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Tales of an African City





Smart Metropolitan Regional Development - Economic and Spatial Design Strategies

> 2/3 Year 2017, 1st of June Presented in this Bulletin

DAKAR ~ CONAKRY ~ ABUJA ~ JOHANNESBURG ~ NAIROBI

By Authors

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STUDY AREAS Our research project consist now of 16 Metropolitan Regions



INSTITUTIONS There are 25 different institutions involved

	Private company	Society	University	Non-profit Organisation	Private Institution	Government	t Research Institute	
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MILESTONES

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Bulletin 1	Pittsburgh, Naples,	15 th March,	Chapters Draft 1	15 th November, 2017
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Bulletin 2	Dakar, Conakry, Abuja,	1 st June,	Chapters Final draft	31st December, 2017
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Images on the cover are from Dakar, visualizing the differences of downtown area and poor neighborhoods. (Source: Shutterstock.)

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DAKAR

SENEGAL

Gora Mboup - Adrien Coly - Momar Diongue - Mame Cheikh Ngom - Papa Sakho TOWARDS A SMART METROPOLITAN REGIONAL DEVELOPMENT ECONOMIC AND SPATIAL DESIGN STRATEGIES

Introduction

The Dakar Metropolitan Region, administratively called region of Dakar, is sub-divided into four departments: Dakar, Pikine, Guediawaye and Rufisque. The first three departments form the urban agglomeration of Dakar [1]. The Department of Dakar forms the city of Dakar. Though they have distinct geographical boundaries, all three (the metropolitan, the agglomeration and the department of Dakar) have the same name, Dakar, making always confusing the production and analysis of urban development statistics in the metropolitan. For instance, in 2015 the population of the department of Dakar is 1.2 million, the population of the urban agglomeration of Dakar is 2.8 million, and the population of the Dakar Metropolitan Region is 3.3 million including all departments. While the urban agglomeration occupies only one third (179 square km) of the land of the metropolitan region (551 square km), it constitutes 85% of the metropolitan region population. In terms of population density, the figure for the urban agglomeration of Dakar is more than 15,000 inhabitants per square km while the figure of the metropolitan region is less then 5,000 inhabitants per square km with the low densely population of the department of Rufisque.

Recognizing the unbalanced Dakar metropolitan regional development, the Senegalese government have taken bold actions to transform the urban landscape from a monocentric to a polycentric metropolitan region with the creation of urban centres to decongest the Dakar urban agglomeration. This is through five main complementary programmes, reforms and plans: 1) the Plan Senegal Emergent; 2) Act III of Decentralization; 3) Metropolitan Planning; 4) Dakar Urban Master Plan 2035 and; 5) Digital Senegal Strategy 2016-2025. These urban policies and programmes aim to spatially and economically transform the Dakar Metropolitan Region to be smart, sustainable, inclusive, resilient and prosperous.

The Dakar case study will consist of analysing the economic and spatial strategies undertaken by national and local authorities for a Smart Dakar Metropolitan Regional Development. It will be developed through two sections: Section 1 - Dakar in Time and Space: Place of Opportunities and Challenges, which is a factual analysis of the situation in the ground and; Section 2 – Spatial and Economic Transformations for a Smart Dakar Metropolitan Region, which is a prospective analysis of how the different



Aerial view of Dakar, Senegal. (Source: Shutterstock/Dereje)

ways economic and spatial from these different programmes, reforms and plans will contribute to the smartness of the Dakar Metropolitan Regional Development. The Study will be based on the conceptual framework developed in the African Smart Economy in Smart Cities studies published in 2016 including four African cities: Cape Town, Nairobi, Dakar and Lagos. However, this framework will be modified and adapted to the metropolitan region context for a better integration of ICTs in the planning, the design and the management of the metropolitan region as well as its economic development.



Figure 1 – Smart Dakar Metropolitan Regional Development Conceptual Framework. Source: Mboup G., 2016. in Smart Economy in Smart Cities (ed. V. Kumar et al.), Springer, to be adapted by the author to Dakar Smart Metropolitan region.

The opportunities for ICT to support the overall urban challenges and opportunities are enormous, and the Dakar Metropolitan Region must integrate and use ICT solutions to facilitate the greater provisioning of urban services. Following the exigency of the city of the 21st century that calls for sustainability, inclusion and prosperity, the planning and management of human settlements must take into consideration the gain in knowledge on various conditions that make cities smart, green, ecological, liveable and healthy. Thorough increased efficiency and innovation, ICT increases economies of scale and agglomeration, and promote diffusion of knowledge, even at the smaller human settlements. Small settlements as small firms are benefiting from ICT in making their

goods and services beyond their territories. Virtual offices, virtual networks, teleconferences are increasing large public participation and inclusion. Digital firms can start and scale up quickly with relatively little staffing or capital investment. ICTs harness the benefits of agglomeration economies in easing circulation of goods and services and encouraging polycentric urban development and allowing synergies between centres nd sub-centres. They intensify urban nodes and corridors to maximize the benefits of concentration. This is the context where we are introducing economic and spatial strategies for a smart metropolitan regional development to unlock the potential of Dakar metropolitan region to be smart, sustainable, inclusive, resilient and prosperous.

However, ICT alone will produce little in the smart metropolitan regional development. 'Smart' is not an end in itself [2]. It is the way ICT is integrated in the city development that will determine the city smartness. From the beginning of the 21st century a digital citizenship, particularly the "Millennials" generation, has started to emerge in Dakar as in many African cities. Maximizing the digital dividends requires better integration of ICTs with the other factors of smart cities such as: city foundation, infrastructure development, environment sustainability, social development, disaster prevention, resilience, peace and security. ICT can be seen as substitution and catalyst factors, but the other factors (or the analogue part) of the operation are crucial in making smart economy. Those factors include the city foundation, institutions and laws, infrastructure development, social development, social inclusion, environmental sustainability, disasters prevention and resilience (particularly in the context of climate change), peace and security. Most tasks have an aspect that cannot be automated by technologies and that requires human judgment, intuition, and discretion. This is where lies the crucial role of human capital associated with institutions and laws, efficient governance, management and administration.

Without improvement on accountability at all levels, ICT alone cannot change the outcome of the economic productivity equation. African Countries that are able to swiftly adjust to this evolving digital economy will reap the greatest digital dividends, while the rest are likely to fall behind.

Summary of section 1 – Dakar in time and space – Place of Opportunities and Challenges

The dynamic transformation of the Dakar Metropolitan Region has occurred in different paces, times and places in terms of urban form and structure: density distribution, and compactness. From a population of about 214,000 in 1950, the Dakar Metropolitan Region has a population of 3.5 million in 2016. Since 1950 Dakar has been a primate city with more than half of the national urban population living in the urban agglomeration. This chapter assesses the spatial growth of city and how populations are spatially distributed. In space, growth of city can occur in many ways: infill, extension, inclusion or leapfrog [3]. However, little had been known on these different forms of spatial growth of cities until recently with the development and use of GIS technologies. We will use these technologies to assess the spatial growth of the Dakar Metropolitan Region. Yet the average population density of over 15 000 inhabitants per km2 masks densities as high as 40 000 persons per km2 observed in certain municipalities of Dakar city proper as well as in the suburban areas of Pikine and Guediawaye compared to densities below 5,000 persons per km2 in high income areas in the department of Dakar and other areas in the Department of Rufisque which are mainly agriculture areas.

Since the colonial period, the Dakar Metropolitan Region has been the engine of the Senegalese economy. Today, it occupies a pivotal place in the trade sector both nationally and internationally. Its autonomous port, its international airport, its international trade center, its touristic sites and its commercial centres are assets for the Senegalese economic sector. Indeed, the Dakar Metropolitan Region contributes nearly 55% of the national Gross Domestic Product (GDP) [4] and has a concentration of nearly half of Senegalese civil servants. Nine out of ten employees in Senegal's trade, transport, banking and industrial enterprises are in the Dakar Metropolitan Region [4]. However, most these urban advantages are concentrated in the city of Dakar. Though the Dakar Metropolitan Region had been administratively divided in four departments, in reality the other three departments act as suburbs of the department of Dakar, where the main commercial and administrative businesses are concentrated. The other three departments remain haunted by the early spatial and social division [5]; they are not well planned, and they lack sufficient land allocated to streets, other public spaces, basic infrastructure and security of tenure [6].



Figure 2 - Dakar Population Density Map, 2015. Source: population density computed and geo-referenced using ARCGIS software by the authors applied to the ANSD 2015 Projection. Population, Housing, Agriculture and Livestock Census, 2013.

Despite its potential to be sustainable, inclusive and prosperous, Dakar Metropolitan Regional development has, indeed, been hampered by its weak foundation. Many settlements in the agglomeration lack a sewerage system and rainwater drainage facilities, and adequate waste management sites are missing, which are key components of smart basic infrastructure along with connection to water and energy. Flooding during rainy seasons as well as uncollected garbage is frequent phenomena in all parts of the agglomeration, but particularly in poor settlements. Frequent energy shortages also affect the city's economy. In addition, infrastructure for non-motorized transport (e.g. pavements or sidewalks for walking and bicycle lanes for cycling) is often lacking, poorly developed, on the decline or does not appear to rank high among city planners' priorities [6]. This has led to high incidences of traffic fatalities involving pedestrians and cyclists. Streets that provide space only to motorists are characterized by congestion and high CO² emissions. These challenges are associated with poor land administration and governance, characterized by corruption and lack of transparency in public as well as private transactions [6].

Summary of section 2 – Spatial and Economic Transformations for a Smart Dakar Metropolitan Region

This second section is a prospective analysis of different ways economic and spatial transformations from these different programmes, reforms and plans will contribute to the smartness of the Dakar Metropolitan Regional Development. First We will analyse the spatial transformation expected from the five main complementary programmes, reforms and plans developed by national and local authorities, which are: 1) the Plan Senegal Emergent; 2) Act III of Decentralization; 3) Metropolitan Planning; 4) Dakar Urban Master Plan 2035 and; 5) Digital Senegal Strategy 2016-2025. These urban policies and programmes aim to spatially and economically transform the Dakar Metropolitan Region to be smart, sustainable, inclusive, resilient and prosperous. Second we will analyse the economic transformation expected in these programmes, reforms and plans. Third we will proceed with a holistic analysis using the conceptual framework presented in the introduction in consideration of all dimensions of the

smart metropolitan regional development such as: smart metropolitan regional foundation , ICT, smart Institutions and laws, smart economic development, smart infrastructure development, smart environment, smart social development, smart peace and security and smart disaster prevention and resilience.

The new era of Dakar Metropolitan Regional Development with the creation of digitally served urban centres is guided by two main policy reforms/plans: the "Act III of Decentralization" in 2013- an administrative reform, and the "Plan Senegal Emergent (PSE)" in 2014 - a holistic framework for sustained development and economic growth. Under the Act III of Decentralization, each department is sub-divided into municipalities. Overall, the metropolitan has 48 municipalities. Each municipality is headed by a mayor, who is responsible to, among other things, preserve, maintain and administer the properties and assets of the municipality, ensure municipal waste management and hygiene, protection and conservation of historic sites and monuments, promotion of national and local cultures, preparation and implementation of various kind of plans (including master plans and detailed urban plans), and management of health and education programmes. The Act further gives guidelines on municipal finance, which is key in the implementation of urban programmes. This is a clear demarcation of the original urban development management where administrative and financial management of municipalities was performed at the central level; it opens the road to polycentric specialized urban centres [7].

The Plan Senegal Emergent (PSE) provides further guidance on the Dakar Metropolitan Regional Development, strategically based on three axes: 1) structural economic growth and transformation; 2) human capital, social protection and sustainable development; and 3) governance, institutions, peace and security. At the sectorial level, the PSE is glued around six main sectors: energy, infrastructure, business environment, telecommunication, human capital and finance. Flagship projects under the PSE include developing Dakar as a regional logistics hub for production and distribution of industrial products and services in West Africa; development of multi-services and touristic hubs; development of Dakar as a referential regional campus with five world-class interna-



Figure 3 – PSE Flagships Projects. Source: Republique du Senegal, Plan Senegal Emergent, 2014.

tional schools; creation of business parks hosting international companies and institutions; and making Dakar an international medical city. The plan anticipates that these flagship projects will result in strong convergences and synergies within the region and improve the attractiveness and competitiveness of Dakar, and Senegal at large [8].

Creation of urban centres to promote Dakar Metropolitan Regional Development

In order to decongest Dakar, three categories of urban centres are being planned to take place in the Department of Rufisque, situated in the East of the Metropolitan Region: Urban centres of the "Massif" structured around national sport centres and an international exposition centre; Coastal urban centres structured around coastal touristic areas and; Eco urban centres at the "Lac Rose" characterized by the presence of micro-organisms and mineral elements. Overall seven urban centres are planned to take place in the first phase of the programme. These urban centres are created to support economies of scale and agglomeration. For instance, the Special Economic Zone of Diamniadio will constitute a multifunctional platform for most of the income-generating activities (industry, crafts, clothing, equipment, infrastructure, etc.). It is part of the national policy to encourage companies to relocate and diversify their activities outside the department of Dakar and attract new investors, notably with: the creation of a manufacturing unites with high added values; Assembly and processing industries; Construction of several logistics platforms (transit, storage) to streamline internal and regional transport flows; Creation of two zones dedicated to export services, integrated and connected [8].



Figure 3 – Map of Dakar Metropolitan Region with the creation of the six urban centres. Source: Source: Mboup G., 2016. in Smart Economy in Smart Cities (ed. V. Kumar et al.) Springer.

In the urban centre of Diamniadio, it is also planned to create an integrated campus of reference by 2018 with the creation of at least five world class professional schools; Business Park by 2017; Establishment of "Dakar Medical City"; Integrated tourist areas; Regional airline hub (medical, tourism, regional headquarters of companies and international institutions, education-training). In addition to the creation of urban centres in the Metropolitan Region, the national authorities have also planned to expand the development of the Dakar to other bordering cities, namely, Thies and Mbour to form the Triangle of Metropolitan Regions: Dakar-Thies-Mbour [8].

Shift in the Dakar Metropolitan Regional Development occurs in the era of the digital revolution in Senegal as it occurs everywhere in the world. For these past 15 years, along the economic power of Dakar, the Senegalese government has taken various initiatives favorable to the development of ICT at all levels. It has created legal institutional framework to support regulatory mechanisms on the development and use of ICT. Under the PSE, Senegal has particularly initiated the large digital programme called Senegal Digital Strategic Plan 2025. The slogan of the Plan is "ICT for all and for all uses by 2025 in Senegal with a dynamic and innovative private sector in an efficient ecosystem". The government is also putting in place an ambitious project of a technology park in one of the urban centres, Diamniadio, called "Diamniadio Technology Park". The park is based on the Silicon Valley model and intends to promote data revolution and higher education centres. It has also introduced ICT platforms such as E-Governance, E-Education, Einfrastructure and supports education and training on ICT. The city of Dakar in partnership with the mobile operator Tigo (a subsidiary of Millicom International Cellular Group) has also launched the Dakar Digital City initative, a pilot project " SSID : City Wifi Dakar" to make free internet connection available in large public places [9].

Along the transformation of the Dakar metropolitan regional development, national authorities have put in places planning guidelines through the Urban Master Plan of Dakar (Plan Directeur d'Urbanisme - PDU) 2035 and National Plan for Territorial Development "PNAT". The PDU 2035 aims at urban development of the region of Dakar and its surroundings by 2035 [10]. Its main objectives are: Sustainable Urban Development; Compact cities connected with a transport network; Robust and Resilient city and; Vibrant city with active interaction between information, goods and people. The PNAT proposes five development urban areas: Multifunctional urban areas; Areas for economic activities; Areas for agriculture activities; Areas for touristic activities; and Areas for conservation. The PNAT also identifies areas with high risk for habitation and any other activity. In these areas, modification of the land including by residential structure, or any cadastral operations is prohibited. This plan promotes green areas and other protected areas for environmental purposes or spaces with light recreational facilities, which, when well integrated enhance the character or the ecological value of the area. Specific focus areas of the PNAT also aim at: controlling the internal urban growth; reducing the proliferation of slums; promoting a balanced urban development; and meeting the housing demand [11].



Figure 5: Planning and management of transport Infrastructures in the Dakar metropolitan region (road, ail, air and Water). Source: Republique du Senegal, 2014. Plan National d'Amenage-

However, the Dakar metropolitan regional development with a population of more than 3 million comes with its constraints or requirements in terms of infrastructures such as road networks and transportation systems which are key for linking services such as workplaces, health centers, schools, markets, etc. Efficient mobility is required to allow localities of the metropolitan region to specialize in the production of goods and services for which they have comparative advantages and ease interlocalities cooperation. This will allow large scale production of goods and services that can be distributed within the metropolitan regions and beyond with time, cost and reliability opportunities [12]. The government of Senegal has quickly realized that development of the Dakar metropolitan region will be achieved only through the development of efficient mobility means. In the PSE, it is indeed, planned: the construction of road infrastructures (1170 km of paved roads, at least 4000 km of rural roads, 7 bridges and Art, modernization of bus stations); the construction of maritime infrastructures (restoration of inland ports of new infrastructures and port platforms); the conrailway struction of infrastructures (rehabilitation of 573 km of railway line, construction of a new standard gauge line) and airport facilities (rehabilitation of regional aerodromes), a tramway is also under development. The newly created international airport, located in the urban centre of Diamniado, is expected to have a capacity of 6 million passengers by 2020 and 10 million by 2035.



Figure 6 – Multiple choices to access services. Source: Mboup G., 2016. in Smart Economy in Smart Cities (ed. V. Kumar et al.), Springer.

The smart mobility will be analysed using the multiple choices model to access the service. In this model, there are three scenarios: 1) the green panel illustrates a situation of mixed land used or alike where services are walking distance from residence (threshold to be determined). Here we can walk, drive and use ICT, but walking along with the use of ICT to access services is sufficient and then highly recommended; 2) the red panel illustrates the situation where services are far away from residence, in a distance making it impossible for people to effectively walk to reach most services, but are in a reasonable distance (threshold to be determined) where people can use motorized means of transport with the benefits that can offer an ITS; They can also use ICT to perform work outside their workplace or to access other services. This situation includes telecommuting as well as all other forms of ITS such as RTPI and; 3) the third scenario with the blue panel illustrates a situation where the services are very far (threshold to be determined) from residence making it difficult for people to use motorized means of transport every day to services, here the convenient option is the use of ICT to effectively reach ser-

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CONAKRY

REPUBLIC OF GUINEA

Gora Mboup - Khalil Fofana - Mustafa Sangare

TOWARDS A SMART METROPOLITAN REGIONAL DEVELOPMENT ECONOMIC AND SPATIAL DESIGN STRATEGIES

Introduction

Conakry became the capital of French Guinea in 1904 and prospered as an export port, particularly after a railway (now closed) to Kankan opened up the interior of the country for the large-scale export of groundnut [1]. In decades after independence, the population of Conakry boomed, from 50,000 inhabitants in 1958 to 600,000 in 1980, year of economic liberalization and rural migration, to over 1.9 million in 2016. Since 1950, the city of Conakry was, indeed, marked by continuous increase of its share in the national urban population from 15% to 30% in 1960. This exponential growth made it to reach 58% in early year, 1970, and 62% in 1980. However from 1980, there is a decline of its share to less than 40% with the growth of other cities such as the second largest city in Guinea, NZerekore (343,000 inhabitants) [2]. The level of urbanization is generally associated with numerous positive societal outcomes such as technological innovation, various forms of creativity, economic progress, higher standards of living, enhanced democratic accountability, and women's empowerment. From an economic point of view, cities with high densities have the potential for a concentrated, large labour and consumer market. If well planned and designed, Conakry can be a sustainable, inclusive, resilient and prosperous city where citizens enjoy high quality of life.

Despite its potential to be sustainable, inclusive, resilient and prosperous, Conakry has not be able to be the engine of the economic development of the Republic of Guinea as illustrated by its low City Human Development Index (CHDI) compared to other African cities. Among the cities analysed here, only Conakry, Antananarivo and Monrovia have a CHDI which is equal or lower than the national HDI. This is partly due to the fact that Conakry urban agglomeration's development has been hampered by its weak city foundation characterised by proliferation of unplanned settlements, poorly served in basic services and without land tenure security.

Considering that the population of Conakry will double by 2040 to reach 5-6 million inhabitants, the Government of Republic of Guinea commissioned a study for the "Grand Conakry Vision 2040". The study proposes various scenarios of territorial settlements. These scenarios are aimed at preventing disasters that can hamper ecological, social, economic and urban de-



Aerial view of Conakry (Source: http://www.rfi.fr/afrique/20160209-guinee-une-journee-presse-apres-mort-journaliste)



Source: Mboup G., 2016. Smart Social Development for Smart Economy, Springer 2016.

velopment. Based on a structured dialogue within a Technical Committee and a Steering Committee with the Representatives of various ministerial departments, a consensus was reached on "a synthesis, balanced and controlled scenario" which is structured around three levels of intervention: 1) at the metropolitan level to develop and strengthen urban polarities; 2) at the agglomeration level to channel and structure urban extensions and; 3) at the peninsula level to renew the city (urban renewal). Recognizing that the Master Plan of the city of Conakry has become obsolete to tackle the challenges the city is facing, the government has commissioned a study for the "Grand Conakry vision 2040", which is the first step towards developing a new generation of master plans: the master plan of the great Conakry and the national land use planning scheme (SNAT).

The Conakry case study will consist of analysing the economic and spatial strategies undertaken by Government of the Republic of Guinea in the Grand Conakry Vision 2040 for a Smart Conakry Metropolitan Regional Development. It will be developed through two sections: Section 1 -Conakry in Time and Space: Place of Opportunities and Challenges, which is a factual analysis of the situation in the ground and; Section 2 - Spatial and Economic Transformations for a Smart Conakry Metropolitan Region, which is a prospective analysis of how the different ways economic and spatial from these different programmes, reforms and plans will contribute to the smartness of the Conakry Metropolitan Regional Development.

The Study will be first based on the Smart City Foundation conceptual framework to assess the

better integration of ICTs in the planning, the design and the management of the metropolitan region. New urban planning instruments are becoming available with the worldwide spread of ICTs. They make it possible to adopt innovative e-planning approaches, strengthen communication between urban stakeholders, and make communication available at various stages of the planning process. Planning procedures make use of models that show historic and present situations and communicate planned situations [3]. ICT revolution is also opening new frontiers in land tenure reform, and land tenure experts and stakeholders must grasp this unique opportunity for the regularization of land that go hand and hand with eplanning.



Figure 2 – Urban planning, urban policies, basic infrastructure. Source: Adapted from Mboup, 2015 – Sustainable City Foun-

Using the full conceptual framework of a modified Smart Metropolitan Regional Development centered on the Sustainable City Foundation, the study with assess the economic development impact the Grand Conakry Vision 2040 may have through the transformation of the Conakry form and structure.



Figure 3 – Sustainable City Foundation Impact on Metropolitan Regional Development. Source: Adapted by the author from Mboup G., 2015. Sustainable, Inclusive and Prosperous Cities.

Summary of section 1 Conakry in time and space – Place of Opportunities and Challenges

This section will be based on the Smart City Foundation Conceptual Framework presented at the introduction. A smart city foundation is composed of three elements: Urban Planning & Design, Land Policies and Basic Infrastructure. For a city foundation to be smart, it must be inclusive at the onset of the urban planning and promotes mixed neighborhoods where social clustering is discouraged. Having all the poor living together creates slums and fuels instability and insecurity. Inclusive urban planning eases access to basic services (water, sanitation, housing, education & health) and to decent employment for all. A key element of smart urban planning is a smart street network that reduces travel time and encourages walking and social interactions. Smart urban planning enhances infrastructure development, environmental sustainability, economic and social development; makes cities resilient and prepared to overcome natural disasters; and promotes mixed neighborhoods where services are walking distances from people's residences.

Successive planning does not prevent the continuation of unplanned urbanization along the

population growth of Conakry. Development projects suffer from top-down logics that struggle to find a real territorial adaptation. Due to lack of affordable housing and land, the urban poor are forced to settle on the periphery. Conakry metropolitan region extends considerably all along the peninsula limited only by its physical borders (the mangrove) and administrative boundaries (the prefectures bordering Dubréka and Coyah) [4]. The metropolitan region is not well planned with sufficient land allocated to streets and public spaces, and it lacks smart basic infrastructure and smart institutions and laws [5]. Many settlements in the metropolitan region lack a sewerage system and rainwater drainage facilities, and adequate waste management sites are missing, which are key components of smart basic infrastructure along with connection to water and energy. Flooding during rainy seasons as well as uncollected garbage is frequent phenomena in all parts of the agglomeration, but particularly in the poor settlements. Frequent energy shortages also affect the city's economy. In addition, infrastructure for non-motorized transport (e.g. pavements or sidewalks for walking and bicycle lanes for cycling) is often lacking, poorly developed, on the decline or does not appear to rank high among city planners' priorities. This has led to high incidences of traffic fatalities involving pedestrians and cyclists. Streets that provide space only to motorists are characterized by congestion and high CO² emissions [6]. These challenges are associated with poor land administration and governance, characterized by corruption and lack of transparency in public as well as private transactions.

Summary of section 2 – Spatial and Economic Transformations for a Smart Conakry Metropolitan Region

Using the conceptual framework presented at the introduction, this section will assess the smartness of the "Grand Conakry Vision 2040" in term of urban and territorial planning as well as in terms of economic growth. The "Grand Conakry Vision 2040" aims to guide the development of a new generation of master plans: the master plan of the great Conakry and the national land use planning scheme (SNAT). These master plans will provide guidelines on land use, land tenure administration and governance, provision of basic services, management of solid waste, protection of the environment, and other urban development aspects that will make the Conakry Metropolitan region sustainable. All these elements are part of, what we call, the metropolitan regional foundation. In addition to Urban Planning, Basic Infrastructure and Land Policies, the Smart City Foundation takes into consideration the ICT component as an enabler.

The Grand Conakry Vision 2040 occurs in the era of the digital revolution in Conakry as it occurs everywhere in the world. For these past 15 years, the Guinean government has taken various initiatives favorable to the development and ICT at all levels. It has created legal institutional framework to support regulatory mechanisms on the development and use of ICT. We are taking it further with the development of a holistic approach in the making of Conakry a Smart Metropolitan region to respond to the need for a better integration of ICTs in the planning, designing and managing metropolitan regions. The opportunities for ICT to support the overall urban challenges and opportunities are enormous, and the Conakry Metropolitan Region must integrate and use ICT solutions to facilitate the greater provisioning of urban services. Following the exigency of the city of the 21st century that calls for sustainability, inclusion and prosperity, the planning and management of human settlements must take into consideration the gain in knowledge on various conditions that make cities smart, green, ecological, liveable and healthy; and the progressive emergence of the ICT infrastructures and their correlates such as social media and in general big data. This is the context where we are introducing the smart metropolitan regional development to unlock the potential of Conakry metropolitan region to be sustainable, inclusive, resilient and prosperous.

The main objective of the Grand Conakry Vision 2040 is to "improve the living conditions of the residents of Conakry and adapt land-use planning and planning policies to the rapid urbanization of the metropolitan region" [7]. The "Grand Conakry - Vision 2040" is conceived as the preliminary framework for the elaboration of a future Master Territorial and Urban Planning. Its objective is to define the main key points and themes to be considered in order to make Conakry a modern liveable metropolis safeguarding the environment. The study aims to be the reference framework for several ministerial departments, communities and local authorities to set a long-term urban development target by 2040 [8].

- At the metropolitan level, to develop and strengthen urban polarities will consist of: 1) Fixing and attracting populations in urban polarities; 2) Building a strong metropolitan region based on territorial solidarity and; 3) Preserving the natural and agricultural environment to enhance the productive force of the territory.

- At the agglomeration level, to channel and structure urban extensions will consist of: 1) Preventing the process of urban sprawl in order to preserve the natural environment through the establishment of perimeters for urban land use; 2) Structuring, reorganizing and controlling the urban extensions.

- At the peninsula level, to renew the city will consist of: 1) Building an efficient, safe, healthy and pleasant capital and; Optimizing the use of the soil by densification of its structure to accommodate new urban areas with improved living conditions.

From the three scenarios, a resulting scenario is built with seven ambitious goals for a sustainable Conakry for all: 1) Strengthening territorial balances to create a network of solidarity-based cities in a preserved environment; 2) Controlling the city limits to prevent urban sprawl and preserve urbanization; 3) Optimizing the port system to decongest the city and protect the populations; 4) Restructuring the centrality to rebuild an efficient urban system on the peninsula; 5) Restoring the landscapes to build a healthier, safer and more enjoyable city; 6) Making the city sustainable to provide housing for everyone in mixed and lively neighborhoods and; 7) Thinking waste as a resource to protect people, the environment and generate wealth.

Strengthening territorial balances will consist of: a) Strengthening and organizing urban polarities in a modernized, hierarchical network connected to the regional network and;
Preserving fragile natural areas and agricultural economic zones, natural Park and protecting the islands and; c) Develop the agroindustrial sector.

2) Controlling the city limits will consist of: a) Setting up new geographical boundaries ac-

cording to the administrative, demographic and economic weight of the capital city; b) Reviewing the administrative planning of the Grand Conakry and adapt the institutional and regulatory framework and; c) Optimizing land use.



Figure 4: Conakry and surroundings. Source: Republique of Guinea, European Union and Louis Berger, 2016. Grand Conakry Vision 2040

3) Optimizing the port system will consist of: a) Valuing the harbor tool in harmony with urban development (transfer of polluting and hazardous activities) and the creation of a dry port and; b0 Modernizing and streamlining existing facilities.

4) Restructuring the centrality will consist of: a) Reorganizing the urban fabric; b) Redeploying the centralities along the peninsula and the metropolitan area around the structuring facilities; c) De-locating tertiary activities from the tip of the peninsula (Kaloum) to appropriate and developed sites; d) Implementing a genuine mobility strategy; e) Restructuring the urban network; f) Developing a Urban Travel Plan (UDP) at the metropolitan area scale; g) Developing capacities systems (a network of heavy axes in its own right to alleviate traffic) and diversification of the transport supply by facilitating inter-modality by means of adapted structures and; h) Creating an authority for the management and regulation of urban transport.

5) Making the city sustainable will consist of: a) Ensuring a balanced distribution of settlements, structuring proximity facilities as well as urban services in a network that promotes accessibility; b) Initiating the opening up of equipment, and controlling densification of the peripheral sectors; c) Proceeding with the creation of a public operator responsible for producing and managing the social housing stock; d) Implementing an ambitious land tenure policy, financing mechanisms, operational procedures and legal arrangements, in order to allow the community to operate on urban development in the name of the general interest and to better frame the creation of public or mixed operators and; e) Establishing mechanisms for regular participatory communication and dialogue with populations.

6) Restoring urban landscapes will consist of: a) Restoring water quality and natural flows of the peninsula; b) Renovating public spaces for the comfort and living environment of the inhabitants; c) Protecting and managing the coastline to guarantee the integrity of the maritime public domain (DPM) by a "littoral law"; d) Establishing safeguard perimeters to protect sensitive areas and create the Mangrove Natural Park, and protecting the islands from urban pressure; e) Modernizing the agricultural sector and develop the potential of arable land and wetlands, including in urban areas.

7) Restoring urban landscapes will consist of: a) Establishing a coherent strategy and reorganize the sanitation network master plan; b) Creating networks for the collection, sorting, treatment and recovery of urban waste and; c) Enhancing communication and training.

This section will assess how ICT can make this process with innovative e-planning along with design, management and monitoring. From the beginning of the 21st century a digital citizenship, particularly the "Millennials" generation, has started to emerge in Conakry as in many African cities [9]. Maximizing the digital dividends requires better integration of ICTs with the other factors of smart cities such as: city foundation, infrastructure development, environment sustainability, social development, disaster prevention, resilience, peace and security. ICT can be seen as substitution and catalyst factors, but the other factors (or the analogue part) of the operation are crucial in making smart economy. ICT alone will produce little in the smart metropolitan regional development. 'Smart ' is not an end in itself [10]. It is the way ICT is integrated in the city development that will determine the city smartness. Those factors include the city foundation, institutions and laws, infrastructure development,

social development, social inclusion, environmental sustainability, disasters prevention and resilience (particularly in the context of climate change), peace and security. Most tasks have an aspect that cannot be automated by technologies and that requires human judgment, intuition, and discretion. This is where lies the crucial role of human capital associated with institutions and laws, efficient governance, management and administration. Without improvement on accountability at all levels, ICT alone cannot change the outcome of the economic productivity equation. African Countries that are able to swiftly adjust to this evolving digital economy will reap the greatest digital dividends, while the rest are likely to fall behind.

ICT can also impact the transport sector in many ways among them we can enumerate two which will be the focus of this paper: a) the digitalization of the transport sector as it happens in all sectors and; b) substitution (partial or full) of mobility to perform or access services [11]. The ICT revolution with the rapid development and use of Internet, digital mobile communication, and "big data" analysis enable to create a less costly and more powerful "intelligent transport systems" (ITS) [12]. The ITS have a greater potential to more efficiently manage transportation assets, improve road safety, reduce traffic congestion and travel time. This will boost productivity and reduce greenhouse gas (GHG) emissions [13].



Figure 5 – Multiple choices to access services. Source: Mboup G., 2016. in Smart Economy in Smart Cities (ed. V. Kumar et al.), Springer.

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ABUJA

NEW CAPITAL OF NIGERIA

Femi Olokesusi - Femi Ola Aiyegbajeje - Ibitayo Modupe Arije SMART DEVELOPMENT FOR ABUJA AND ITS REGION

Introduction

Towards meeting our commitment to the proposed publication titled Smart Metropolitan Regional Development: Economic and Spatial Design, this bulletin introduces the research team's strategy while at the same time, highlighting the structure of our contribution which is in progress. The Abuja Smart Metropolitan Regional Development revolves round a sustainable, inclusive and prosperous city that promotes a people-centric approach based on the integration of smart city foundation, information and communication technology (ICT), innovation, smart institutions and laws into its developmental and operation architecture. Properly implemented Smart regional development reduces spatial disparity, enhances infrastructure provision, environmental sustainability, economic and social development. In addition, it builds resilience and promotes mixed neighbourhood where services are walking distances from peoples' residences.

The founding fathers of Abuja buoyed by near unanimous public support, wanted it to meet some of the ideals of a restructured polity based on the principle of equal access, equal citizenship, environmental conservation, city beautiful, functional city, effective regional development and rapid national economic growth [1]. The relocation of the seat of the Federal Government from Lagos to Abuja was officially effected in 1991. The area now known as the FCT (see Figure 1) covers a total land mass of about 8,000 square kilometers. It is bounded by Nasarawa State to the east, Kaduna State to the north, Niger State to the west, and Kogi State to the south. Abuja's natural endowments such as its rolling hills, isolated highlands and other endearing features make it a delight. For the purpose of governance, there are six Area Councils in the FCT, each subdivided into wards headed by councilors. Abuja Municipal Council (AMAC) otherwise known as the Federal Capital Territory (FCC) is the most prominent of the six Area Councils. The other five Area Councils are officially referred to as Satellite Towns (See Figure 2). Abuja an official population of 1.4 million in 2006 (see Table 1), but given the daily influx of people into the territory, the population today could be well over 8 million people [2].



View of Abuja, Nigeria. (Source: http://www.nigerianeye.com/2013/04/in-pictures-beautiful-city-of-abuja.html)



Figure1: Map of Nigeria Showing the Location of Lagos and Abuja (Abuja Geographic Information System (AGIS), 2006). Source [4]

Urban and Regional Planning in Abuja

The Federal Capital Development Authority (FCDA) which was created by the Federal Government of Nigeria to administer the new capital territory, signed two major contracts: First with International Planning Associates-a consortium of some world renowned firms of Urban Planners, Designers and Architects to prepare a Master Plan for the Federal Capital City (FCC); and secondly with Doxiadis Associates Nigeria Limited in 1981 for the preparation the Abuja Regional Plan covering the entire FCT [15] [16]. International Planning Associates (IPA) submitted the City Master Plan in 1979, while actual physical development activities started in the early 1980s. Doxiadis Associates Nigeria Limited submitted the Regional Plan to FCDA in 1983. The Abuja City Master Plan is based on the principle of a functional city with a crescentshaped structure, occupying a very prominent place in the FCT. Apart from making provision for traditional land uses such as housing, transport, industry, commerce, institution and recreation, the plan also provides for maximum flexibility for accommodating a broad spectrum



Figure 2: Map of the FCT Showing the Location of Abuja City (*AGIS*, 2006). *Source* [4]

of socio-economic groups and cultural affinities [10] [11]. The Abuja Regional Plan recognizes three types of land use. These include (a) Spatially extensive zones (b) Spatially comparatively less extensive zones and (c) Linear zones. The specific goals of the Abuja Regional Plan as derived from it, include the followings: preservation of the natural environment; decentralization of activities nuclei with Abuja Municipal as the highest order nucleus; achievement of economies of scale and a high degree of self-sufficiency especially in food production; balanced economic development of the various areas; creation of a comprehensive rural-urban integration system and hierarchical ordering of settlements; and coordinated comprehensive development in the wider regional context (Federal Republic of Nigeria, October, 1983). In the light of the above, the aim of our study is to analyse the extent to which both the Master Plans for Abuja City and its Region have been implemented as well as how they replicate the core precepts of Smart City approaches.

Area Councils	Headquaters	Population	
Abaji	Abaji	58,642	
Bwari	Bwari	229,274	
Gwagwalada	Gwagwalada	158,618	
Kuje	Kuje	97,233	
Kwali	Kwali	86,174	
Municipal	Abuja	776,298	
Total		1,406,239	

Table 1: Population of FCT Abuja and its Area Councils in 2006. Source: [5].

Existing Problems

Due to rapid urbanization, unplanned suburban development, the rushed movement of public servants from Lagos to Abuja and other factors, Abuja city and its region is now confronted with a number of challenges some of which are: increased Level of Insecurity; slum Settlements; housing Inadequacies; poor electricity and water supplies; inadequate transportation and traffic infrastructure and rolling stock; poor environmental sanitation; implementation of both the city and regional plans; inadequate public open spaces and inadequate ICT penetration and application.

Methodology

Given the existence of a Regional Plan for Abuja, our study will analyse the level of the failures, challenges, successes and provide possible suggestion that could assist in adding value to the development of the metropolis and the region based on the key elements of smart urban and planning: i) infrastructure development, ii) environmental sustainability, iii) social inclusion, iv) peace and security, v) social development and vi) disaster exposure and resilience [14]. The United States Environmental Protection Agency (EPA) Smart Growth Program will also be useful in this study. The EPA strategies will revolve round these three strategies: Compact and Infrastructural Development, Walkability and Range of choices for the people.

Compact Region and Infrastructural Development

In transforming Abuja into a smart region, compact development of infrastructural facilities is essential and needed. This entails using land and resources more efficiently and redeveloping old or neglected areas while retaining existing infrastructure, which can create economic advantages for real estate developers, investors, businesses, and local governments [9].

Walkability

Another strategy that could help in achieving the effort of making Abuja a smart region is to make neighbourhoods in the city have wellconnected streets and a mix of land uses near each other. In addition, by creating a neighbourhood with facilities that could aid walking and bicycling easy in order to make transit more convenient and appealing. Projects in walkable neighborhoods command a price premium, earning real estate developers and investors a higher return on investment [9].

Range of Choices

Provision of varied choices for the neighbourhoods is also a way of creating a smart metropolitan region. This is because people and businesses value places that bring together a variety of activities to create vibrant environments. Communities with access to transit also help people reduce their transportation costs, enabling them to save money or spend more on their homes, entertainment, or other things they value [9].

The Key Planning Areas for Study:

Continuous Influx of Migrants

The urban population in Nigeria is growing at a rapid rate. This is evident in the increase in its population about 2.8% per annum with a 5.5% urban growth per annum [13]. Most noticeable problem is the continuous influx of people into the FCT. One worrisome trend of the migration is that most people fleeing from many areas of conflict end up resettling in the metropolitan Abuja city simply because of the perceived secured environment. In addition, job seekers in search of the non-existent government jobs end up in Abuja and as they come, they join in swelling the population of the city.

Increased Level of Insecurity

Abuja is a highly stratified city peopled by privileged few political elites, retired military officers, former military and civilian heads of states and business people who have allied themselves with the high-ranking military officers and/or political office holders (both elected and appointed). These groups of residents are also in a favoured position, as they are often the first to get land allocations at highly subsidized prices. These individuals are a very small percentage of the Nigerian population but are highly influential and very rich. The flamboyant lifestyles of these elites made some poor Nigerian belief they can easily secure a decent livelihood in Abuja thereby generating an increased influx of unemployed poor Nigerians with no means of livelihood thus increasing the level of crime and criminal activities in the region.

Housing Inadequacies

Production of houses for outright sale by smallscale builders and private housing firms, for sale and mortgage-funded housing are very limited [5]. The reluctance on the part of corporate housing firms for providing rental housing units to low income occupants because the high return margins required are just not available from this particular group [6]. One of the major problems of housing in Abuja is largely because of non-involvement of private firms to play a major role in housing production. For instance, only few private investors are involved in housing production.

Slum Settlements

The housing problems in the region have resulted in the emergence of a number of shantytowns and squatter settlements occupied by workers and the growing service population in such settlements as Mpape, Kubwa, Karu/ Nyanya, Karmo, and Gwagwalada. These settlements have developed rapidly as slums as they are generally unplanned, overcrowded and lacking basic amenities and infrastructure [12]. With a view to meeting the demand for more land for housing and other land uses, the Ministry of Federal Capital Territory has increased the size of the FCC from its original planned land area of 259 square kilometers to 1,123 square kilometers (AGIS, 2015). An action of this nature is poised to have several implications, which we are keen to unravel.

Poor Electricity and Water Supplies

Water supply to some parts of the Abuja me-

tropolis has always been epileptic in the recent decades. Sometimes, water supply to different parts of the metropolis may be disrupted for three days to enable technicians to carry out repairs on a damaged water trunk main line around Gishiri in the Mabushi District of Abuja. Usually, when this happen, residents of Wuse I, Wuse II, Garki I, Garki II, Maitama, Asokoro, Wuye, Gudu, Games Village, Karu and Nyanya would experience water supply shortages. Abuja metropolis is faced with erratic power supply and poor water supply. A resident ascertained that 'sometimes we see light (electricity) one day, and the next three days no light (electricity) and this is affecting our businesses. According to an official of Federal Capital territory Administration (FCTA), it was observed that the provision of basic amenities such as potable water and stable electricity would help to boost the standard of living of citizens.

Transportation

Transportation is an essential and indispensable catalyst for activating and stimulating the pace of economic, social, political and every other human endeavours in any society. Transportation, as one of the basic infrastructures, is required for effective and efficient functioning of urban centres. This then suggest that transport infrastructure has to be developed in a logical way, so as to ensure that movement of people, goods and services are conducted quickly, economically, safely, comfortably and in an environmentally-friendly manner [7].



Figure 6: A Typical Congested Road in Abuja. Source [8]

Poor transport management has resulted in heavy traffic congestion on the roads and the highways within the city, thus making commuting a harrowing experience to and from work in Abuja a petrifying experience for most road users, The flashpoints are the entry and exit roads to the FCT, namely the Outer Northern Expressway (ONEX), the Outer Southern Expressway (OSEX) and of course the Nyanya/ Mararaba/AYA road.

Environmental Sanitation

Provision of adequate sanitation for a region such as Abuja is equally a herculean task. The way and manner the metropolis manages its disposal will be assessed.

Implementation of both the City and Regional Plans

Extant literature seems to indicate that the authorities are faced with some problems in the Abuja City Master Plan implementation process, hence the emergence of slums, urban sprawl and inadequate organized open spaces, and poor physical development in the satellite towns. Consequently, our study would critically examine the Regional Plan for Abuja FCT within the context of observed development and the Smart Urban Planning framework.

Inadequate ICT Penetration and Application

A core element of smart city, its economy and governance is the extent to which information, and communication technology has been adopted and how both government institutions, private organisations and the public are utilizing them. Thus, we will ascertain the penetration and utilization as it is obviously very germane to our study.

Conclusion

In our conclusion, we shall outline our findings and give suggestions on how Abuja metropolis can transform into a smart metropolitan region using the EPA and the key elements of smart urban planning.

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JOHANNESBURGH

SOUTH AFRICA

Gora Mboup - Naledzani Mudau - Paida Mhangara

TRANSFORMING JOHANNESBURG FROM AN APARTHEID TO A SMART METROPOLITAN REGION

The Long March to a Sustainable, Inclusive, Resilient and Prosperous Metropolitan Region

Introduction

The City of Johannesburg, located in the Gauteng province, was established in 1886 following the discovery of gold on what had been a farm. From a population of 26,303 in 1890 to 102,078 in 1896, Johannesburg is, today, the largest city in South Africa and is one of the 50 largest urban areas in the world. The population of the Greater Johannesburg Metropolitan Area including suburban regions such as Ekurhuleni, the West Rand, Soweto and Lenasia is over 10 million making it a megacity. But the population of Johannesburg is estimated at 4.9 million in 2016. The Greater Johannesburg Metropolitan Area represents 14% of the national population. It is an engine of South Africa with a share of 18% of the national GDP which itself represents 24% of the African GDP. This is the reason Johannesburg is considered a global African city [2].

Johannesburg was the centre of the apartheid regime in South Africa that lasted from 1948 to 1990 and has been named as being among the most unequal cities in the world. The City Foundation of Johannesburg has historically been guided by a segregationist ideology manifested through institutions & laws, urban planning & design, and access to basic services and amenities. During the Apartheid, the majority of township areas designated for non-white people were situated between 25 and 30 km away from the central business district, leading to significant transport challenges. Originally an acronym for "South-Western Townships", Soweto, one of the townships, originated as a collection of settlements on the outskirts of Johannesburg, populated mostly by native African workers from the gold mining industry [3].

The dismantling of apartheid in the early 1990s came with calls for inclusive development in South Africa, mostly guided by Nelson Mandela's ideal of a democratic and free society. The entire city of Johannesburg was then considered as one without distinction of race. The task of promoting social inclusion in an already separated city bestowed upon the new "African" government was thus very hard to achieve, even more given that the new leadership did not take time to plan for long-term growth. Different models have however been adopted to make the city more inclusive post



View from Johannesburgh (Source: https://joburg.org.za/index.php?option=com_content&view=article&id=10487&catid=88&Itemid=266)

apartheid, the key ones being on participatory planning and design; development of inclusive public spaces; improvement in basic infrastructure provision and public transport particularly to the poor neighbourhoods and; development of policies that encourage inclusive human settlement and trade [4].

The Johannesburg case study will consist of analysing the economic and spatial strategies undertaken by national and local authorities for a Smart Johannesburg Metropolitan Regional Development. It will be developed through two sections: Section 1 - Johannesburg: from an Apartheid to an Inclusive Metropolitan region, which is a factual analysis of the urban form and structure during the Apartheid and Post-Apartheid and; Section 2 - Spatial and Economic Transformations for a Smart Johannesburg Metropolitan Region. Section 1 will analyse: the Progressive institutionalization of a racial, social exclusion: and Use of Urban Planning and Design to mainstream an Apartheid City Foundation where Black Africans are systematically excluded from the access of most basic services. This will be followed by the long march to freedom and social inclusion until the abolition of the Apartheid regime in 1990. The first decade of post Apartheid will be analysed here, particularly institutional and legal reforms put in place to create a country for all. The section 2 will consist of analysing urban policies and programmes put in place by national and local authorities for the transformation of Johannesburg to a Smart Metropolitan Regional. Johannesburg is the first African city that introduced the Bus Rapid Transit in its transport system in 2010. It is also among the few African cities with an explicit Smart City Programme. The Study will be based on the conceptual framework developed in the African Smart Economy in Smart Cities published in 2016 including four African cities: Cape Town, Nairobi, Dakar and Lagos. However, this framework will be modified and adapted to the metropolitan region context for a better integration of ICTs in the planning, the design and the management of the metropolitan region as well as its economic development.

Summary of Section 1 – Johannesburg: from an Apartheid to an Inclusive Metropolitan region

This section will analyse first the *Progressive institutionalization of a racial, social exclusion*. The vision of policy directives gave birth to grand

apartheid (separate development) in 1948 will be analysed, a system that was as much an economic and spatial dispensation as it was a political and legal one. It will also analyse the Use of Urban Planning and Design to mainstream an Apartheid City Foundation. The Group Areas Act of 1950 brought forth strict zoning principles based on a misrepresentation of both Ebenezer Howard's garden city movement and Le Corbusier's Ville Radieuse planning approaches [5]. The adopted zoning models twisted the core principles of functional segregation put forward by the two visionaries to achieve racial segregation, in which the whites would be situated in the most advantageous spaces and the non-whites settled in the least desirable areas. The apartheid extended to all basic infrastructures and services and impacted social and economic development of black Africans.

The long march to freedom and social inclusion: Insecurity and urban violence will also be analysed. With an apartheid city foundation characterized by apartheid institutions and laws, apartheid urban planning and design, and apartheid access to basic infrastructure and services, the excluded people of Johannesburg had to fight for their social freedom. Both peaceful and violent protests were held in the city between 1950s and 1990 when apartheid was officially abolished, each with varied outcomes. The first decade of post Apartheid will be analysed here, particularly institutional and legal reforms related to urban planning and land tenure put in place to create a country for all. The Smart City Foundation will be the conceptual framework of our analysis. A smart city foundation is composed of three elements: Urban Planning & Design, Land Policies and Basic Infrastructure. For a city foundation to be smart, it must be inclusive at the onset of the urban planning and promotes mixed neighborhoods where social clustering is discouraged. Having all the poor living together creates slums and fuels instability and insecurity. Inclusive urban planning eases access to basic services (water, sanitation, housing, education & health) and to decent employment for all. A key element of smart urban planning is a smart street network that reduces travel time and encourages walking and social interactions. Smart urban planning enhances infrastructure development, environmental sustainability, economic and social development; makes cities resilient and prepared to

overcome natural disasters; and promotes mixed neighborhoods where services are walking distances from people's residences.



Figure 1: Conceptual framework – Smart City Foundation. Source: Mboup G. et al, 2016. Smart City Foundation – Driver of Smart Cities.

In the African context where many cities are of density higher than 10,000 persons per square km, South African cities are particularly of low density. This is particularly true in the case of Johannesburg where the population density is only 3,300 persons per square km in 2016. The case of Johannesburg is common to South African cities as illustrated by the low population density also observed in Cape Town (4,700 persons per square km) and Pretoria (2,500 persons per square km), all being cities of 3 million or more [6].

Summary of section 2 – Spatial and Economic Transformations for a Smart Johannesburg Metropolitan Region

The section 2 will consist of analysing urban policies and programmes put in place by national and local authorities for the transformation of Johannesburg to a Smart Metropolitan Region. Johannesburg is the first African city that introduced the Bus Rapid Transit in its transport system in 2010. It is also among the few African cities with an explicit Smart City Programme. The Study will be based on the conceptual framework developed in the African Smart Economy in Smart Cities studies published in 2016 including four African cities: Cape Town, Nairobi, Dakar and Lagos. However, this framework will be modified and adapted to the metropolitan region context for a better integration of ICTs in the planning, the design and the management of the metropolitan region as well as its economic development.

To ease management of municipalities, the administration of Johannesburg metropolitan region is now decentralised into 7 regions following the creation of the post-apartheid City of Johannesburg Metropolitan Municipality in 2000. "Each region is operationally responsible for the delivery of health care, housing, sports and recreation, libraries, social development, and local community-based services. Each region will develop their own Local Integrated Development Plans (LIDPs). A LIDP guides a region's future development. For this reason,

Figure 2: Population, are and density of the Great Metropolitan Area of Johannesburg, in 1990, 1998, and 2013 Source: Angel et al., 2016. Atlas of Urban Expansion 2016, First Edition

	S A BOARD
Density: 2240 inhab/km2 2880 inhabitants/km2	3050 inhabitants/km2
Area: 1408 km2 1648 km2	2626 km2
Pop: 3,148,133 (1990) 4,726,764 (1998)	8,000,159 (2013)



the LIDP zones closely follow the boundaries of the regions. LIDPs deal with city development, management and growth over a five to 10-year period. While they deal with local issues, they take an integrated approach to issues such as transportation, housing and environmental management. An overall Metropolitan IDP looks at the bigger picture and ensures that LIDPs don't conflict or lead to wasted resources. LIDPs will be revised annually so as to respond to changing conditions both locally and at a city level" [7].

Despite several urban policies and programmes put in place for an inclusive sustainable urban development in Johannesburg, the metropolitan is still facing enormous challenges such as [8]:

- Slow economic growth marked by: a) Structural weaknesses in the global economy coupled with a weak Rand; b) Rising interest rates and inflation; c) Income inequality and poverty remain prevalent and; High Unemployment rate, particularly among young people; informal economy;

- Social exclusion characterised by: a) exclusion of poor communities from access to housing and land; b) mobility is still a challenge for the urban poor;

- Urban violence and insecurity: crime rates are still among the highest in the world

- Climate Change: the city is facing climate change with Johannesburg being ranked 13th in the world of Greenhouse Gas (GHG) emitters and largest GHG City in South Africa;

- Corruption and lack of transparency are still on course

Considering these challenges, the City of Johannesburg has put in place a holistic smart city programme to be implemented at 85 % by 2021. This programme encourages innovation and efficiency; preservation of resources for future generation; resource sustainability with, for instance, 30% diversion in waste disposed by landfill. The programme is extended to natural resources, environment pollution and carbon emissions [9]. For the year 2017/2018, the city of Johannesburg have elaborated ten points for urban development including to: 1) ensure that the entire City embraces the environment of a new coalition government; 2) Promote economic development and attract investment towards achieving 5% economic growth; 3) Ensure pro-poor development that addresses inequality and provides meaningful redress; 4) Create a culture of enhanced service delivery; 5) Create a sense of security through improved public safety; 6) Create an honest and transparent City that fights corruption; 7) Create a City that responds to the needs of residents; 8) Enhance financial sustainability; 9) Encourage in-



Figure 4: 35 City-Wide Community Based Projects. Source: City of Johannesburg, 2017-18 draft Integrated Development Plan Review.

novation and efficiency through programmes such Smart City and; 10) Preserve our resources for future generation [10].

Five pillars are the bedrock on which these ten points will be delivered:

PILLAR 1: Grow the economy and create jobs

PILLAR 2: Enhance quality of life by improving services and taking care of the environment

PILLAR 3: Advance pro-poor development that provides meaningful redress

PILLAR 4: Build caring, safe and secure communities

PILLAR 5: Institute an honest, responsive and productive government

This will also be based on city-wide community based projects.

At the spatial level, the transformation of the city of Johannesburg will consist of:

1. Compact city – combining density, diversity, proximity and accessibility, reducing distances, travel times and costs, bringing jobs and social amenities to single use, marginalised residential areas, reducing energy consumption and infrastructure costs.

2. Inclusive city – ensuring balanced service provision (hard and soft) and opportunities for all by diversifying land uses, promoting social mixing and bridging social, spatial and economic barriers.

3. Connected city –enhancing public transit and ICT infrastructure at provincial and urban scales to re-connect the city, starting from 'the Corridors of Freedom' to street and neighbourhood-level connectivity.

4. Resilient city – building a metropolitan open space system as a protection buffer, preserving valuable green infrastructure and areas of high agricultural potential, promoting sustainable energy use, reinforcing the urban development boundary and protecting biodiversity resources.

5. Generative city – focusing investment in transformation areas and nodes towards: achieving positive social, economic and environmental returns on investment; spurring economic growth and job creation and enhancing public space and promoting sustainability (social, environmental and economic).

At the mobility level, Johannesburg is the pioneer in BRT in the African continent. "As soon as the BRT was introduced and operational in 2010, a robust but affordable bus management system was required, as there are many financial gains that can be made with the successful implementation of such a system. The Automatic Public Transport Management System (APTMS) was developed by a private consortium to deliver an ambitious range of information and services, including dynamic passenger information. The whole system was managed by a centralized control centre with



CCTV monitoring on vehicles and in stations allowing headways to be monitored and provide direct voice communication with station staff and drivers" [11]. Today four other South African cities - Cape Town, Durban, Tshwane (Pretoria) and in Rustenburg have adopted the BRT and have also introduced the ITS for transport planning, management and monitoring. Eight other South African cities are planned to adopt BRT or alike for efficient pubic mobility. All buses are equipped with free wi-fi on the trunk route, full air conditioning, low-floor technology which supports Euro V emission levels, vehicle stability and a cashless automated electronic system that is fully monitored by camera and censors.

Intelligent Inter city mobility - The Gauteng Open Road Tolling Project was commissioned by the South African Roads Agency Ltd. in order to finance the upgrading of a network of approximately 185km of freeway in Gauteng. This project uses electronic and automated methods of levying and collecting toll charges using 42 Tolling Points and is estimated to generate in excess of 2 million Tolling Point vehicle passages per day. The project comprises of the following sub-systems: Road Side Systems (overhead gantries), Open Road Tolling System Back Office, Transaction Clearing House and Violations Processing Centre. This project entailed the design, supply, installation and commissioning of remote traffic monitoring systems (RTMS) and equipment at 22 sites along the N2 between the Airport and City Centre. Aspects of the remote monitoring of traffic covered include the detailed recording of traffic volumes, vehicle types and vehicle speeds during all traffic conditions. The roadside sensors are capable of recording multi-lane data up to 10 lanes separately [12].

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NAIROBI

KENYA

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ACHIEVING REGIONAL DEVELOPMENT THROUGH ENHANCED CONNECTIVITY IN THE NAIROBI METROPOLITAN REGION

Introduction

Metropolitan regions offer opportunities for both economic and spatial growth, but also provide socio-economic and political challenges that surpass existing administrative units, often requiring the establishment of special management authorities. The Nairobi Metropolitan Region (NMR) was officially delineated in 2008 through a presidential decree and its management placed under a new ministry named Nairobi Metropolitan Development (MoNMD). The metro region constitutes of five administrative counties1 (Nairobi City, Kajiado, Kiambu, Machakos and Murang'a,) covering approximately 32,000 KM² with a projected population of about nine million [3] (Figure 1). The vision of NMR was to be a world class African metropolis that is able to create sustainable wealth and offer a high quality of life to its residents, investors, people of Kenya and visitors. These were premised on the recognition that there is a close nexus between economic, social, cultural and environmental wellbeing. The NMR's mission was be to build a robust internationally competitive, dynamic and inclusive world class infrastructure; to support development and to enhance linkages & accessibility to national, regional and global contexts [3].

To achieve the vision and mission, the MoNMD formulated the Nairobi Metro 2030 strategy with seven key result areas that included: building an internationally competitive and inclusive economy for the metropolitan region's prosperity; deploying world class infrastructure and utilities; enhancing the quality of life and inclusiveness; delivering a unique image and identity through effective place branding; ensuring safe and secure region, and building and sustaining inclusive and efficient metropolitan governance structures. Of major interest in this chapter are the objectives to establish 'world class infrastructure and utilities supportive of world class living, working and business environment; integrating information and communication technologies in the development and management of infrastructure and utilities' and establishing inclusive and efficient metropolitan governance systems [3].

The achievement of the Nairobi Metro 2030 strategy and subsequently the infrastructure and connection vision has been hindered by



Panoramic view of Nairobi (Source: Shutterstock/Aleksander Todorovic) ¹ Kenya is divided into 47 independent governance structures called counties, each with its own governance structure.



Figure 1: Map of the NMR (Source: [3])

several challenges. First, the manner in which the metro region was formed has served to largely hinder its smooth operationalization and function. The top-down approach to its formation undermined ownership by some of the local authorities thus arousing coordination challenges. Since its inception, most of the municipalities affected have been reluctant to actively participate/be part of the metro region. This challenge was compounded by the shift in Kenya's governance structures in 2010 that led to the creation of independent county governments that are now charged with the management of urban settlements within their jurisdiction. Second, there seems to be missing governance and institutional links translating to function duplication and furthering of the coordination challenge. Upon the establishment of the Metro in 2008, MoNMD was charged with the responsibility to coordinate the activities of the metro region. The governance structure however failed to acknowledge the functional, financial and political independence of the involved municipalities. At its inception within Kenya's old governance system, the metro region consisted of 15 independent local authorities. Though local authorities partly relied on the national government for financial allocations, each controlled its budget and local revenue. As a result, metro wide projects could only be funded/carried out by the MoNMD and usually with limited support from affected local authorities. Further, in a bid to achieve the limited number of ministries specified by the new 2010 constitution, the MoNMD ministry was transformed to a state department under the ministry of Land, Housing and Urban Development, reducing its institutional significance and budgetary allocations.

The Nairobi Metropolitan Region possesses huge potentials for smart growth in all the sectors of the economy such as modernization of service industry, industrial growth and upgrading, agricultural sector diversification and marketing. For example, from the NMR vision and mission, the Kenyan government commits to come up with various strategies including developing and pursuing a Smart strategy for Nairobi Metropolitan Region. In pursuance to this the government has come up with various smart metropolitan enablers such as the recent formation of the Nairobi Metropolitan Area Transport Authority (NAMATA) which will provide a comprehensive and dynamic platform for addressing the challenges in the transport sector that have affected the Metropolitan Area. The body shall formulate a sustainable integrated public transport strategy that will be the basis for the orderly development of the proposed Metropolitan Area masstransit system, which incorporates both bus rapid-transit and commuter rail. This may be a concept borrowed from Washington Metropolitan Area Transit Authority (WMATA) which can help the NMR in achieving the principle of delivering sustainable transport choices which has an impact on other principles such as promotion of clean energy and attracting investments which will lead to increase in employment and business opportunities, given that NMR has itself a big consumer market for most of its products.

Another intervention which is likely to facilitate achievement of smart NMR is the Nairobi Metropolitan Service Improvement Project (NaMSIP) which is focussing on different development projects such as sewerage, roads, boreholes, markets and building the capacity of officers working in the NMR counties. These interventions will also help the NMR to achieve some aspects of interconnectedness within the NMR which is also a principle of smartness.

Approach -Virtual and Physical connectivity as spatial and economic strategies for metropolitan development

The Nairobi Metropolitan Region (NMR), being the most urbanized part of the country and producing over 50% of the country's GDP, is arguably the heartbeat of the country [1]. Any inefficiency in the functioning of the region is therefore bound to be enormously felt by the economy. Cognizant of this, we intend to analyse major activity nodes within the NMR (figure 1), their linkages (both virtual and physical), and appraise them against the qualities of smart city systems [2]. Virtual/ non-physical linkages will include the role of Information and Communication Technologies (ICTs) in shaping of a functional metropolitan region, and the physical linkages will include mobility networks and how their development has resulted in growth of commercial links between the main activity nodes, which mostly comprise of smaller towns within the five counties.

ICT development and usability as a key indicator of a smart city system will form the central focus of the Nairobi study. The key indicators we intend to use to measure how ICTs are shaping the economic and spatial structure of the metro-region include a) the types and structure of targeted interventions to boost ICT development and interconnectivity within the nodes, between the nodes and the center, as well as between the nodes, b) whether these interventions are working to boost virtual connectivity and whether they are contributing to enhanced productivity, and c) how the structures are working, and the challenges and opportunities being experienced. Of particular interest under this component will be how devolution, and the decentralization of governance structures, is enhancing virtual connectivity between the centre and nodes, and how this is affecting the connectivity patterns, particularly by reducing the need to travel to the centre regularly.

Smart mobility, which is one of the building blocks of a smart city system will be used to unpack the issue of physical connectivity within the Nairobi metropolitan region. The study will aim to understand and explain four key indicators a) the existing mobility alternatives within the metro region, b) how efficient the alternatives are in terms of boosting productivity, c) which mobility options have resulted in the largest economic and spatial growth within the metro region, and d) the externalities associated with differential growth (economic and spatial) recorded within the larger metro region (including linear growth along transport corridors, concentrated growth associated with emerging mobility terminuses etc).

Currently, the two major transport systems used within this region are road and rail, with road being outstandingly dominant. The high dominance of road transport is associated with huge losses in wasted human resource and fuel. Our intention is to investigate the value of lost economic productivity along the transport corridors for each mobility alternative, and how these could be reduced by adopting virtual linkages through ICT development. We also intend to compare huge investments made in the transport sector (with an intention to enhance connectivity within the metro area) against the actual value attained through the investments. The development of the widest dual carriage way in Kenya - the Thika Highway - provides an untapped opportunity to set -up the first bus rapid transit (BRT) in Kenya. We shall assess the impact a smart mobility plan involving a BRT on Thika Road and a complementary light rail service connecting major NMR nodes. A look into return on investment and payback period for such a major infrastructure project will be key in evaluating the viability of the investment [6]. Moreover, we shall assess the strategies currently employed by the transport management authorities. An example of a recent policy intervention by the state is the establishment of Nairobi Metropolitan Area Transport Authority (NAMATA)[7], an authority that will be in charge of developing a sustainable integrated public transport strategy. The authority is yet to develop any strategies, and it will be important that the strategies it develops comply with smart city systems.

In addition, we will focus on the role of ICT in shaping mobility within the NMR. Majority of road users in the region are already using mobile applications, such as 'GoogleMaps' and 'Ma3route' to report, monitor and avoid traffic jams. Accordingly, traffic management authorities such as Kenya Urban Road Authorities (KURA) have implemented the Nairobi Intelligent Traffic System (NIIT) to control traffic and monitor offenders. Against other traffic monitoring systems [8], we will assess the reliability, robustness, and smartness of the currently employed approaches.

Our central argument is that, the progress of Nairobi Metro will highly depend on how the region harnesses infrastructure development, ICT and the human resource to create a vibrant economy able to sustain the rapidly growing population. Therefore an understanding of the underlying challenges and opportunities that support or hinder the management and connectivity of the metro region is paramount.

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