

Towards Smart Cities for Sustainable and Efficient Socio-Economic Development: Reflections from Lanseria, South Africa

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Abstract: The evolving concept of "smart city" has recently been considered globally as a strategy for achieving sustainable urban planning through the use of Information and Communication Technology for socio-economic development. Like in many countries, South Africa's cities are considered as centres for modern development and innovation which directly contributes towards socio-economic development. Through urban planning, there must however, be a balance between development interventions and the natural environment for sustainability compliance. In his State of the Nation Address, President Cyril Ramaphosa indicated that South Africa is in need of a smart city that can amend the apartheid socio-economic spatial make-up and accordingly, "a new smart-city is taking shape in Lanseria, which 350,000 to 500,000 people will call home within the next decade". Therefore, the purpose of this paper is to theoretically determine South Africa's readiness towards building sustainable smart cities which can effectively respond to the apartheid spatial planning. Given that smart city concept is not well-defined, which approach has South Africa adopted in their smartness given the failure of the Modderfontein Smart City? Although a number of cities globally have implemented smart city projects for sustainable socio-economic development, the principles of smart cities are techno-centric and economic in nature with limited focus on social, cultural and environmental factors affecting sustainable urban development. Are South Africa's smart cities taking the principles into consideration? The paper concludes that South Africa needs to clarify its conception of smart cities in order to ensure that they respond to the existing socio-economic status of the country. That is, the country in its current state, which is characterised by problems in all its State Owned Enterprises, high unemployment rates and levels of poverty, and, huge debts associated with development, is not ready to implement smart cities for socio-economic development.

Keywords: Smart city, South Africa, Socio-economic development, Sustainable development, Urban development

1. Introduction

Globally, a number of countries have introduced smart city projects with the hope to develop their spaces into "smarter" and more "residential" areas (Mahizhnan, 1999; Komninos, 2014; Hausmann, 2015; Aina, 2017; Komninos, 2018; Ait-Yahia, Ghidouche & N'Goala, 2019; Bwalya, 2019). This evolving concept of "smart city" has recently been considered globally as a strategy and mechanism for achieving sustainable urban planning through the use of Information and Communication Technology (ICT) for society's socio-economic development (Ait-Yahia *et al.*, 2019). That is, technology is used as the main strategy to solving modern development related challenges which are inclusive of high population growth, safety and security challenges, road traffic congestion and pollution, among others. The aim behind the development of these smart cities has been mainly to provide the society with better quality of life through ICT. "Internet technologies are used to empower

citizens and organizations in developing innovative and collaborative solutions that make cities more efficient, sustainable, and inclusive" (Komninos, 2018:783). The success of these smart cities as well as their development strategies, depend on the governance which demonstrates the ability to adapt to the existing local context and responding to societal needs (Mahizhnan, 1999; Hausmann, 2015; Ait-Yahia *et al.*, 2019; Bwalya, 2019). Therefore, there are no standard universal approaches and strategies to developing a smart city, each geographic area must design suitable solutions to its spatial context problems and population dynamics.

Recently, cities are faced with challenges mostly related to urban growth, sustainability and stability, inequality and safety which their intensity and complexity differ based on geographic characteristics, populations dynamics and socio-economic factors (Ait-Yahia *et al.*, 2019). The challenges, therefore, requires efficient governance for their resolution

of which one size fit all approach would not be appropriate because cities and regions of various countries do not go through the same development patterns nor do they experience the same development related growth rates (Hausmann, 2015; Aina, 2017; Komninos, 2018; Ait-Yahia *et al.*, 2019; Bwalya, 2019). Sustainability and stability challenges are related to the conservation of natural habitats and ecosystems including the aqua ecosystems, efficient land use, air quality versus CO₂ emissions, climate change and adaptation, renewable energy and saving, sufficient sanitation as well as water use, reuse and management, among others (Komninos, 2018). As a result of rapid urbanization, most cities are faced with these sustainable development challenges. Safety is one of the major challenges in most cities of various countries. The challenges are related to both man-made and natural threats, such as crime which includes attacks on infrastructure and vandalism, terrorism; natural disasters and urban road accidents, among others (Smith, 2013; Aina, 2017; Komninos, 2018; Bwalya, 2019). Therefore, smart cities are a response to growth, sustainability and safety related challenges by providing improved living conditions and quality of life to the society. They further offer a number of mechanisms that enable societies to advance and expand the economy, infrastructure and services, as well as protection of the environment. Accordingly, smart cities offer the adoption of new technologies and information resources, improved governance characterised by operational efficiency in both public and private sectors, and encourage changes in the societal behaviour by offering advanced and immediate solutions (Aina, 2017; Komninos, 2018; Ait-Yahia *et al.*, 2019; Bwalya, 2019).

It is against this background that this paper hopes to theoretically examine South Africa's readiness towards building sustainable smart cities which can effectively result in aspired socio-economic development. The paper consists of five sections inclusive of this introduction. The second section discusses the conceptualization of smart cities in order to understand what they are and their characteristics. In the third section, smart cities as a mechanism for socio-economic development are outlined. The fourth section provides a critical analysis of South Africa's smart city and its efficiency and sustainability as a response for socio-economic development. Experiences from Modderfontein are used to reflect on Lanseria's efficiency and sustainability as a smart city. The last section concludes that South Africa in

its current state, which is characterised by problems in all its State Owned Enterprises, high unemployment rates and levels of poverty, and, huge debts associated with development, is not ready to implement smart cities for socio-economic development.

2. Conceptualising Smart Cities: Old Wine in New Bottles?

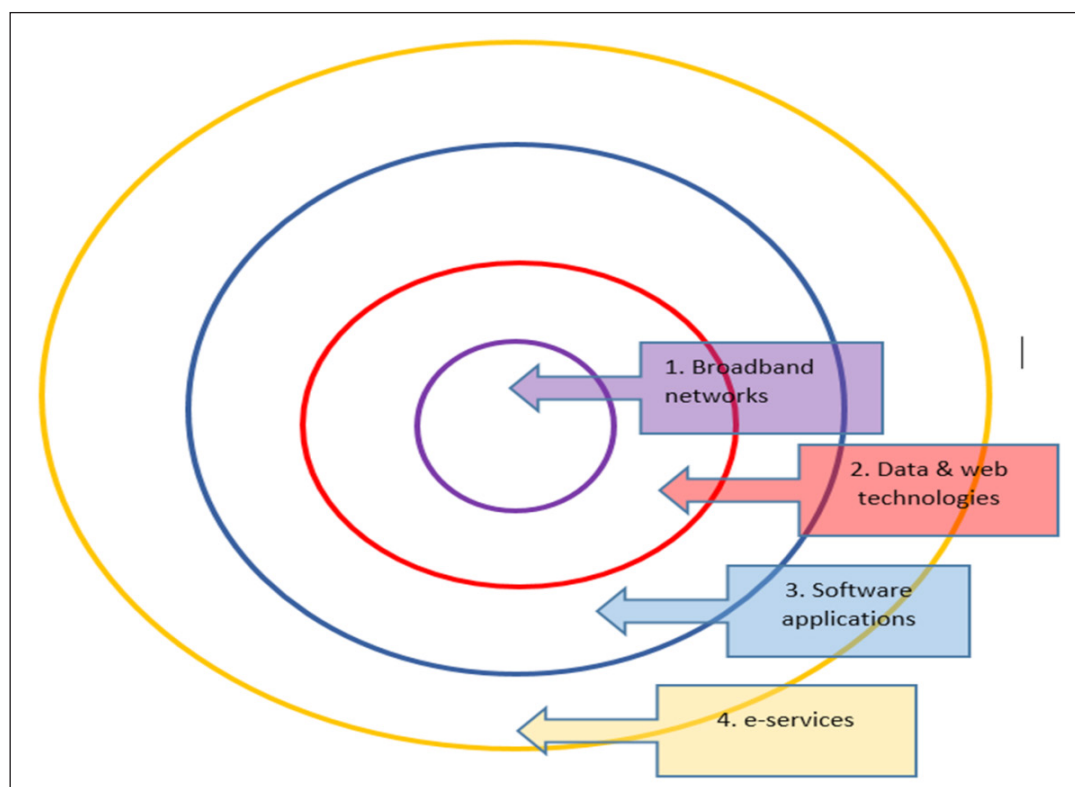
In the past, concepts such as "virtual city", "digital city" or "information city" were used to refer to cities that adopted ICT to promote society's social constructs in support of democracy as well as the development of urban marketing (Graham & Aurigi, 1997; Anthopoulos, 2017). However, currently, the smart city model has occupied the centre stage of urban development and planning against traditional planning approaches such as dense city, new urbanism and compact city and gated-communities, among others, which dominated urban development in the 20th century (Aina, 2017; Komninos, 2018). According to Komninos (2018:783), "new urban reality of the smart city emerges from broadband networks, software applications, data from sensors and user engagement, which make cities interactive, measurable, innovative, and real-time responding entities". That is, the success, sustainability and efficiency of these cities depend more on modern ICT in resolving the urban challenges that previous models failed to address mainly associated with growth and sustainability. The adoption and use of ICT is expected to guide and implement more efficient and sustainable use of resources as well as assist in making well informed systematic development decisions (Aina, 2017; Ait-Yahia *et al.*, 2019; Bwalya, 2019). However, the success of smart city requires more than ICT. There should be holistic and interdisciplinary approach, which integrates social sciences, engineering, information technology and knowledge management, among others (Aina, 2017; Komninos, 2018; Bwalya, 2019).

'Smart city' as a concept has been in use in the literature from 1980s although it became popular in urban planning and development, IT and engineering after 2000. The first reference to the concept between 1988 and 1990, was used to demonstrate provision of urban services using ICT as well as innovations in urban mobility through information technologies for better environmental, social and economic benefits (Hall, 1988; Raynal, 1988; Komninos, 2018). Whereas, Newstead (1989), Batty (1990), and Masser (1990) revealed how the

integration of ICT in urban development could sustain and promote competitive advantages of cities through technological development. From then up-to-date, numerous definitions and conceptions of smart city have been developed. According to Anthopoulos and Reddick (2016), smart cities are places that promote local sustainable development by offering innovative solutions which are grounded mainly, but not solely, on ICT with the hope of improving society's lives and livelihoods. For Meijer and Bolívar (2016), smart city is defined as the ability of a place to attract and mobilize human resources and build social capital in partnership with various stakeholders which include individuals and organizations by using ICT. According to Anthopoulos (2017, in Bwalya, 2019:408), as per ISO standards, smart cities are "geared toward cities that can easily adapt to changing environmental settings, where information can pervasively be accessed, and decisions made intelligently in a sustainable manner". In most of the definitions, the main dimensions of a smart city which are stressed include the importance of integrating ICT in the various development aspects of the society. The concept is multidimensional and multifaceted and manifest in various aspects of the socio-economic development.

Komninou (2014:23) further noted that from the definitions, there are three main elements that emerged which are classified as follows: "(1) the city, citizen, user, activities and infrastructure and flows in cities; (2) the information, knowledge, intelligence and innovation institutions and processes within cities; and (3) the smart systems, urban technologies, the Internet, broadband networks and e-services of cities". The three elements denote that smart cities should be areas that adopt and use the Internet as well as web technologies which are integrated with social networking and urban users' engagements with the hope of advancing innovation as well as problem-solving competencies in urban areas. That is, the 'digital space' of cities is core and critical in building sustainable and successful cities. This digital space is described as "a system of rings superimposed and bonded together, each one having specific characteristics and functionality" (Komninou, 2018:784). The centre ring of the digital space consists of "broadband networks" which could be either or both wired and wireless which enable connectivity and communication, through sensor networks and different types of technology devices (Komninou, 2014; Komninou, 2018). (Figure 1).

Figure 1: Digital Space Rings



Source: Author's own creation

The second ring which is more advanced than the centre ring, consists of "data and web technologies" that enables data creation, data processing, visualization and insight from data (Komninos, 2014; Komninos, 2018). In the third ring, there are "software applications in different domains of urban areas which comprises of education, entrepreneurship, transportation, healthcare, energy and public safety, through visualization (Komninos, 2014; Komninos, 2018). The outer ring, which is the last ring, is made-up of e-services through selected applications that are adopted by the governance institution of the city for provision of e-services on a regular basis (Komninos, 2014; Komninos, 2018).

3. Smart Cities and Socio-Economic Development

Although technology occupies the centre stage for transition of an area into a smart city, it is however, not only the requirement. Additionally, smart city also requires the enhancement of various socio-economic infrastructures which includes "smart university and education" which are guided by context as well as anticipated future development (Bwalya, 2019). Due to the newness of the smart city concept, there are no universally accepted principles and/or common strategies that can be adopted towards the design and development of these cities (Mahizhnan, 1999; Komninos, 2014; Hausmann, 2015; Komninos, 2018; Ait-Yahia *et al.*, 2019; Bwalya, 2019). However, the "silent agreement" seem to be about building "smart public administration", "smart governance", "smart resources" as well as "smart city planning and design" through the integration of ICT into urban and regional spaces and cities' socio-economic infrastructure (Aina, 2017; Bwalya, 2019). In line with the silent agreement, Aina (2017) suggested that the framework for smart city development should be divided into two categories. The first category of the suggested framework comprises of the typologies, characteristics, dimensions and strategies for the development of smart cities whereas the second category includes the procedures, components and performance appraisal systems of smart cities (Aina, 2017). The characteristics or dimensions of smart cities in the first category are identified as "smart economy", "smart mobility", "smart governance", "smart environment", "smart living" and "smart people" (Aina, 2017; Bwalya, 2019). Accordingly, smart economy involves economic competitiveness, innovation, and ability to transform and advance the economy for better and improved development. Smart mobility

entails the integration of ICT with transport for stability and sustainability whereas smart governance focuses on promoting transparency in governance and encouraging public participation through e-governance as well as ensuring that there is efficient service delivery (Aina, 2017; Bwalya, 2019). For smart environment, sustainable management of natural resources is at the centre of development while smart living is concerned about provision of quality of life as well as strengthening of society's social cohesion. Smart people dimension directly links with the development, improvement and sustainability of human and social capital (Aina, 2017; Bwalya, 2019). That is, the first category of the framework is object-specific whereas the second category is process-specific in which it deals with processes and procedures towards achieving smart cities.

Albino, Berardi & Dangelico (2015) compiled and analysed diverse theoretical dimensions in which they revealed that smart cities should integrate at a minimum of four of the following dimensions or characteristics: "networked infrastructure", "innovative and entrepreneurial urban development", "social inclusion" and "natural environment". Therefore, society's socio-economic development is embedded within a number of approaches towards developing smart cities. These characteristics could be included, either explicitly or implicitly, with other dimensions that are believed to be part of the development of smart cities for the promotion of socio-economic development. Deakin, (2014, in Aina, 2017:50) emphasised that "cities are smart when the ICTs of future internet developments successfully embed the networks society needs for them to not only generate intellectual capital, or create wealth, but also cultivate the environmental capacity, ecology, and vitality of those spaces which the direct democracy of their participatory governance open up, add value to and construct". On another notion, Mora, Bolici & Deakin (2017) asserted that most of the approaches towards the development of smart cities have mainly been techno-centric with insufficient investments on cultural, social and environmental aspects of development. Although economic development is at the centre, social development is always neglected and in cases wherein it exists, it is mostly an unintended outcome. Smart cities do have potentials of improving society's socio-economic development as suggested by Aina's (2017) development framework and many others that consider the social dimension as a critical factor towards sustainability of these cities.

4. South Africa's Smart City as a Response to Socio-Economic Development: Analysis of Sustainability and Efficiency of Lanseria

The evolving concept of "smart city" has recently been considered globally as an approach for achieving sustainable urban planning through the use of ICT for socio-economic development (Mahizhnan, 1999; Komninos, 2014; Hausmann, 2015; Aina, 2017; Ballard, Dittgen, Harrison & Todes, 2017; Komninos, 2018; Ait-Yahia *et al.*, 2019; Bwalya, 2019; Brill & Reboredo, 2019). Like in many countries, South Africa's cities are considered as centres for modern development and innovation which directly contributes towards socio-economic development (Bwalya, 2019). By building housing in townships and rural areas that are far from economic activities mostly based in towns and cities, the majority of post-apartheid housing delivery has also aggravated apartheid spatial planning patterns (Dittgen *et al.*, 2017; Brill & Reboredo, 2019). Although these housing projects were addressing high levels of poverty and inequality in the country, they seemed to be an extension of the historic apartheid spatial plans (Dittgen *et al.*, 2017; Brill & Reboredo, 2019). The social, economic as well as spatial inequalities and ecological disparities beg for more inclusive and integrated spatial planning. In response to the challenges, South Africa realised its potential and conceived its first project for smart city development under the former President Thabo Mbeki's leadership (Bwalya, 2019). The conceptualization of the city further continued through the governance of the former President Jacob Zuma, and it is currently being developed by the City Johannesburg Metropolitan Municipality (Dlodlo, Mbecke, Mofolo & Mhlanga, 2013; Bwalya, 2019). The aim behind the transformation and development of Johannesburg City into a smart city is the desire to ensure that it becomes enlisted as one of the world class cities which responds to current and future challenges through the integration of technology.

Due to high migration rates as well as increased urbanization in search of economic growth and development, City of Johannesburg is experiencing pressure on its development resources and services such as water, electricity, sanitation, transport and internet connectivity (Dlodlo *et al.*, 2013; Bwalya, 2019). Currently, with the mushrooming of informal settlements around the city, most of these settlements are without water, sanitation

and road infrastructure, among other services and infrastructure. On average, during peak hours, it can take up to 3 hours to travel a distance of 25 to 35 km into and around the city (Bwalya, 2019). Therefore, smart development approaches are a necessity in responding to these kinds of challenges. Regardless of the above-mentioned challenges, City of Johannesburg is still considered and ranked first in Africa for its urban development strategies as well as ICT maturity (BusinessTech, 2017). To maintain its competitiveness, there is a need for the city to upgrade its development strategies for innovation and sustainability reasons. Presently, there were two smart city projects in Johannesburg, transforming the existing City of Johannesburg and building of the new Modderfontein Smart City. Modderfontein is a 1600 hector site located in north-east of City of Johannesburg which was then purchased by Zendai in 2012, a Chinese developer based in Shanghai, for the development of a smart city tagged the "Manhattan of Africa" and "Africa's New York", among others (Dittgen *et al.*, 2017; Brill & Reboredo, 2019).

In their planning, the two cities were not supposed to be developed individually but as a collective, implemented in two phases over 40 years (Dlodlo *et al.*, 2013; Bwalya, 2019). In the first phase, the focus in the design of the Johannesburg Smart City was on public spending towards the development of public Wi-Fi hotspots in order to increase Internet accessibility of the city's society (Dlodlo *et al.*, 2013; Bwalya, 2019). With the increase in internet connectivity, the hope has been that the society will be able to engage in the knowledge economy and improve their socio-economic development (Bwalya, 2019). However, it must be noted that internet connection on its own, is not sufficient precondition for the successful operation of a smart city. Collectively, investments in networked infrastructure, promotion of innovative and entrepreneurial urban development, strengthening social inclusion and protection of the natural environment are some of the key components of a successful smart city. The second phase entails a public-private partnership wherein Modderfontein Smart City was to be designed, developed and built from scratch (Dlodlo *et al.*, 2013; Dittgen *et al.*, 2017; Bwalya, 2019). Therefore, as a key stakeholder, the City of Johannesburg Metropolitan Municipality was to be fully involved in both phases of the two developments in which the developments hoped to establish and promote "smart health" and "intelligent transportation"

principles that can be achieved through smart cities (Dlodlo *et al.*, 2013). Although City of Johannesburg is still in its early stages of development, there is still more to be done with establishing an efficient and sustainable city that is capable of promoting and supporting socio-economic development (Bwalya, 2019). That is, smart cities must promote and support socio-economic infrastructure and ICTs for development through public-private partnerships and societal integration in the cities' smart systems.

However, the Modderfontein Smart City never came into existence due to discrepancy challenges between the new city plans and the requirements of the City of Johannesburg Metropolitan Municipality. The first challenge was that, regardless of the developer's assurance of extending the Corridors of Freedom, it was not clear how Modderfontein could contribute to such development because it is outside the demarcated corridors and also not integrated with the Bus Rapid Transit systems (Dittgen *et al.*, 2017). The second challenge was with regard to the excessive supply of the office and commercial spaces which were as many as those of Sandton with a potential of undermining the existing economic centres in and around City of Johannesburg (Dittgen *et al.*, 2017; Brill & Reboredo, 2019). Given the existing oversupply of office spaces in the city, the plan also failed to present well, the unique economic focus of Modderfontein City from those of existing urban spaces. The third challenge was that the planned Modderfontein Smart City failed to house sufficient and diverse range of residents from various economic groups which was against the City of Johannesburg Metropolitan Municipality's social housing focus. Instead, the city was planned to offer housing developments ranging between R800,000 and R 2,500,000 (Dittgen *et al.*, 2017; Brill & Reboredo, 2019). Although the planned city emphasised density, public transport, and transit oriented development, its developments failed to respond to the socio-economic realities of the municipality (Brill & Reboredo, 2019). Therefore, the imaginative visions of the city were certainly inappropriate for South Africa's context in relation to and not limited to expertise, rates of sale versus economic reality as well as factors regarding inequality and socio-economic exclusions.

Of late, in his State of the Nation Address, President Cyril Ramaphosa indicated that South Africa is in need of a smart city that can amend the apartheid socio-economic spatial make-up and accordingly,

"a new smart-city is taking shape in Lanseria, which 350 000 to 500 000 people will call home within the next decade" (Ramaphosa, 2020: n.p.). In promoting South Africa's social cohesion agenda, Lanseria will be a city wherein people from various economic classes with different income levels will be housed (Makhura, 2020). Therefore, there will not be any opportunities for socio-economic exclusion. The new city will stretch from Lanseria (Gauteng) to Haartebeespoort Dam (Madibeng, North West), and is planned to develop during this decade (Makhura, 2020). According to the President, the development is led by the Investment and Infrastructure Office in The Presidency together with the provincial governments of Gauteng and North West Provinces, in partnership with the cities of Johannesburg, Tshwane and Madibeng as well as the private sector. Thus far, an innovative process meant to fund bulk water, sewerage, electricity, roads and digital infrastructure is the foundation of the new city (Ramaphosa, 2020). Lanseria smart city "will not only be smart and 5G ready, but will be a leading benchmark for green infrastructure continental and internationally" (Ramaphosa, 2020: n.p.). That is, technology will be employed in "converting waste to energy and setting up electricity micro-grids that we expect to draw at least half its power from renewable sources" and rely mainly on rainwater harvesting to ensure that it has small carbon footprint (Makhura, 2020: n.p.).

The planned city's economy and infrastructure are centred around the existing Lanseria Airport and are also designed to encourage cross-cultural living. The current Lanseria Airport City Mega Project is planned to be transformed into a high-density mixed-use residential area (Gauteng Department of Human Settlements, 2019). Accordingly, the city which will be implemented over 10 years and will consist of 50,000 residential units to house the 350,000 to 500 000 population as well as almost 5000 000 square metres of commercial floor space (Gauteng Department of Human Settlements, 2019). The Lanseria City aims to embrace regional transportation nodes wherein Gautrain will extend its route to the city, be an "ICT, training, and research centre" complemented by travel, tourism and leisure attractions, as well as manufacturing, logistics, and business hubs (Gauteng Department of Human Settlements, 2019). As already indicated by the premier of Gauteng Province, Mr David Makhura, Lanseria will be a green city with a determination to take into consideration, the natural environment

for minimal environmental impact while promoting equitable socio-economic development for the society.

Given that smart city concept is not well-defined, it is also important to understand the approach that South Africa has adopted in its "smartness" given the failure of the Modderfontein Smart City as well as the current socio-economic circumstances. Although smart cities are more focussed on the integration of ICT in their design and operations, South Africa's Lanseria City is silent on how technology will be used to enhance its efficiency and sustainability. The focus is mainly on protection of the environment, reduction of the carbon print and minimal use of natural resources. Reflecting on the Modderfontein case, other than the inclusion of mixed-use residential areas for housing various socio-economic groups, the question remains what else is incorporated as part of the smartness of the city? Other than the spatial layout and design as well as aesthetics, what techno-centric aspects differentiate Modderfontein from Lanseria that assures that the city will be a success? With South Africa's current state, which is characterised by collapse of its State Owned Enterprises, high unemployment rates and levels of poverty, and, huge debts associated with development, this paper begs to question the country's readiness to implement sustainable and efficient smart cities for effective socio-economic development in the society. For example, for smart cities to function efficiently; transport, sustainable energy and ICT are at the centre of the development. Through urban planning, there must however, be a balance between modern development interventions inclusive of ICT and the natural environment for sustainability compliance.

5. Conclusion and Recommendations

This paper discussed the various conceptualizations of smart cities in order to understand their nature. Additionally, smart cities as a mechanism for socio-economic development was also discussed. A critical analysis of South Africa's smart city and its efficiency and sustainability in responding to the adverse effects of apartheid settlement planning and need for effective socio-economic development was also provided by using experiences from Modderfontein to reflect on Lanseria's efficiency and sustainability as a smart city. The paper revealed that, although a number of cities globally have implemented smart city projects

for sustainable socio-economic development, the principles of smart cities are techno-centric and economic in nature with limited focus on social, cultural and environmental factors affecting sustainable urban development. The paper concludes that South Africa needs to clarify its conception of smart cities in order to ensure that they respond to the existing socio-economic status of the country. That is, the country in its current state, which is characterised by problems in all its State Owned Enterprises, high unemployment rates and levels of poverty, and, huge debts associated with development, is not ready to implement smart cities for socio-economic development.

Based on the theoretical findings and challenges of this paper, the following recommendations emerged so as to ensure sustainability and efficiency of smart cities for socio-economic development in South Africa:

5.1 Misconceptions of Smart Cities

Given various conceptualization of smart city across different countries, South Africa as a developing country must also conceptualize its smart city in relation to its socio-economic and ICT infrastructural development. Adopting conceptualization of the concept from other countries might be misleading given the differences in development levels, therefore, South Africa must be clear and specific in its conceptualization of smart cities in order to be able to implement and sustain them.

5.2 Collapse of South Africa's State Owned Enterprises

Sustainable development is crucial for continuous provision of infrastructure and services for socio-economic development. However, South Africa's state owned enterprises, specifically Eskom, is at the edge of a collapse. The unstable electricity provision will adversely affect the productivity of smart cities especially because they require electricity to function effectively. Therefore, South Africa through Eskom, must ensure that there is uninterrupted electricity supply in its planned smart cities.

5.3 Unstable Internet Connections and High Data Costs

The core element of smart cities is ICT and its infrastructure as well as associated services. However,

the high costs of data and unsustainable internet connections are threats towards the success and functioning of smart cities. Therefore, South Africa must ensure sustainable internet connection as well as affordable data cost to the majority of the population inclusive of the poor which are paramount to the success of these developments.

5.4 High Unemployment Rates and Levels of Poverty

One of the major challenges that South Africa is faced with is high unemployment rates and levels of poverty. Therefore, the planned smart cities must provide solutions on how to reduce these high rates of social ills taking into consideration the current socio-economic status of the country and that of the selected location for these developments.

5.5 Huge Debts Associated with Development

As it stands now, South Africa has huge debts associated with loans for development. The question is therefore, where will the money to fund these planned smart cities come from? Will the cities be able to generate revenue that will perhaps assist in paying the debts? It must be clear in their plans as to how the funds will be acquired taking into considerations existing debts.

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