiatives even if they have limited financial means. Poverty could exclude a substantial section of society from the advantages of a smart city if only those with adequate financial resources can make use of the smart technologies and initiatives available. For instance, if a service made available to people require them to have access to an electronic device with sufficient data, a significant proportion of a city may not be able to utilise the service due to financial constraints.
- Implement smart initiatives that are accessible even to those residents that may not be digitally literate. Do not assume that all people are “tech-savvy” digital citizens that have the knowledge and skills to effectively use digital technologies to communicate with others, participate in society and create and consume digital content⁵⁶. If a municipal service can only be accessed or provided via a smart technology (ICT), some sectors of society may be negatively affected and further disadvantaged or marginalised. For instance, if appointments to make use of a service can only be made online, those who may not be computer literate or do not have access to a computer or similar device will be unable to make use of the service.
- Incorporate the needs of marginalised sectors of society such as those living in informal settlements, backyard shacks and overcrowded accommodation in the city centre and other parts of the city when implementing smart technologies and initiatives. These living conditions could hamper access to the opportunities that a smart city is supposed to provide.
- Accommodate the requirements of people with disabilities. A smart technology or initiative should be accessible to the widest possible range of users including people with illnesses or disabilities (temporary or permanent) that affect aspects such as their mobility, balance, sight, hearing, touch, memory, strength, stamina, etc. Adhere as far as possible to the principles of universal design (see The Neighbourhood Planning and Design Guide⁵⁷ for more information).
- Identify smart initiatives that would not exclude members of society that may not have some of the personal assets, such as motor vehicles, required to share in all the benefits the city or town can offer. For instance, those who are dependent on public transport may not benefit from certain smart initiatives that require people who have access to a private vehicle to move around in the city. Similarly, without a safe, reliable, effective and efficient public transport system, a smart mobility initiative may not be successful. Without first addressing the

basic needs of commuters, smart technologies and initiatives may in some cases have a negative effect on their quality of life.

- Identify smart initiatives that would empower those involved in the informal economy. Informal traders and service providers make a significant contribution to the well-being of the city as a whole, and they should be integrated into, and supported by, smart cities.

4.2.2 An inclusive smart city uses technology as an enabler rather than a driver

Technology, specifically ICT, should be used as a means to an end; a tool or mechanism that enables and improves certain functions and operations. Technology could significantly increase the effectiveness and efficiency of cities and of municipal service delivery. However, technology should not be employed for technology's sake. The selection and implementation of technologies should be informed by real needs and requirements rather than the assumption that technology in itself will solve a particular problem. To guide decision-making and increase the likelihood that technologies will be fit-for-purpose, the following should be taken into consideration:

- Opportunities should be identified to incorporate innovative and intelligent approaches involving a range of technologies, methods, processes and other interventions. Smart responses to urban challenges are not limited to the application of technologies only. Not all smart cities have to include expensive or sophisticated technology.
- Care should be taken not to utilise technologies that would further marginalise the poor and vulnerable groups. Ignoring the fact that many people may, for instance, not have the financial means to make use of ICT-based initiatives, or may not be IT literate, or may not have access to ICT equipment and services, may contribute to a widening of the digital divide. Opportunities to include all communities in all aspects of the city should be explored. For instance, technologies could be utilised to improve the lives of all, not just the more affluent.

What is the digital divide?

The digital divide can be described as the gap between those individuals, households, businesses and geographic areas who have access to modern information and communication technology and those who lack access. Although public discourse is often pre-occupied with whether people can afford access to computers, cellular phones, network connections and internet data, a lack of skills, opportunities and even confidence can also contribute to the widening of the digital divide⁵⁸. Stephen McNair of the University of Surrey describes the challenges associated with the digital divide:

"Just as the industrial revolution made some level of literacy and numeracy a requirement for all, so the electronic revolution within contemporary society makes digital literacy essential. People who lack access to relevant hardware and software, and a basic understanding of ICT, will also lack the confidence that they can continue to learn as the technologies evolve; they will remain digitally illiterate. As the technologies become ever more embedded in everyday life – and increasingly taken for granted by those with relevant equipment, skills and understanding – so the exclusion of those without this new literacy deepens. Such exclusion is a major policy concern in all countries. It poses a dynamic problem, in that the very concept of ICT literacy is itself constantly changing as new technologies emerge."⁵⁹

- The choice of technology should be determined by the local context, needs and resources available. To support the creation of inclusive smart cities, the selection of technologies

should be based on a thorough understanding of the purpose of the technology. For instance, installing digital infrastructure for internet connectivity may be viable in urban areas, but it may be prohibitively expensive to do the same in vast rural areas. This would require the identification of creative alternative cost-effective options that are suited for rural environments.

- Recent technological developments should be explored to understand their potential benefits and usefulness. In particular, 4IR technologies could provide municipalities with opportunities that did not exist before.

The Fourth Industrial Revolution

The Fourth Industrial Revolution, 4IR and Industry 4.0 are labels developed to apply to the era of cyber-physical systems that go beyond mere automation, with industries and systems that are decentralised but integrated and transparent, self-optimising, self-configuring and self-diagnosing.

Technologies and concepts that are commonly associated with 4IR and smart cities include the Internet of Things, Human Enhancement Technologies, Virtual Reality and Augmented Reality, Near Field Communication, Advanced Materials and Smart Materials, Speedy connectivity (5G and Wi-Fi 6), 3D Printing and Additive Manufacturing, Big Data, Distributed Ledger Technologies and Blockchains, smart electrical grids, bots, drones, satellite enablement, facial recognition, and autonomous or driverless vehicles.

The Presidential Commission on the Fourth Industrial Revolution (PC4IR) recently published a report (Government Gazette No 43834, 23 October 2020) Recommendations in the report include the need to invest in human capital related to 4IR. The immediate need to reskill the youth, and to navigate complex human issues of ethics, wellbeing, identity etc. are highlighted.

The commission also recommends that platforms for citizen participation be created. It states that the Fourth Industrial Revolution must become a citizen's initiative, and that it should be rooted in communication amongst sectors of society to ensure awareness, inclusive participation and a collaborative construction of the desired path forward.

- A true understanding of the interaction between technology and humans are the key to the successful implementation of a technology. Most, if not all, technology-based interventions are dependent on human input. If qualified, capable human resources are not available to operate and maintain a technology solution, the technology will not function as intended. If a technology requires specialist operators, the likelihood of accessing the required human resources should be carefully considered before acquiring the technology.
- Acquiring technologies without a thorough understanding of their benefits and disadvantages could result in fruitless expenditure and no improvement in efficiencies. Merely incorporating technologies in certain components of a city will not necessarily result in a smarter city. However, the application of appropriate technologies could make a significant contribution to improving the quality of life of those living in the city or town.

"A city is not smart because it uses technology. A city is smart because it uses technology to make its citizens' lives better."

- Smart Cities Council, 2015⁶⁰

4.2.3 An inclusive smart city is shaped by, and responds to, the local context

When planning any form of smart city, the local conditions need to be carefully considered to ensure that appropriate technologies and initiatives are implemented. Factors common to all South African cities and towns include poverty, inequality and unemployment. Challenges also relate to characteristics of our cities (e.g. informality) and municipal capacity. Other aspects to consider include the following:

- In addition to the macro-level context, decisions regarding a smart city initiative should be informed by the nature of the specific city or municipal area for which the smart city initiative is planned. Micro-level features (physical, social, cultural, etc.) should be acknowledged, as should the needs, priorities, aspirations and resources of the people who inhabit the city. Local knowledge can be used to develop simple but innovative responses to everyday challenges.
- A predetermined concept of an “ideal” smart city should not drive the planning and implementation of smart cities. Popular images of smart cities are often high-tech visions that are clean and orderly, and they mostly do not resemble real life conditions in cities. While cities share traits (especially cities that are of similar size or those that resemble each other in terms of developmental nature), the combination and prevalence of these traits differ significantly among places. Generalised smart city “solutions” should be avoided as these ready-made “solutions” will likely result in additional costs, ill-fitting responses and excluding key role players⁶¹.
- Smart city initiatives that respond to the local context are sensitive to the uniqueness of a place and the local stories, knowledge and values that shape the place. The development of different smart cities therefore each represent a particular journey. A smart city in Rwanda will not look similar to a smart city in South Africa, nor should they. Likewise, a smart city in Gauteng may look different to a smart city in KwaZulu-Natal.

“The conceptualisation of Smart City, therefore, varies from city to city and country to country, depending on the level of development, willingness to change and reform, resources and aspirations of the city residents.”

- Smart Cities Mission, Ministry of Housing and Urban Affairs, Government of India⁶²

4.2.4 An inclusive smart city is informed by the real needs of the community

The active participation of the community in the identification, development and implementation of smart city initiatives could contribute significantly to the success of initiatives. The following aspects need to be considered:

- Active participation means more than mere consultation. The Red Book describes community participation as follows: “When implementing a project, a consultative process often merely involves asking key stakeholders for their opinions about proposed interventions. This does not allow for meaningful involvement in the decision-making process. A participatory process, on the other hand, requires people to be actively involved in decision-making from the very beginning of a project that would affect them. They should participate in the planning, design implementation and management aspects, rather than only being involved after most of the critical decisions have been made”⁶³.
- Community participation is not an event such as a workshop that needs to be completed before a next step could be taken. It should be seen as an integral part of the entire process and the fundamental approach that governs all aspects, from inception through to implementation. This approach requires the community to be involved in all aspects of the

development and implementation of an initiative (including the conception, planning, design, delivery and management phases) rather than being mere passive recipients.

- The term community refer to all role players, stakeholders and affected parties relevant to the proposed initiative. These include residents, the business community (formal and informal), universities, research organisations, government departments and industry.
- Another aspect of community participation relates to the contribution that the community could make once an initiative has been implemented. They could provide feedback to assist with the improvement of the initiative, they could contribute by sharing information and data, and they could assist with monitoring and evaluation processes.

4.2.5 An inclusive smart city embraces innovation, partnerships and collaboration

A smart city should incorporate a collection of several projects, initiatives and actions that originate from both the public and the private sector and from citizens themselves. The following factors should be considered:

- Some initiatives may be implemented at a municipal level, focusing on providing city-wide access to technology; implementing new thinking to the provision of engineering services; or integrating data from different systems into a central operations centre. Other initiatives may be aimed at the neighbourhood level, involving citizens through social media and mobile applications to create responses to issues that matter to them and that may enable behaviour change.
- Regardless of the level of implementation, partnerships could foster innovation and creativity and allow for the testing of new ideas. If partnerships are established with the right entities and approached in a sensitive manner, it will create such a conducive "ecosystem". Smart city initiatives could unlock opportunities to approach urban challenges in innovative ways, apply new thinking to old problems, or use ICT to allow for efficient operations. However, this will require a partner-wide commitment to innovation. "Whilst critiques of the smart city as discourse are well-founded, there is a danger that they overlook the necessarily experimental and emergent nature of smart city restructuring."⁶⁴
- It is therefore important to identify reliable partners that share the same values and objectives. Partners would have different motivations for participating in a smart city initiative, and it may sometimes be difficult to reconcile, for instance, the purely commercial intentions of some partners with more benevolent intentions of others. Partners could represent a range of interest groups, including the ICT industry, business, academia and the research fraternity.
- Partnerships need to be carefully managed, and roles and expectations should be clearly understood by all partners. Rightly or wrongly, smart city agendas may sometimes be driven by the private sector rather than by the government. However, it is the role and duty of local government to ensure that smart city initiatives are guided by the relevant urban development and planning policies, strategies, plans and frameworks.

4.2.6 An inclusive smart city is sustainable, resilient and safe

This principle aligns with and complements SDG 11, which calls for cities to be inclusive, safe, resilient and sustainable. All smart cities are not inevitably sustainable, resilient and safe. It is therefore important to consciously incorporate the principles of sustainability, resilience and safety into smart city initiatives. The following should be considered:

- Be clear on what sustainability really involves. There are various definitions of a sustainable city. For instance, the South African Cities Network⁶⁵ describes it as "...an urban form of

development that meets the needs of the present without sacrificing the ability of future generations to meet their own needs. It is characterised by low ecological footprint, lowest quantity of pollution possible, efficient use of land, recycling and re-use of materials and conversion of waste to energy." Smart initiatives and technologies have the potential to enhance all these characteristics and increase resource efficiency.

- A city is a complex system, and improving its sustainability requires a multi-faceted, integrated approach. Aspects that could be addressed through smart interventions and technologies include human, social, economic and environmental dimensions of sustainable development. Smart cities have the potential to improve the quality of life of all residents, create economic opportunities and address environmental challenges. However, the identification of smart initiatives and technologies should be guided by a thorough understanding of the local context and an understanding of real needs and challenges.
- Utilise smart initiatives and technologies to create a more resilient city by enhancing the city's ability to deal with and prevent chronic stresses and acute shocks. Chronic stresses could be caused by longer-term disasters such as extreme levels of crime and violence, poverty and inequality. Acute shocks could be the result of floods, storms, fires, disease outbreaks, droughts and earthquakes. Extreme weather conditions often cause sudden, devastating disasters, and due to climate change, these conditions are becoming more and more common. Smart initiatives and technologies could inform the way cities are planned, designed and managed to ensure they are better prepared for disasters and are able to withstand the consequences. For instance, long term planning can be enhanced through geospatial modelling and analysis, assisting with predicting droughts and other disasters. Combined with real-time data, this would allow municipal officials to comprehensively manage and monitor critical assets.
- Smart technologies could play an important role in creating safe communities. They could assist the police and other law enforcement agencies with crime prevention and detection, and they could improve the effectiveness and efficiency of scarce resources. Private security and community groups could also utilise smart technologies and initiatives to improve safety and security in neighbourhoods. When selecting and implementing technologies to support safety and security initiatives, all the characteristics of an inclusive smart city as outlined in this section should be carefully considered. In particular, technology should be used as an enabler rather than a driver. Technologies and smart concepts that could potentially be employed to improve community safety and security include CCTV surveillance, AI, facial recognition, predictive policing, data, community safety apps and e-Policing.
- The creation of safe communities is linked to social cohesion, as referred to in, for instance, the NDP, the 2016 *White Paper on Safety and Security*, and the UNDP publication *Community Security and Social Cohesion*. It follows that smart city initiatives aimed at safety and security should not have a negative effect on social cohesion. Smart initiatives aimed at improving community safety and security should also be guided by the IUDF, in particular the cross-cutting priority on urban safety and Policy Lever 7 (Empowered active communities), the *UN Systemwide Guidelines on Safer Cities and Human Settlements*.

5 Factors that should inform the planning and implementation of smart city initiatives

The guiding principles discussed in **Section 4** support decision-making for the identification of appropriate smart initiatives and technologies. A few cross-cutting factors should also be considered in any smart city planning and implementation process. The following can assist with planning and implementation decisions:

- A thorough understanding of the nature and purpose of a proposed smart city initiative is critical to fully comprehend the role and impact of the particular initiative within the wider city.
- The likelihood of smart city initiatives to succeed depends on alignment with existing plans and initiatives in the municipality.
- Smart city initiatives could be enhanced by learning from peers.

5.1 The nature and purpose of a proposed smart city initiative

Decisions regarding any smart city initiative should be guided by a clear understanding of the nature and purpose of the proposed intervention. Smart city initiatives could be focused on benefitting different target markets, e.g. municipality-driven smart city initiatives may address the needs of the entire city, while private sector-driven smart city initiatives will likely focus on a portion of the city's residents. However, as far as possible, no smart city initiative should have an adverse effect on certain communities or certain areas of the city. Smart city initiatives should first and foremost be aimed at improving the lives of the people residing in the city. To achieve this, a shared understanding of the aims and objectives of a smart city initiative is critical. A useful start is to agree on the interpretation of "smart" and "city" (see **Section 2.2**).

An understanding of "smart" should be developed in collaboration with all relevant role players. Different stakeholders may not have the same motivations for participating in a smart city initiative, and it may sometimes be difficult to reconcile, for instance, the purely commercial intentions of some entities with more altruistic intentions of others.

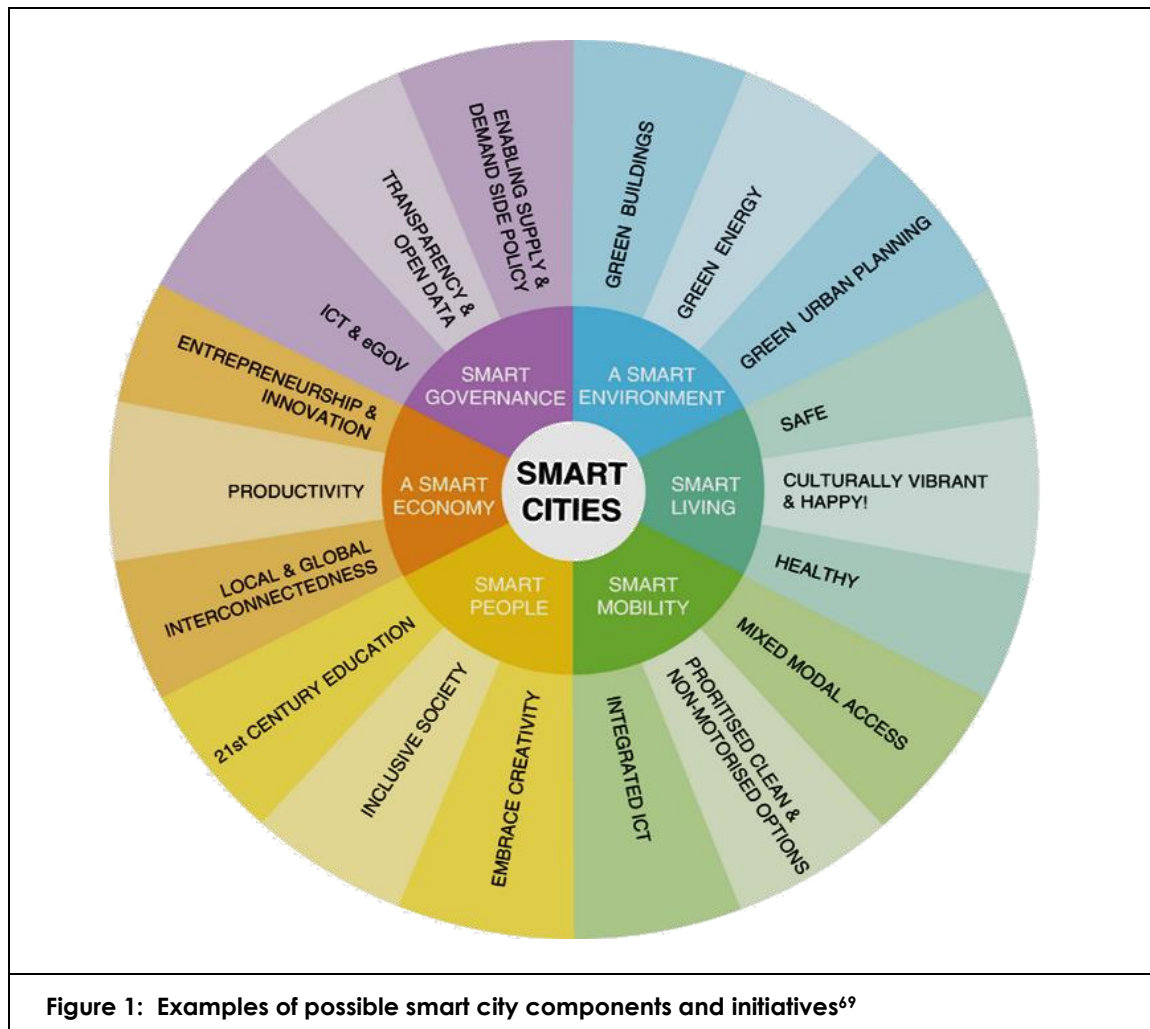
The identification of city-wide smart initiatives - an incremental approach

Smart cities are often described as a combination of various smart components. These components could refer to, for instance, infrastructure elements, or they could be different operational areas that are central to a city's functioning. Giffinger et al⁶⁶ identify the following areas: economy, people, governance, mobility, living and environment. Examples of possible smart initiatives that could be implemented in support of each of these areas are illustrated in **Figure 1**. Different cities would identify different areas which may include some or all of these examples but could also include other areas such as health and safety and security. The possible smart city components and initiatives indicated in **Figure 1** could also assist all spheres governments with deciding which areas to prioritise, or to evaluate where most existing initiatives are located.

There are many options for launching municipal smart city initiatives. A choice can be made as to the focus of a smart city initiative. For instance, the initiative could focus on a particular theme or aspect of the city. The focus could be on becoming a connected city by, for example, providing free Wi-Fi to all communities, or the focus can be on becoming a "green" city by, for example, limiting greenhouse gases through an upgraded and smart transportation system. Examples of smart cities that chose a specific theme to focus their smart city initiative include the Indian cities of Dholera and GIFT City. The former has been framed as a smart industrial city⁶⁷, while GIFT City is framed as a global financial and IT hub⁶⁸. In choosing a theme, aspects that need to be considered include the availability of capacity, resources, and capabilities to implement and maintain such an initiative.

Since cities and towns involve complex systems and components, smart city initiatives could not be implemented all at once. They should be implemented incrementally according to a longer-term strategy. Needs and opportunities should be prioritised, and interventions should be planned and implemented over an extended period of time.

There should also be agreement on the meaning of the word “city” for a specific smart city project or initiative. Smart city interventions can be aimed at a part of the city, the city as a whole or a greenfield development outside of an existing city. Whether an initiative will be implemented municipality-wide, within a neighbourhood or precinct or outside of the city, it is essential to determine how the initiative will relate to other (smart or conventional) projects and to the different components of the city.



5.2 Alignment of smart city initiatives with existing planning and operations

Smart city interventions could be intentionally disruptive and challenge the status quo or the conventional way of doing things, but smart city initiatives should ultimately be supportive of the planning outcomes as agreed on in existing municipal plans and strategies. These include the proposed new One Plans that are part of the District Development Model, municipal IDPs and any other municipal strategies or plans (refer to **Section 3.5.2**).

While the aim of smart city interventions should be to create inclusive cities that are also sustainable, resilient and safe, these initiatives will have a higher likelihood of success (and realising the set outcomes) if they are incorporated into the core business of a city. By linking such initiatives to existing municipal functions, interventions and strategies, it may be easier to get support, access resources and ensure sustainability.

This mainstreaming of smart city initiatives requires an understanding of the complexity of a city as a system of systems. Cities and towns involve a range of interlinked functions and components, and smart city initiatives could link to one or more of these in various ways. The potential components are presented in **Figure 2**.

Smart city initiatives should link at various points with conventional operations and services provided by the municipality. These services may include waste management, water treatment, sewerage management, licensing, primary health care, disaster management, community safety, metro police and social development /services. In addition to the services provided by municipalities, the immovable assets of the city, such as community centres, early childhood development facilities, parks and squares, recreational facilities and sports facilities could also link to smart initiatives.

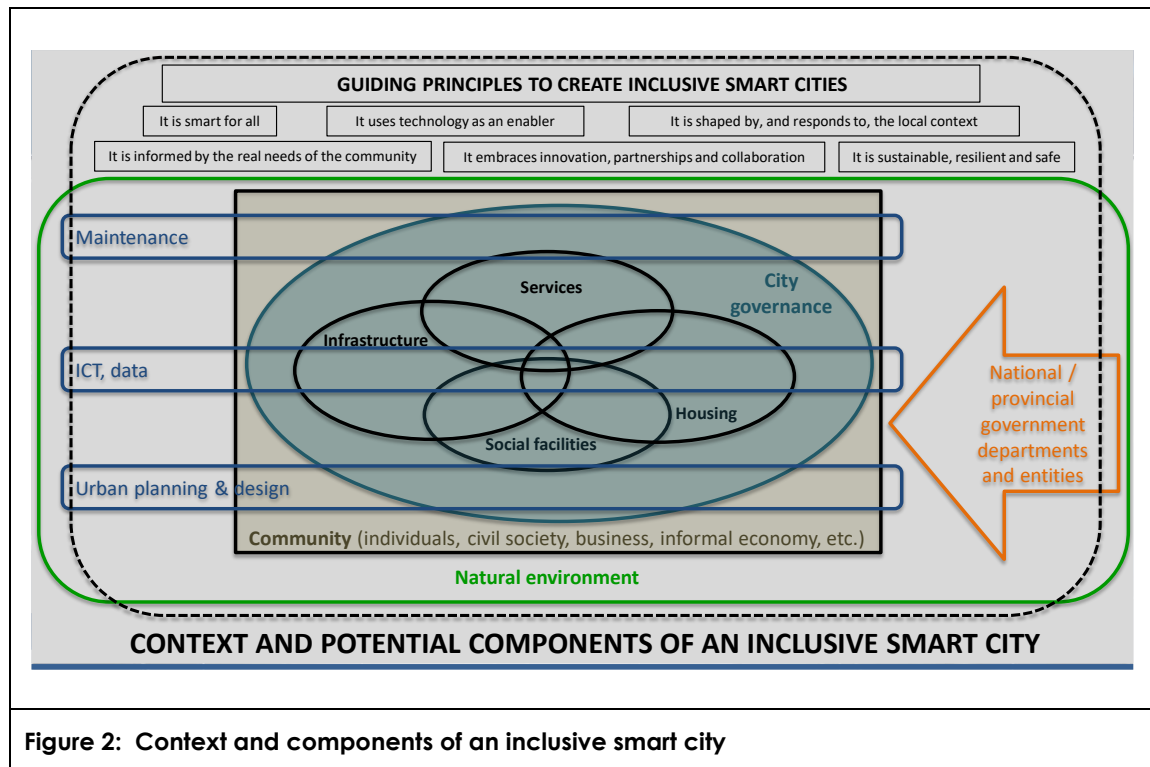


Figure 2: Context and components of an inclusive smart city

The municipal role players highlighted in the figure are potentially involved in and affected by smart city initiatives and may include private individuals, formal businesses, informal businesses, NGOs, CBOs, educational and research institutions and special interest groups (people with disabilities, faith-based groups, etc.). As mentioned, city governance should be actively engaged in smart city initiatives and this may include strategic planning, financial management, human resources, administration, procurement, occupational health and safety.

Smart city initiatives will also have multiple linkages with on-going municipal processes and systems such as infrastructure maintenance, informal settlement upgrading, development planning and the management of ICT and data.

Intergovernmental relations are as important to smart city initiatives as they are to municipalities and smart city initiatives should link to national and provincial government departments and entities at multiple points.

5.3 Share smart city experiences

The sharing of experiences related to the planning and implementation of smart city initiatives have a number of benefits. These could include the following:

- Spreading and reducing risk.
- Reducing costs.
- Improving efficiency and productivity (working smarter, reducing efforts and time spent on finding information, planning, implementing, reworking etc.).
- Assisting with making informed decisions (what to do/ not to do).

Experiences could be shared in various ways, including the following:

- Knowledge sharing platforms (web-based).
- Communities of practice that facilitate regular contact.
- Visiting good examples.
- Reviewing reports and articles of other programmes and projects.
- Formalising monitoring and evaluation (documenting of lessons learnt).

Although smart city thinking has not been mainstreamed in South Africa, there are examples of how the concept has been embraced:

- In an overview of the City of Johannesburg's smart city agenda, Backhouse⁷⁰ describes the city's approach as having "modest goals, starting with connectedness". The City of Johannesburg places emphasis on aligning its smart city strategies with its IDP process. Officially declaring its intentions to transform into a smart city in 2013, the city approved a Smart City Strategy and Implementation Roadmap in 2014. A Smart City Unit was established within the municipality. Lawrence Boya, the director of the Smart City Unit at the City of Johannesburg, describes the focus of the smart city programme:

*"A smart city programme needs to be fully integrated into the Integrated Development Plan (IDP) of the city and become one with the IDP. When implementing a smart city programme, a holistic approach is required. The smart city ambition should be a societal ambition not just a top-down strategy from the city. All stakeholders and communities should be involved and a smart city should be citizen-centric, reflecting the desires of citizens, and addressing the needs of the citizens."*⁷¹

Current smart city initiatives in the City of Johannesburg include integrated transport systems, last-mile connectivity such as optical fibre and Wi-Fi, and automated and integrated police enforcement management systems. An example of an intervention that could be classified as smart, came as a result of a study conducted by Johannesburg Water to improve the productivity of its work force. According to Ntshavheni Mukwevho⁷², Managing Director of Johannesburg Water: "One of the outcomes of this study indicated that teams spend too much time in the depots in the morning as well as traveling to sites where work needs to be carried out." It was found that, among others, an inefficient call centre-based system and a lack of route planning were contributing to delays in service delivery. The company investigated the use of technology to digitise and optimise its operational process, thereby increasing productivity (e.g. the number of tasks per resource), deliver business process efficiencies through the semi-automation of tasks, reduce costs (e.g. travelling time) and improve service delivery (e.g. provide near real-time communication to its customer base). One of the interventions that followed from this study was to establish an integrated dispatch centre that is more efficient in managing incoming notifications and can communicate spatially-linked incidents and requests to the workforce by the use of tablets.

Johannesburg has also been the site for a number of private sector initiatives to develop precincts or satellite cities as smart cities. The best-known being the Modderfontein development that promised to build a new urban district described with narratives of smart and sustainable urbanisation. The original plans were not realised and Brill and Reboredo⁷³ argue that the project threatened to reaffirm existing patterns of inequality in Johannesburg and possibly lead to environmental degradation in the area. The City of Johannesburg opposed the proposed development as they considered some of the proposals as contradicting wider city goals.

- The City of Cape Town launched a first version of their Smart City Strategy in 2000 (the most recent review took place in 2016). The strategy was aimed at achieving existing city objectives such as job creation, economic growth, improving resident's engagement as well as building a system of high-quality public services that could be made accessible to a wide range of citizens. The strategy lay a foundation for significant investment in business process integration and

automation to promote efficiencies in city systems and service delivery⁷⁴ and gave rise to the implementation of an Enterprise Resource Planning (ERP) system that still serves as the digital backbone of the municipality⁷⁵.

Current smart city initiatives within the municipality is guided by a Digital City Strategy. The University of Cape Town's Urban Real Estate Research Unit (URERU) published a series of four publications⁷⁶ on Cape Town's smart city progress. For a detailed exploration of the policy mechanisms in place to drive Cape Town's smart city aspirations, an assessment of how far the city is along its path to becoming "smart", and an interpretation of what is needed to drive successful smart city development in Cape Town, these documents are available online.

In 2016 the City of Cape Town was named the smartest city in Africa by the Smart City Playbook^{iv}. In the publication, the City of Cape Town was commended for "adopting an approach suitable to its local context. Rather than pursuing grand projects that its citizens cannot benefit from, it is tailoring its efforts to what it perceives are their needs."⁷⁷ In addition, the metro "has made strong efforts in investing in the less glamorous, but necessary work of providing basic training to ensure that people in the city are equipped to make use of digital services as they are introduced."⁷⁸

The wider Cape Town area also has its share of private sector initiated smart city developments. At the end of 2019 the City of Cape Town approved the Harbour Arch mixed-use precinct. The development is labelled as smart and sustainable and boasts a shift towards water-conscious design and planning, including rainwater and greywater harvesting, dual-flush plumbing systems, and water storage facilities. The developer will also be investigating the viability of installing an on-site desalination plant to take advantage of the ground water available in the Cape Town foreshore area. Upmarket residential estates in the wider metropolitan area have also invested in smart city-type technologies such as biometric access control and number plate recognition.

Smart city initiatives should be planned from the outset to allow for monitoring and evaluation. This will make it possible to share lessons with peers. While initiatives or interventions should not be copied without adapting them to the local context (what works in one setting may not work in another), lessons can be learnt from both local and international initiatives. A few examples of lessons learnt are provided below.

- Retrofitting a city to become smart is a long term process. For instance, Cape Town launched a first version of their Smart City Strategy in 2000 (the most recent review took place in 2016)⁷⁹. The city's digital strategy builds on the ERP system that dates from the early 2000s⁸⁰.
- Smart technologies and initiatives need not necessarily exclude certain segments of society. For example, Rwanda's Irembo platform can be accessed by using unstructured supplementary service data (USSD), which do not require an internet connection, thereby including users with basic mobile phones⁸¹.
- When implementing certain smart city technologies, ethical implications should be carefully considered. For example, Gaffney and Robertson⁸² report that certain smart technologies collecting data for Rio's City Operations Centre are only applied in limited geographic areas (in this case some of the wealthiest areas of Rio de Janeiro). They argue that where there are more cameras and monitoring, there is more intervention on the part of city managers and the system actually is "exacerbating the digital and socio-economic divides that characterise the city".
- Piloting smart city initiatives proved to be useful in some settings. According to Backhouse et al⁸³ the City of 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.

^{iv} The Smart City Playbook is a report that documents the best practices of cities around the world by Machina Research. The 2016 edition was sponsored by Nokia.

- Smart city initiatives should not be driven by technology, they should respond to challenges. For instance, Johannesburg Water first identified challenges regarding the productivity of their workforce. As a next step they investigated the origins of the problem and only then considered whether an ICT solution will address some of the challenges⁸⁴.
- Partnerships and collaboration between all relevant stakeholders from the outset is key when developing a smart city. Construction of the planned Modderfontein smart city reportedly could not go ahead because it did not align with the spatial plans of the City of Johannesburg⁸⁵.
- In certain circumstances it may be possible to adapt and replicate certain smart technologies and initiatives for use in different locations. For instance, India's Safecity platform has been duplicated in Kenya, Cameroon and Nepal⁸⁶.
- Implementation of smart city technologies is often dependent on a range of governance policies. For instance, Quayside in Toronto, Canada faced challenges as no national data-governance strategy was in existence before the launch of the project⁸⁷.

6 Initiating smart city interventions

6.1 The motivation for becoming a smart city

The following questions are often asked in discussions about smart cities: How smart is our city? How do we make our city smarter? How can we measure how smart a city is? What smart technologies could we implement? These questions may result in responses that focus on smart for the sake of being smart or employing technology for technology's sake. Being smart should not be an end in itself; it should be the means to an end. It is essential for a municipality to critically interrogate the reasons why it wants to become smart. The motivation should be more substantial than a need to be known as a smart city. Smart city initiatives should first and foremost be aimed at improving the lives of the people residing in the city.

To ensure that this remains the focus, the right questions need to be asked to determine what the motivation is of those wanting to make a city smarter. At the most basic level, it is suggested that a smart city initiative should be informed by the answers to the following questions:

- Are the people living in our city or town satisfied with the services we (local government) provide? If not, improving the delivery of basic services should be the first priority rather than a smart city initiative that may not satisfy people's most pressing needs.
- How can the city become smarter and use smart technologies to enhance the effectiveness and efficiency of the services we deliver to improve the quality of life of those we serve as a local government?

Start with identifying the challenge you need to address and the results you would like to achieve. Then consider the various options that could assist you, including adjusting a process or procedure, or adopting new ways of dealing with challenges.

6.2 Assessing the smart-readiness of a municipality

The decision-making framework summarised below provides municipalities and other role players with guidance on the planning of smart cities. The framework is structured as a two-pronged assessment and decision-making process to determine the readiness of municipalities to become smarter, involving the following:

- Pre-conditions for becoming smarter: The first step is to assess the municipality and the current situation to gain an understanding of the ability of the municipality to provide services under

current conditions. The intention is to establish whether there is a strong foundation on which to build a smart city initiative, or, phrased differently, whether the basics are in place.

- Enablers for implementing smart city technologies: The second step is to assess where the municipality could improve its ability to deliver services. The purpose of this assessment is to establish whether the municipality has the means and ability (or can acquire the ability) to harness and leverage smart technologies and initiatives to improve the effectiveness and efficiency of the services delivered.

6.2.1 Pre-conditions for becoming smarter

This component of the smart-readiness framework involves an assessment of the current conditions in a city with respect to, for instance, the existing engineering infrastructure, the facilities, amenities and housing available to residents, the ability of the municipality to deliver services, the governance structures and the available financial resources. These aspects could be grouped into three interlinked clusters:

- Institutional and organisational arrangements
- Existing infrastructure
- Capacity of government officials and communities

i Institutional and organisational arrangements

Aspects to consider include the robustness of current governance structures, levels of cooperation within the municipality, levels of cooperation between the municipality and role players outside the municipality, compliance with legal requirements and sectoral policies, existence and scope of internal policies and by-laws, effectiveness of business processes, and vacancy levels.

ii Existing infrastructure

This step involves an assessment of existing municipal infrastructure, facilities, amenities and housing with respect to, for instance, their quality or condition, quantities or the number per population (where appropriate), their age, their distribution across the city, backlogs and the planned future developments.

iii Capacity of government officials and communities

In addition to an assessment of physical infrastructure, an assessment also needs to be conducted to establish if the human resources are available to utilise the infrastructure. People are required to provide services and maintain infrastructure. Factors to consider include people's knowledge, skills, competencies, experience, qualifications, attitudes, values and past performance, as well as possible re-skilling and training programmes that may be required when implementing a smart city initiative. Another critical aspect to consider relates to the capacity of communities to participate in and contribute to smart city initiatives.

6.2.2 Enablers for implementing smart initiatives and technologies

The assessment of the pre-conditions will assist in reaching an understanding of where a municipality's challenges or "pain points" are. This will guide the direction of the second component of the decision-making framework, which involves the enablers as discussed next.

i A smart city plan

The drive to become smarter should be a coherent effort across the municipality and it is dependent on partnerships with the business sector, communities and other spheres of

government. There are different ways to coordinate, plan and implement smart city initiatives, such as developing a plan, strategy or roadmap, or designing programmes and projects. It would be useful to follow a sound project management approach where there are programmes linked to projects to allow for effective planning, budgeting and resourcing. Any of these approaches should be informed by a thorough understanding of the local context. Questions that should be answered include the following:

- Should a city-wide strategy be developed, or should sector-specific strategies be developed dealing with specific smart city initiatives, e.g. a strategy focussing on smart water initiatives?
- What is the intention with the smart city initiative (vision, purpose, impact)?
- How do we link our intended interventions with existing plans (e.g. the IDP) and policies (such as the IUDF and NSDF)?
- Do we need to develop a focused implementation plan for smart city initiatives or do we incorporate these initiatives into other plans?
- How do we ensure that our smart city initiatives contribute to the development of a sustainable and resilient city and also address climate change and natural resource challenges?
- Can the strategic intent and vision be translated into reality by those responsible for implementation? In other words, are the strategic / management decisions synchronised with the realities at an operational level?
- How do we link smart city initiatives to a budget, especially if such initiatives are cross-cutting and involve various departments and role players?
- How does a smart city strategy relate to line functions, and how would progress and impact be monitored and measured across the city?
- How is synergy across the city strengthened to enable the smooth implementation of a smart city initiative?
- How can we exploit 4IR technologies, and what are the challenges?
- What are the risks and unintended consequences linked to the implementation of smart initiatives and technologies?
- How do we plan for monitoring and evaluation of the smart city initiative?

ii Digital infrastructure

The availability and quality of digital infrastructure are important for smart cities. In this instance, digital infrastructure refers to the physical assets required to operate technologies such as digital communication, computing or data storage. To enable smart city development, digital infrastructure is required to collect data, bring the data to a central point, and then analyse the data to make it useful. The following should be taken into consideration:

- What types of instrumentation do we need (meaning a network of sensors that can detect, sense, measure and record real-time data)?
- What type of interconnected and integrated systems do we need (i.e. a system that can communicate and interact with users, operators and managers)?

- What type of systems do we need that can analyse the situation, enable quick responses and optimise solutions (how do we gain useful intelligence)?

iii Skilled people

To enable smart city implementation, people with the right skills and abilities in the right places are critical. It is the people, not just the technology, which makes a city smart and therefore municipalities will have to extend investments beyond technology and data to investment in human resources. In some instances, it may be possible to upskill or retrain existing staff, but in other instances people with specific competencies may have to be employed. The possibility of certain skills becoming redundant as a result of implementing smart technologies should be carefully considered. Decisions need to be made regarding the following:

- Would we need to employ people with specialist skills and experience to implement a particular smart city initiative?
- Would we be able to upskill existing staff to operate and maintain technologies associated with a smart city initiative?
- What skills/competencies would we require in future to support and maintain smart interventions?
- Do our politicians and officials have the willingness and ability to embrace change and accept innovations and smart interventions? Do all involved share the same vision?

iv Partnerships

Collaborating with appropriate partners could play a significant role in the success of smart city initiatives. The key is to establish partnerships that will contribute to the success of the initiative and support the overall aim of creating an inclusive smart city. It is therefore important to identify reliable partners that share the same values and objectives. Partners would have different motivations for participating in a smart city initiative, and it may sometimes be difficult to reconcile, for instance, the purely commercial intentions of some partners with more benevolent intentions of others. Partners could represent a range of interest groups, including the ICT industry, business (often technology companies), academia and the research fraternity. The following need to be resolved:

- Who should take ultimate responsibility for the coordination of our smart city initiative?
- How do we ensure that all relevant departments participate meaningfully in such initiatives?
- How do we measure performance and impact of cross-cutting smart city initiatives?
- How do we improve synergy between various role players with different mandates and performance indicators to ensure the success of smart city initiatives?

v Community involvement

The active participation of the community in the identification, development and implementation of smart city initiatives could contribute significantly to the success of the initiative. The term community could refer to all role players, stakeholders and affected parties relevant to the proposed initiative. These include residents, the business community (formal and informal), universities, research organisations, government departments and industry. Smart city initiatives allow city citizens to co-create their living environments by becoming active role-players that provide data that feed into the smart city system and contribute to better decision-making. However, it is important to consider the fact that many people may, for instance, not

have the financial means to make use of ICT-based initiatives, or may not be IT literate, or may not have access to ICT equipment and services.

7 Conclusion

To have an impact, the SCF has to be applied in practice. Municipalities would require support from the DCoG, provinces, SALGA and other National Departments with the implementation of the framework. This could involve assistance with assessments to establish the smart-readiness of a municipality, the development of a local smart city strategy, and the planning and implementation of smart city initiatives.

A capacity building programme to empower local government officials, councillors and other role players would also be of value to ensure appropriate, inclusive smart initiatives are implemented. In addition, a platform needs to be provided for the sharing of smart city learning amongst all role players. This would assist in creating a strong learning culture, establishing communities of practice, and building the national capacity for smart city planning and implementation.

We need to imbue our planning processes with a set of principles and values upon which we can all build solidarity, commitment and unity. This SCF outlines a set of principles that supports these ideals and could be used to measure our collective progress in creating inclusive smart cities.

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