

1 WHAT DOES “SMART CITY” MEAN FOR AFRICAN MUNICIPALITIES?

Investigating the current status, enablers and restraints, and the future of smart city adoption in Africa

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Smart Cities have been (and are being) implemented globally, most notably in Singapore in Asia, but also in other prominent cities in India, Denmark, Finland, England and USA. Smart Cities are cities which use technology for the management and monitoring of infrastructure, customers, personnel, finances, and systems within the city. A Smart City enables efficient management of municipal infrastructure, including water, sanitation, roads, stormwater and electricity.

Municipalities within Africa are faced with significant challenges related to the management of infrastructure. Most notably, Africa has seen rapid urbanisation over recent decades, and this trend is expected to continue. It is projected that 70% of the world will live within cities by 2050. Therefore, there is an imperative that African cities are resilient, able to accommodate and manage the population influx. Herein, Smart Cities are perceived as facilitators for sustainable development. Furthermore, the Constitution of South Africa requires that basic services are prioritised for all, as everyone has the right to basic services. The question is therefore posed how can Smart City concepts be implemented within the African context, and should these concepts be considered at this time?

This paper investigates the drivers for Smart City implementation within African municipalities. The Smart City concept in this paper is considered to include African cities, towns, townships, or rural areas. The paper aims to indicate that despite the adoption of the Smart City concept globally, there are key sectors within African local governments which would unlock the adoption of the Smart City concept to realise sustainable, resilient, efficient cities of the future. The hypothesis of the study was that technology, although an important factor, is not the limiting factor to the implementation of Smart Cities in Africa, but that the adoption of Smart Cities requires an enabling environment with financial and institutional support driving integrated efficiency, security, sustainability, and community engagement into all operations of the city. Effective Smart City implementation take cognizance of the various critical success factors in making cities vibrant and liveable.

The primary research was obtained through a multi-criteria analysis of the maturity level of the adoption of Smart City within the various municipal infrastructure sectors within the African continent, including South Africa. The primary data was gathered through a comprehensive questionnaire consisting of qualitative and quantitative data. This research is complimented by a review of the current Smart City frameworks, or strategic approaches, used globally and within Africa.

INTRODUCTION

Urbanisation

Africa is transitioning from a rural to an urban continent over the coming decades. Globally, the transition to urbanisation is expected to be most rapid in Africa and Asia, with Africa having 56% of the population living within urban areas by 2050 (United Nations 2014). Africa is expected to be the fastest urbanizing region from 2020 to 2050 (United Nations 2014). This will mean that African cities, which house approximately 1.1 billion

people will need to accommodate almost double this population by 2050, which also comprise of informal settlements (Muggah & Kilcullen 2016).

By 2030, Africa is expected to double the megacities (i.e. cities with populations exceeding 10 million) within the continent from Cairo, Kinshasa and Lagos to Dar es Salaam, Johannesburg, and Luanda. The African large cities (i.e. cities with populations between 5 and 10 million) will see an increase from three in 2014 to twelve in 2030 (United Nations 2014).

Historically, urbanisation has strongly correlated with economic development (Kessides 2006). However, this correlation is weaker in developing countries, especially in Africa, here some countries have increased urbanisation levels with no increase or declining income (Kessides 2006; United Nations 2014).

Therefore, there is an imperative that African cities are resilient, able to accommodate and manage the population influx. The cities will need to adequately sustain economic development and sustained service delivery through improved income and employment opportunities. This means that the cities will need to not only deliver new infrastructure but also manage existing infrastructure related to water, sanitation, energy, transportation, information and communications (Anderson & Galatsidas 2014). Within the South African context, the Constitution mandates government to prioritise basic service delivery to all through the right to basic services (RSA 1996).

Smart cities

The term Smart Cities has developed naturally out of the technological revolution over the last few decades, as evidenced through the smart building industry. Although there are many examples of Smart City initiatives, Smart Cities broadly defined are cities which use technology for the management and monitoring of infrastructure, customers, personnel, finances, and systems within the city. Smart Cities make use of technology to do more with less (Townsend 2013). Such ambitions are enabled through sensors, such as the Internet of Things, providing quantitative data feeds real-time from infrastructure; and integrated management systems within the municipal environment. It has been argued that enhancing municipal performance will deliver improved services, which align with the Constitutional mandate of delivering basic services to all (Divall 2015).

Smart Cities on one level refer to an integrated city which minimises waste within resources and fruitless expenditure, and is seen as a centralised, integrated system as indicated in Figure 1.

The second approach to Smart Cities is to consider the initiatives which emanate from the use of technology and the digitisation of infrastructure. This includes examples from smart metering, smart street lights, increased use of renewable energy sources (including wind or solar power), ICT



FIGURE 1: Overview of the Smart City Concept Integration

rollout, sustainable transportation (including ride sharing, driverless cars, non-motorised transportation), and resource management including water, energy or transportation. The key initiatives been promoted through Smart Cities are toward energy (and resource) efficiency, transportation, lowering carbon emissions and reducing operational costs (Monaghan 2013). Each of these initiatives require specific focus to the problems faced within the city and the implementation of these solutions are specific to the structures and capabilities within the municipality.

The Smart City initiatives which are implemented globally are becoming part of the infrastructure development, whether rolled out through new infrastructure development or through refurbishment of existing infrastructure. Smart Cities are considered a journey more than a destination - a city in "beta". Smart Cities are focused on leveraging the strengths of the city through iterative initiatives and processes. It is important to note that Smart Cities do not hinge on technology alone. Smart Cities ultimately have the same goals as all municipalities and government institutions, namely (Patel 2017):

- Sufficient and reliable supply of water with nominal losses;
- Sufficient and reliable electricity supply with nominal losses;
- Safe environment with waste disposal and treatment;
- Sustainable transportation modes and reduced congestion;
- Affordable housing and services;
- ICT connectivity and availability;
- Good governance (e-Governance);
- Participation of citizens within the city;
- Sustainable environment;
- Safe cities, ensuring security of citizens especially the vulnerable;
- Access to affordable healthcare and education.

Africa's cities are poised to transform through the adoption of advanced technologies. Smart Cities were identified as part of South Africa's National Development Plan as key developmental goals for global competitiveness (Content 2016). The main question that needs to be answered in the roll-out of technology within the built environment and the municipal services is the goals, including direct benefit or value, that such technology aims to achieve within the municipal working environment. To achieve these goals, it is essential that the municipality develop integrated Smart City master plans or strategies to ensure that the initiatives dovetail with the overall objectives of the municipality. Without an integration of initiatives, the municipality risks having disparate systems which make managing the data unattainable. Therefore, the ambitions and perceived benefits of the Smart City initiatives will not be realised. The efficacy of these initiatives must be tracked and monitored through a range of specific performance indicators.

Smart Cities are characterised by other descriptors such as resilient cities, safe cities, future cities, green cities, or sustainable cities. For this discussion, the concept of a Smart City is considered to include these aspirations.

Methodology

It is against this backdrop that Smart Cities are perceived as facilitators for sustainable development. The question is therefore posed how can Smart City concepts be implemented within the African context, and should these concepts be considered at this time? Within the African context, it was considered that Smart Cities refer to cities, towns or rural places.

The primary research was obtained through a multi-criteria analysis of the maturity level of the adoption of Smart City within the various municipal infrastructure sectors within the African continent, including South Africa. This data was gathered through a questionnaire consisting of qualitative and quantitative data. The questionnaire was disseminated

electronically through email. The survey made use of a commercial on-line survey tool which anonymised all user data. All respondents were informed that the participation in the survey was voluntary prior to commencing with the survey.

The survey consisted of up to 14 questions, depending on the input from the respondent. The survey was estimated to require 5 minutes to complete. This provided rapid appraisal of the respondent's views on the state of Smart Cities within their organisation. The survey was sent out to approximately 800 respondents varying from national, provincial to local municipalities, state owned companies, or other government institutions within Africa.

The aim of the survey was to provide insight into the state of Smart City adoption within the African context. The results were analysed based on the feedback to date.

Results

All results were analysed as provided by the respondents. The results are provided as a percentage of all responses for each of the relevant questions. The information was considered to be correct and no corrections or additions were made to the data outputs. The results are discussed based on the following outline:

- Overview
- Drivers and Challenges
- Implementation Strategy
- Institutional Priorities

Overview

The respondents indicated that their main experience was based in the government departments, as indicated in Figure 2. It is noted that no response was provided from the ICT, sanitation and wastewater, or solid waste departments. The majority of the respondents were from the transport sector and the governance sector. The governance sector refers to all facilitating services including but not limited to customer services, financial services, human resources, or management. It is noted that there were 8% of respondents who did not have a thorough understanding of any of the sectors.

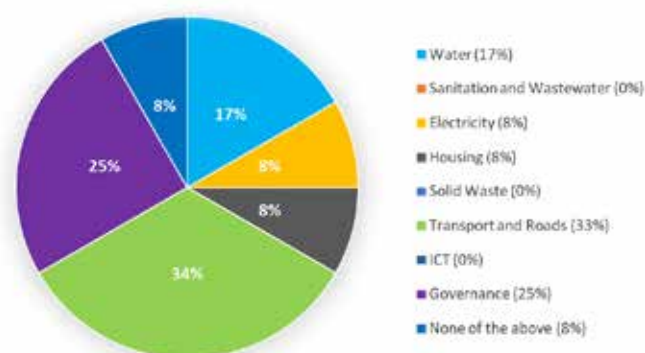


FIGURE 2: Key sector participation in survey

Drivers and Challenges

The key finding from the survey was the expectation that Smart City initiatives should be developed to facilitate basic service delivery. This view was shared by 92% of the respondents, whilst the remainder considered basic service delivery as the main before Smart City initiatives could be considered.

Main drivers for implementing Smart Cities within institutions are presented in Figure 3. The main driver for Smart City implementation is

based on increasing the efficiency of the infrastructure or fixed assets. The finding from the drivers for Smart City implementation aligned with the response that Smart City initiatives will be facilitators of basic service delivery.



FIGURE 3: Main drivers for Smart City implementation

The respondents were asked to prioritise or rank each of the following challenges which were identified through literature and experience as potential challenges to the implementation of Smart Cities. The results are indicated in Figure 4. A key finding was that most of the proposed challenges were considered critical to moderate challenges for the implementation of Smart City solutions.

The main challenges to the implementation of Smart City initiatives were:

- Operational and capital cost related to the implementation of smart city initiatives
- Limited institutional capacity, resources and political will to implement and manage smart city solutions
- Community need for basic service delivery and appropriate smart technology to facilitate such basic service delivery

Implementation Strategy

The majority of the respondents (67%) indicated that the organisation had developed Smart City Strategies or Master Plans, whilst 17% did not have a plan in place and 16% did not know whether a relevant strategy or master plan was in place.

The expectation was that Smart Cities would be funded through external funding, either through government grant funding or private investment, as indicated in Figure 5. The results were consistent with the finding that the cost of the Smart City initiatives were considered challenges to the implementation thereof.

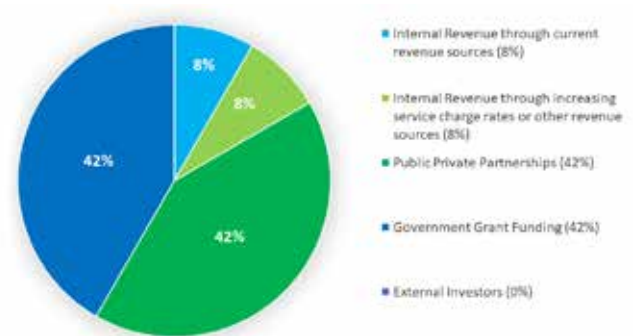


FIGURE 5: Expected main sources of funding for Smart City implementation

The expected business model for the implementation of Smart City initiatives was predominantly through increased internal revenue generated through reduced expenditure due to increased efficiencies within the institution and efficient planning and revenue collections. It is noted that none of the respondents believed that the implementation of Smart City initiatives would yield no increased revenue for the institution.

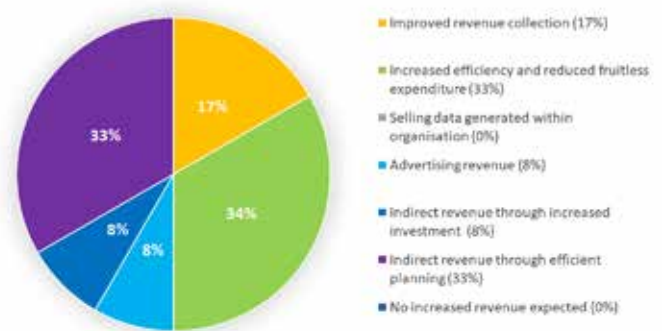


FIGURE 6: Expected main sources of revenue from Smart City initiatives

Institutional Priorities

The priorities within the institutions for Smart City initiative implementation was focused toward increasing investment confidence within the institution and their jurisdiction. The main priorities for implementation were indicated in Figure 7, and indicated that real-time infrastructure monitoring (i.e. using sensors and the Internet of Things) was not the main priority for institutions.

The survey finally identified that there were key Smart City initiatives being implemented within institutions throughout Africa, predominantly in the governance, ICT and electricity sectors. It is noted that the governance

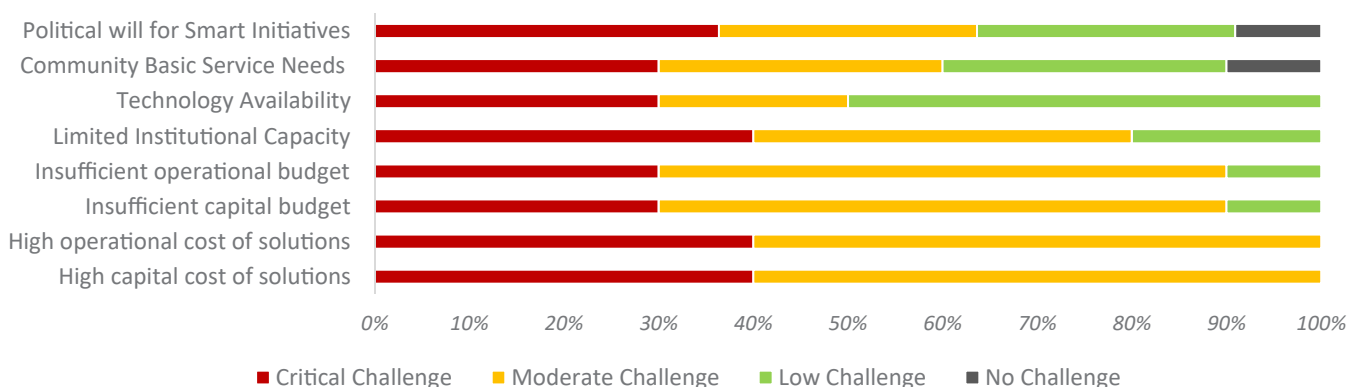


FIGURE 4: Prioritisation of challenges for Smart City implementation

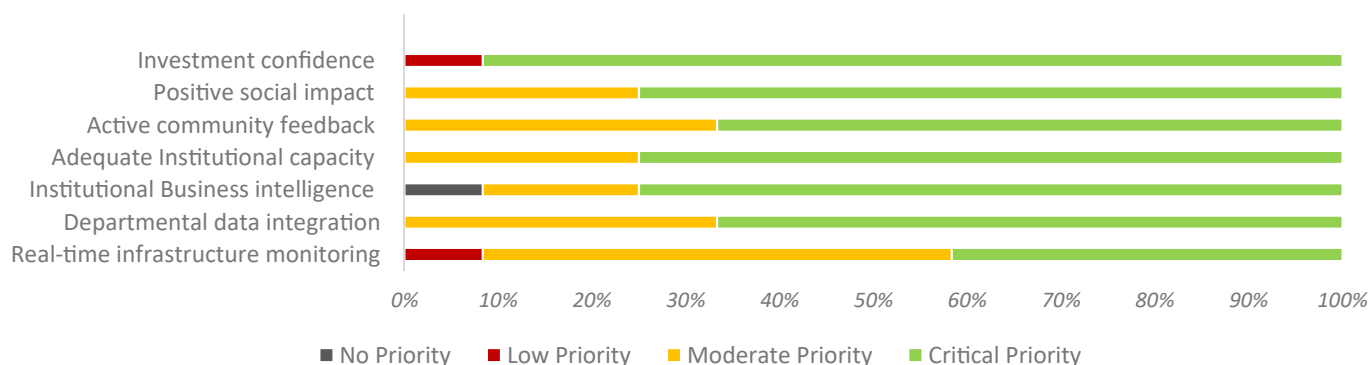


FIGURE 7: Institutional priorities for Smart City initiatives

sector refers to institutional support activities related to finance, customer services, human resources, management, or other departments. The results are indicated in Figure 8.

Conclusions

Smart Cities are globally perceived as enablers for sustainable development. Smart Cities are specifically relevant to Africa through the increased urbanisation that will take place over the next decades. However, Smart Cities will also potentially create enabling environments for towns and rural areas, which are expected to be a part of African countries for the foreseeable future.

This paper investigated the drivers for Smart City implementation within African municipalities based on an online survey. One of the key findings was that the concept of a Smart City was perceived as enablers for basic service delivery. Furthermore, majority of the respondents indicated that they were aware of Smart City strategies or master plans within their institutions, and several projects or initiatives were being rolled out throughout Africa which were components of the Smart City.

The hypothesis of the study was that technology, although an important factor, was not the limiting factor to the implementation of Smart Cities in Africa. The results indicated that the cost associated with the technology procurement and operations were considered significant challenges to the implementation of Smart City initiatives.

The results could not provide clarity on the enabling environment required for Smart City implementation but the author is still convinced that the success of the Smart City initiatives will require financial and institutional support driving integrated efficiency, security, sustainability, and community engagement into all operations of the city. The focus must remain on the key service delivery requirements and challenges specific to the city and leverage technology to increase institutional efficiency and transparency to increase investor confidence within the city.

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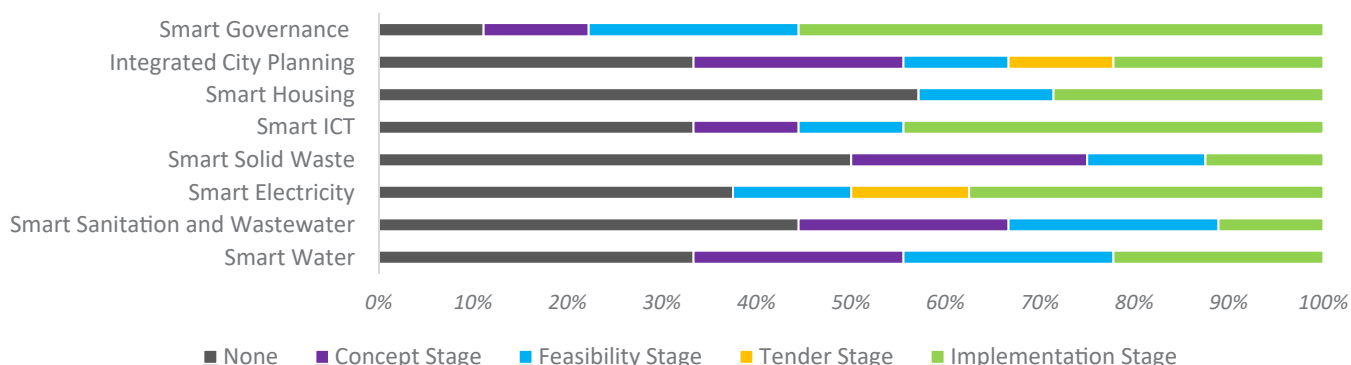


FIGURE 8: Institutional maturity in implementing Smart City initiatives