Architecture and the Green Urbanism of Africa's Urban Built Environment: The Omen towards Smart Cities in Africa

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Abstract:

The concept of "Smart" Cities has gain increasing international attention. Some cities in the Americas, Europe and Asia manifests features of a smart city- greatly improved quality of life, and the urban built environment. Though a city commands a leading role in the global economy, recent data shows rapid urban growth in the developing nations as outstripping capacity for their cities to cope with infrastructure and services. Perhaps many African states are yet to recognize either the anticipated rapid growth or the deteriorating living conditions of their urban poor. A need thus arise as for further understanding of the effects a smart city portents for Africa's urban built environment; its sociocultural and economic simulations, is theme of research. What intrinsic effect does a smart city portents for the urban sustainability of Africa's cities? Paper identify the gaps that need to be discussed for further understanding of what a smart city portents on the ongoing campaign for Africa development. The challenge therefore may be subject to the conceptualization of architecture, green urbanism and the urban built environment towards achieving sustainability for growth, as the omen towards a smart city will be formidable in Africa.

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Key words: Africa, Architecture, Green Urbanism, Smart Cities,
Urban Poverty, Urban Sustainability

1 INTRODUCTION

Africa's goal towards the eradication of extreme poverty may
depend largely on what methods and means her states manage
their cities and resources. Recent studies posits Africa's GDP as
projected to reach $1.6 trillion by 2020. Many of Africa's cities
are where the vast majority of modern productive activities are
concentrated. Contributing the greatest opportunities in social,
economic and cultural resource for her citizens. However,
Cities- *the urban built environment-* are centers for economic
growth, innovation, and employment. Adiukwu & Adiukwu F. F
(2016) posits rapid urbanization in African as reflecting
significantly migration trend - comparative increase in the
population of urban residents is largely a result of metamorphic
dynamism of rural-urban migration and city expansion. Indeed,
many of Africa's cities grew historically out of some natural
advantage in resource. Rapid urban growth in the developing
world has seriously outstripped the capacity of most of her
cities to provide adequate infrastructure and other basic service
for her citizens. Authors identify three dynamics that may have
forged the rapid growth of Africa's cities as: industrialization,
transportation, and information communication
telecommunications. Recent studies estimates that over a third
of Africa's 1 billion inhabitants now live in cities, and 72
percent of these urban population now live in slums but by 2030
scholars' projects that proportion will have risen to half of its
population. A city if well managed, offer important
opportunities for the environment, economic and social
development. Cities account for 70% of global energy use and
greenhouse gas emissions. In many African cities, exception of
South Africa, public provision of serviced land and housing is

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steadily declining. The Reason many researchers and scholars credit to poor resources and political will, widespread corruption and illegal practices, administrative bureaucracy, especially in the identification of land rights for low-income groups. The concept of smart city as envisaged through an architectural lens by Rios, is a city that offers motivation, shares culture, knowledge, and life; a city that motivates its populaces to create and flourish in their own lives. A smart city is an admired city, a vessel to intelligence, but ultimately an incubator of empowered spaces (Rios, 2008). A city is experienced by its inhabitants in its urban built environment-buildings, roads, infrastructure and other structures, public spaces- *all make city life*. Therefore a strong urban design model and policy need to be integrated along with the sociocultural heritage of the city to foster sustainability. A Smart City for its sustainability necessities economic activities and employment prospects for its residents. Subsequently, Africa's Cities needs to identify their distinct advantage and core value competence in specific areas of economic and social activities so as to promote such, by developing the required institutional, physical, socio economic, cultural infrastructures and services. To begin to deal with these situation requires accurate forecasts for future urban growth trend, which in turn must be based on a solid foundation of high-quality statistics and a good understanding of the likely patterns, trends and urbanism of the urban built environment. Relatively it is a challenge to design and integrate technology in appropriate method. Thus method will differ, city to city. The next subsections discuss smart city and the dynamism on which it depends to survive and sustain.

1.1 Concept of Smart City

Concept of Smart City has been visualized on four fundamental Infrastructure as posit by many researchers-physical, social,

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institutional and economic. Based on these four fundamentals, the focus on the growth of Africa's cities in attracting investment, creating jobs, meeting the housing demand, and providing access to key infrastructure and basic services and increasing urban challenges in Africa's cities is a subject of discussion. Infrastructure Development: Africa needs to invest $93 billion (14% of GDP) annually in infrastructure over the next decade, according to the World Bank. Africa currently spends over $45 billion a year on infrastructure.

1.1.1 Physical Infrastructure

The physical infrastructure refers to the intelligent (smart) and cost-efficient physical infrastructure like the system of urban mobility, housing, energy, water supply, sewerage, sanitation facilities, solid waste management and drainage system, etc. integrated via the use of technology form a premise for further discussion as the realities in Africa's cities suggests. Many scholars and researchers concur that urban areas while accommodating more than 50% of the world population, occupies about 3% of the earth surface and generates 80% of global wealth.

1.1.2 Social Infrastructure

The Social Infrastructure in any social system manifests components that work towards developing the human and social capacities, such as the education, healthcare, entertainment, religious facilities and creative arts, sports etc., the open spaces, children's parks and gardens. The social components determine the quality of life of citizens in a city. Thus it is necessary that a city promotes inclusiveness and structures which proactively accommodate the social and financial disadvantaged citizen e.g. disabled, women and children into mainstream development.

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1.1.3 Economic Infrastructure

For a city to attract investments and create economic infrastructure for job prospects, it has to first identify its core values, relative benefits and analyze its potential for generating economic benefits likewise the gaps in the required economic infrastructure, then, can be determined. This would include the development centers for skill development, industrial parks, export processing zones, Trade, service, financial, warehousing and freight terminals etc.

2 AFRICA'S REGIONAL CONTEXT AND TRENDS

Africa is the world's second largest continent in land mass, with a total surface area of 30.3 million km2, including several islands and territories. It accounts for about 14.72% of the world's human population and currently, an estimated total population of over one billion people. However, it has vast capacity in energy resources. It is estimated that more than 40% of Africa's urban resident are living in poverty and over half of the urban population (61.7%) lives in slums (UN-Habitat,2013). What can be harnessed from the potential of large agglomerations of people depends on the resources available, the innovative intelligence and foundations for sustainability and the political will to do what is required, and equity. Human and financial resource is, invested in cities; their development and redevelopment signifies a continuing process. In the case of Nigeria, fuelled by the oil-boom in the1970s, the enduring by-products of rapid urbanization include: slums, overcrowding, poor sanitation, air and water pollution, clogged sewers, solid-waste contamination (Adiukwu, 2015). However, as Africa's cities grow, managing them becomes increasingly complex. Though there are evidence of high rates of urban poverty in many African cities, nevertheless their urban residents as well, enjoy access to education, health

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care, and other basic public infrastructure like electricity, water, and sanitation. Vulnerability and insecurity have weakened the links between citizens and their city. Good governance does more than provide needed services and infrastructure to city dwellers. Effective urban governance can be used as powerful tool to deal with urban growth, poverty, and inequality by allowing for popular participation in decision making, creating connections between civil society and the government, and ultimately fostering the articulation of a common vision for the city (Garland, Massoumi, Ruble, and Tulchin 2007).The rapidity of the urban transformation of Africa cities presents formidable challenges towards the transformation to smart cities. For many researchers, however, the greatest concern is surely the immense increase in the statistics of the urban poor. But there is more to this as it reflects a motivation for contribution to finding solutions to the problems.

2.1 Architecture and the Urban Built Environment

Encyclopedia Britannica defines Architecture - as art and science of designing and building, as distinguished from the skills associated with construction. The practice of architecture is employed to fulfill both practical and expressive requirements, and thus it serves both utilitarian and aesthetic ends. Although these two ends may be distinguished, they cannot be separated, and the relative weight given to each can vary widely. Because every society—whether highly developed or less, settled or nomadic—has a spatial relationship to the natural world and to other societies, the structures they produce reveal much about their environment (including climate and weather), history, ceremonies, and artistic sensibility, as well as many aspects of daily life. Houses in the 21st Century is widely affirmed by scholars and researchers as having a multi-dimensional package of services, which seeks to

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satisfy the basic human need for privacy, aesthetic ideals, comfort, and compliance to statutory values, fiscal economy and other correlated issues of significance in a modern society. In Thailand, India, South Africa, and Chile, collective options now form part of the state package of support provided to low-income citizens in need of shelter improvements. A good environment stimulates the intellectual capacity of man, likewise beautiful and serene environment gives an unending impression to a user (Adiukwu, Ala & Olarenwaju, 2016). Africa's cities needs houses to accommodate large urban population, considering that two third of its population, recent data projects will get accommodated in existing cities. Adiukwu (2014) affirms that Poverty, as index of underdevelopments has a social dimension which evident in the culture of livelihood reflects in the poor quality of housing and the living environment. In the United States, environmental and social advocacy gain momentum as part of the youth movement of the 1960s, in 'revolt' against the perceived problems of high-rise congestion and suburban sprawl. Many scholars believe that architects after the post-World War II building boom were content to erect symbolic civic and corporate buildings that celebrated extravagant consumptions and 'devouring globalization'. At the turn of the 21st century, however, a building's environmental integrity—as seen in the way it was designed and how it operated, became an important factor on how it was evaluated. Thus the early 21st century manifests building of shelter (in all its forms) consuming more than half of the world's resources—translating into 16 percent of the Earth's freshwater resources, 30–40 percent of all energy supplies, and 50 percent by weight of all the raw materials withdrawn from Earth's surface Architecture was also responsible for 40–50 percent of waste deposits in landfills and 20–30 percent of greenhouse gas emissions (Encyclopedia

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Britannica, 2014). Approximately a quarter of the world's urban population lives in slums (UN-Habitat, 2012).

2.2 Green Urbanism of Africa's Urban Built Environment

As the pressures for urban development continues to grow in Africa's cities, a need thus arise as to protecting the urban environment through mechanism that protects and preserves the environment. Many Urban residents in Africa face disparate exposure to increasing risks, lack of open and green space, and poor access to transportation. Merriam-Webster's Dictionary defines Urbanism as the characteristic way of life of city dwellers and in likewise the study of the physical needs of urban societies. Urbanism of Africa viewed in its physical, economic and socio-cultural context, identifies features connected with its patterns, processes, and effects on development. Green urbanism-a new logic for urban development that is indispensable and appropriate–one that provides a spatial context for directing population and investment. Adiukwu & Adiukwu F. F (2016) posits urbanism as a socio-cultural dynamism reflecting and encompasses on the everyday livelihood of the city dweller with significant impacts on the urban built environment, economic, health, security, psychosocial integrity as well as the overall growth and development of the city. Today, more than 50 percent of the world's population lives in urban environment and this figure is projected to rise to 66 percent by 2050 (UN DESA, 2014). One of the most characteristic features of slum life is the precarious quality of the constructions, this forms one of the most visual indications of urban poverty.

3 AFRICA'S URBAN SUSTAINABILITY OUTLOOK

Many Africa's cities reflects the embodiment of contemporary decay of urban life as evident in the standard of living,

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congested apartments, degraded environment, crime, insecurity as the case of terrorism among others. The harmonious relationship between human and environmental systems in sustainability will ensure that human needs are met in the short and long term by conserving and allowing for the generation of the natural environment and human. For human positive activities to be sustainable, there must be a relatively constant capital stock (Alberti, 1996). Population density directly affects different aspects of sustainability such as ecological sustainability combats the irreversible deterioration of the environment and deals with land development and preservation (Castells, 2000; Basiago, 1999). Africa's Environmental sustainability efforts mainly emphasis on achieving a balance between production and consumption, as opposed to prioritizing economic growth. Thus sustainability involves a set of constraints on major activities regulating the human economic system, plus the use of renewable and non-renewable resources. The preservation of natural capital and maintenance of resources is integral to environmental sustainability (Goodland, 1995). Nianxiong (2015) affirms that though people across society have had a general awareness of sustainability principles through the ongoing education for sustainable development, its impact so far, has made limited impact on their lifestyle. Promoting the urban environment for sustainability, particularly working with nature, leveraging on density, clustering of competitiveness and optimizing infrastructure, contributes in no small measure to the attainment of physical, health and psychosocial needs of a people (UN-HABITAT, 2012). Thus, based on the principle of using research (or evidence) to inform design/development, this will foster a positive transition of urban built environment and lead it towards sustainable development (Chen 2015).

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3.1 Urban Poverty

Urban Poverty according to the Copenhagen, resolution (2000) is strongly associated with high levels of environmental risk due to poor quality and overcrowded living conditions and the inadequacies of water, sanitation, drainage, health care, waste collection, poor percolation resulting into flood, building on waterways and pollution of land, air, and water. These negative trends affects the capacity of the environment to cope. Political scientists and economists posits that no society can develop or live in peace when majority of the population is poor. Urban poverty and slum growth are local problems, but their nature and scale demand a global response. Slum dwellers have been denied civic engagement and have no effective means to protect themselves, to make demands for goods and services, or to force accountability of those who represent them (Halfani 2007; UN-HABITAT 2006). Measuring poverty is no less challenging, given the diversity of African cities, there can be no absolute definition. Many Tanzanians or Malians would, for example, likely consider those living in South Africa's "poverty pockets" (Cross et al. 2005) as relatively well-off given their access to health, education, water, and transport. Based on earlier analysis, this study finds applicable some guiding principles. To be sustainable, a city must score on virtually all fronts.

3.2 Urban Life

Building livable cities in Africa, the kind of vibrant, cosmopolitan ideals promoted by many nations is in a context where social and economic relationships are in a constant state of instability and uncertainty (Simone, 2004).The present realities of Africa's cities like Accra, Lagos, Mogadishu, Cairo, Nairobi and many other cities portray a fragmented, polarized, unstable urban space. Evans (2002) posits investment in a common future not only facilitates trade, but also facilitates effective planning and promotes political accountability.

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4.0 SMART CITY- READINESS FACTORS

Many researchers' view the key enabling dynamism for developing smart cities - land access, natural resources, city character, cultural heritage, organizational framework; human capacity as necessary index for a smart city state.

4.1 Land Access

In the sub-Saharan African cities, their urban poor in addition to large sectors of low and middle income groups do not have access to land provided by the public and the formal private sectors: In many African cities, exception of South Africa, public provision of serviced land and housing many view on decline, due to poor resources management, lack of political will, and corruption, administrative and technical bottlenecks, in the identification of land rights and a failure to reach low-income groups. In Cameroon, for example, 1974 legislation required people to apply for a land certificate for private land ownership. The procedures were complex and expensive and seldom took less than seven years to complete. Few people applied, yet in 1989 the certificate became the only recognized proof of land ownership and all other customary or informal rights to land were nullified (Njoh 2003).The failure of governments' urban land and housing policies and the inability of the formal private sector to provide land for housing the poor has reinforced the attractiveness of informal land markets. The African continent has today the largest proportion of the urban population living in informal settlements with poor access to basic infrastructure and urban services and less security of tenure than in formal settlements.

4.2 City Character and Cultural Legacy

Many African cities are organically evolved with local cultural ethos and heritage. Each city does have unique culture, social

values, and technology evident in their urbanism; communal spaces, architecture, art, governance etc. The cities of Casablanca, Lagos, Kinshasa and Johannesburg are different in nature and character. Their unique cultural identity and character are inherent in their urban built environment and their urbanism despite local limits in their conduct of daily life and response. Africa cities cannot afford to avoid cultural heritage in making any city plan. It is not sufficient to identify the cultural heritage only, but what to do and in order to build upon this cultural heritage is a key question that the city stakeholders have to response. What effective ways can governance utilize the cultural heritage of her people is important. There must be a smart approach to utilize cultural heritage as element of social and economic life.

4.3 Infrastructure and Services

Poor infrastructure impedes a nation's economic growth and international competitiveness. Deficient infrastructure also represents a major cause of loss of quality of life, illness and death of citizens. This raises infrastructure services from good investment to a moral and economic imperative. In order to stimulate growth and reduce poverty, it is essential to improve the supply, quality and affordability of infrastructure services. The next section and subsections discuss smart cities and economy. It envisions the outlook of an African smart city.

5 SMART CITIES AND ECONOMY

A smart city is an urban territory that provides exceptionally healthy infrastructure, environmental sustenance, economic viability and citizen well-being using innovative services and concepts. Africa no doubt has promising economic outlook. As cities continues to need a place for work for its residents, likewise a future African smart city. Authors are advocating a

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need to develop industrial and commercial institutions
alongside, to reposition African states in a vintage position for
economic development. The commercial institution would only
be successful in the event that the residents have high income
as evident suggest from smart cities in the USA, UK, EU and
China. Industry whether manufacturing or service would hence
be main source of income generation to support city economic
framework. Service industry requires physical infrastructure in
terms of buildings; and manufacturing industry requires
infrastructure, as economic realities suggests. However
manufacturing industries are a source of pollution and may not
be viable in smart cities. Thus, a model for confronting this
challenge may be that manufacturing industries are planned
within the fringe of smart cities, such that large workforce are
employed. This will complement high cost in managing a smart
city (as present status may not be able to sustain the cost of
living in the smart cities. Hence fringe of such cities may
likewise develop as a place of living for the urban labor.
Another model may be that manufacturing industries are
planned separately a little farther from smart cities at the same
time.

5.1 Smart Cities

Smart Cities are defined by – Smart Energy, Smart Transport,
Smart Water and Waste, Smart Social, and Smart Buildings.
For many people, city life signify a mixture of alienation,
isolation, fear of crime and terrorist attacks, congestion, and
pollution than a feeling of community, participation, animation,
beauty or pleasure (Komakech, 2005). A transition to smartness
many scholars posits can be supported by smart computing: a
new generation of integrated hardware, software, and network
information technology systems with real-time awareness of the
surrounding world that can help urban citizens make more
intelligent decisions. Smart computing transforms cities from

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their traditional forms into smart cities (Nam and Pardo, 2011).
Cities require accurate and real-time information about the
status of urban services in order to improve public safety and
provide adequate infrastructure. However, traditional cities
cannot optimize this provision of services due to constantly
changing conditions as City officials are unable to access the
necessary information for decision making in the right form,
and at the right time. In contrary, a smart city should provide
the required infrastructure for citizens and officials to make
more intelligent decisions. In doing so, it then performs an
essential role in dealing with challenges relating to ecological,
social, cultural, and economic sustainability (Caragliu et al.,
2011). Singapore is an example of a smart city where the
quality of life for residents has been enhanced, her government
has created an IT-based teaching and learning environment for
schools in order to prepare children with creativity and
innovation. In a smart city, all significant infrastructures -
including roads, bridges, tunnels, rail, subways, airports,
seaports, communication infrastructure, water, power, and
major buildings - are monitored in order to exploit the services
available to urban residents (including security services), while
optimizing the use of resources (Hall, 2000). Therefore, the
critical infrastructures of a city can be made more intelligent,
interconnected, and efficient by employing smart computing
technologies (Balaouras, 2010).

5.2 Smart City Architecture
 According to Mostashari et al., (2009), a smart city architecture
comprises three strata

5.2.1 Human/Institutional Stratum
Exclusively includes residents, non-governmental organizations
(NGOs), government regulators, and players in the public and
private sector engaged in the formation of market dynamics.

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The integration of profit boosting goals into the economic utility in the United Arab Emirates, the government of Abu Dhabi in 2006, initiated a project to make Masdar "one of the world's first zero car cities." To achieve this goal, the city invested in renewable energy and sustainable technologies including wind, solar, and biomass (Reiche, 2010). However, the project was not quite successful because only the availability and quality of the smart infrastructures of Abu Dhabi were considered, and the human dimension was considerable overlooked. In a smart city, governments and businesses invest in ICTs to improve sustainable development and quality of life, by providing smart urban infrastructures that will inform urban residents about the desired environmental agenda (Harter et al., 2010).

5.2.2 Data Stratum: includes all data gathering devices, information sensors, local wireless and cellular networks that monitor the status of various systems within the city. This layer integrates subsystems to make the overarching system more "smart."

5.2.3 Physical Stratum: consists of all physical objects and infrastructures and their accompanying physical properties, and provides connectivity for the city's subsystems. For instance, wireless sensors can be installed in components of the physical layer in order to collect monitored parameters and transfer this data to the data network layer. Data network agents, in turn, use those sensors/actuators located within the physical system to monitor the performance of city systems and initiate control actions based on the economic optimization scheme utilized within the social network layer.

5.3 Smart infrastructure
Smart infrastructure provides the foundation for all of the key themes related to a smart city, including smart people, smart

mobility, smart economy, smart living, smart governance and smart environment. The core characteristic that motivates most of these components is that they are connected and that they generate data, which may be used intelligently to ensure the optimal use of resources and improve performance.

5.4 Smart buildings and Smart mobility

A smart building incorporates the different physical systems present in an intelligent way toward ensuring that all the systems work together in an optimized and efficient way. Smart building management systems can improve building energy efficiency, reduce waste and ensure an optimum use of water, and occupant satisfaction. Recent data projects that implementing smart building solutions can save as much as 30 per cent of water usage and 40 per cent of energy usage and reduce building maintenance costs by 10 to 30 per cent. For example, in Austria, plus-energie-bürohochhaus is acclaimed as the first smart office building, feeding more energy into the grid than it uses. Smart mobility is best defined as approaches that reduce congestion and nurture quicker, greener and cheaper transportation options. Most smart mobility systems use data collected from a variety of sources about mobility patterns so as to help optimize traffic conditions in a holistic way. Smart mobility systems include mass transit systems as well as individual mobility systems that feature bicycle sharing, ride sharing, and vehicle sharing, are more recently, on-demand transportation. For example, the bicycle-sharing system in Sao Paulo, Brazil, has saved 570 tons of carbon dioxide emissions since it began operations in 2012. Intelligent transport systems integrate the entire array of multimodal transport options in a city, including both individual mobility and mass transit, in an efficient manner. For example, Poznan, Poland, is presently operating a modern intelligent transport system. Some challenges that arose in its implementation includes a shortage

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of skilled staff, issues related to interoperability and unexpected delays in the construction of hard infrastructure components. The next section envisions the future of African cities.

6 FUTURE FOR AFRICA

The process and manifestation of Smart cities in Africa is likely to generate many problems if not properly planned and managed. Apart from tourism and other time tested approach for integration of cultural heritage, an approach may also be to integrate it in the educational and entrepreneurial activity at different levels. In the paradigm of smart city in Europe and North America, it is observed that major in-migrants in the smart city is due to the pull factor for higher educational infrastructure and high overall quality of life (Winters, 2008). For an African smart city based on economic prospects, it is proposed that a city be developed in the contextual framework on educational, industrial and commercial hubs as observed in some initiative in Ghana, Ivory Coast, South Africa and Nigeria, so as to attract domestic and foreign direct investments and tourism. This will invigorate market dynamic to thrive the cities. Moreover, smart planning enhances the capacity of governance to deliver public services while involving citizens in decision making processes. Socioeconomic sustainability will be enhanced as a result of broad participation of citizens. By 2030, scholars project the populations of Nairobi, Johannesburg, and Abidjan to exceed ten million, and many African cities could have more populations in their poorer neighborhoods, where spatial forms are largely driven by the labors of low-income households to secure land that is affordable. A city's sustainability is achieved when the questions of social, economic and environmental simulations and sustainability are taken into consideration.

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The next subsections examine the cost a smart city portends for Africa, its operations and maintenance, and the manpower.

6.1 The Cost of a Smart City

The people living in smart cities must have their earnings enough to pay for services. Thus smart cities would be affordable only by high income group. It is no mean feat that the cost of a smart is likely to be very high. Thus Land availability at subsidized rates to the developers is the opinion of authors, a strong necessity. In the event, land is not provided at subsidized rates, such cities may not be viable even for middle income group.

6.2 Operation and Maintenance

The operational costs and maintenance of a smart city are to be shared by the residents and the cost of such charges is likely to be very high which can be afforded only by rich and wealthy. Africa's Smart cities would need developing manufacturing and service industries to generate economic resources for a smart livelihood. These industries are to be located near existing manufacturing hubs and centers.

6.3 Manpower

For Africa smart city to be successful in its endeavors, human resource skills need to be available to ensure that all the different facets of the city are adequately and efficiently addressed. For example, a digital or data layer must be added to all relevant operations, and more technology vendors and the integrated functioning of different departments must be dealt with. Human resources skills include planning and design, digital citizenship, data literacy, implementation and management. Investing in smart people, not only smart technology, is essential. Currently there is little research, especially in developing countries, that quantifies the exact

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skills deficit. Thus, to begin with, Africa's cities should conduct their own analyses of skills deficits.

RECOMMENDATIONS

Based on the authors disciplinary platform (architecture, psychology and urban planning and design), the following recommendations, relates to key capacities and a precautionary measure:

i.   Housing "Smart city"-Planning a city requires in depth feasibility study based on commercial, industrial, social, economic, infrastructural and citizen's requirements, plus environmental considerations. Thus, a blue print (master plan) has to be developed first for each smart city. It is therefore important for national and city governments to work together with all relevant stakeholders to develop a common understanding of what a smart city entails in their specific national and local contexts.

ii. Availability of existing infrastructure need be considered before creating new infrastructure. Cost of living in smart cities is expected to be very high considering operation and maintenance cost of services. Thus infrastructure designs need to be people oriented, responding to the needs and challenges of specific urban systems and recognize the potential of technology as an enabler and at the same time understand its limitations for every city.

iii. Adopt a participatory and integrated approach to smart city development that actively engages citizens at all stages of development, and ensuring that cultural and employment factors of society are adequately integrated into the design of smart city plans.

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iv.   Adopting an integrated approach to the conceptualization and design of smart cities and infrastructure to promote the more efficient use of resources and provision of public services.

v.   Strengthen the core ICT infrastructure and Conduct skill gap analysis within workforce and Incorporate insights obtained from data generated from smart city into the governance process

vi.   Further understanding- African nations perhaps are genuinely concerned that new technologies bring in their *trends* and *influence*, which challenge and subvert long established traditions and beliefs, organization, governance, and the very culture and ethos (Mahizhnan, 1999).

CONCLUSION

The preparedness of Africa's cities will be very vital in achieving smartness for its cities. However, there is a positive outlook that African cities still hold great potential for human vitality, creativity and productivity. The difference inherent in the city character and cultural heritage of a city to another, leads to understanding differential condition of infrastructure and services, thus justify consideration in order to foster infrastructure. Hirt (2005) for example, describes how, in Bulgaria, consultation with other professionals on master plans is viewed as an adequate substitute for civic participation. The result is that experts generalize an understanding of values, lifestyles, priorities, and so on from their own part of the world to the rest—they imagine formally employed, car-owning, nuclear families living in formal houses with full services, in cities that are growing relatively slowly and have strong and well-resourced local governments. Models of how the smart city of the future can operate-taking care of its individual

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inhabitants by offering services, security and health, providing optimized prospects for transportation by synergizing many sources of traffic information at the same time and integrating different means of transportation, providing opportunities by participation of people in the community. Thus offering multiple opportunities for social engagement in order to be an active part of society. Both environmental and economic sustainability are also affected by changes in political behaviors and accordingly by participatory governance. There is an urgent need to bridge knowledge and capacity gaps in relation to vital urban and territorial challenges such as climate change, disaster, safety and security, ecosystem connectivity, green infrastructure, food security, health, diet and nutrition. On the part of city residents, changes in consumption, transport and energy behaviors reduce demand that positively affect environmental and economic sustainability of Africa's cities trends to smart city. Africa's smart cities will have to be designed based on sustainability of Africa's habitat for all cadre of the society. Therefore authors recommended that new cities undergo contextual detailing in any proposed model before implementation.

REFERENCES

[1] Adiukwu, Ala & Olarenwaju, (2016). Effect of Earth Construction Acts on the Urban Environment- International Journal of Innovative Research and Advanced Studies (IJIRAS) ISSN: 2394-4404 Volume 3 Issue 9, August
[2] Adiukwu and Adiukwu F. F (2016) Urbanism, Solid Waste and Urban Metamorphosis in Africa-International Journal of Innovation and Scientific Research. ISSN 2351-8014 Vol. 20 No. 1 January, pp. 111-116
[3] Adiukwu, F.O (2015) Housing the Nigerian Urban Lower Income Group: *A Panacea for Industrial Growth* -International

Adiukwu, Fidelis Onyekachi, Adedeji, Afolabi, Adiukwu, Fayokemi Funmilola-
**Architecture and the Green Urbanism of Africa's Urban Built Environment:
The Omen towards Smart Cities in Africa**

Journal of Innovation and Scientific Research ISSN 2351-8014 Vol. 19 No. 2 Dec., pp. 441-447

[4] Adiukwu, F.O (2014) Prospects and Challenges of Informal Settlements and Urban Upgrading in Abuja International Journal of Innovation and Scientific Research Vol. 11 No. 2, pp. 420-426

[5] Alberti, M. (1996). "Measuring Urban Sustainability," *Environmental Impact Assessment review,* vol. 16, 381– 424

[6] Balaouras, U. et al. (2010). "Helping Cios Understand Smart City Initiatives: defining the Smart City, Its Drivers, and the role of the Cio," *Cambridge*, MA: Forrester Research, Inc.

[7] Basiago, A. (1999). "Economic, Social, and Environmental Sustainability in Development Theory and Urban Planning practice," *The Environmentalist,* vol. 19, 145–61

[8]Caragliu, A. et al. (2011). "Comparative Performance Assessment of Smart Cities around the North Sea Basin," *Network Industries Quarterly,* vol. 13(3)

[9] Castells, M. (2000). "Urban Sustainability in the Information Age," Cities, vol. 4 (1), 118–122

[10] Chen B. (2015) A Comprehensive Approach to the Design of Sustainable Buildings: How to facilitate a Constructive dialogue a cross the stakeholder groups. Heidelberg: Springer.

[11] Chen, Bing; Liu, Nianxiong (2015) - Designing Affordable Housing towards Sustainability Standards Paper presented at Conference: Housing – A Critical Perspective Architecture_MPS; Liverpool University; Liverpool John Moores University Liverpool: 08—09 April.

[12] Cross, C., P. Kok, M.Wentzel, K. Tlabela, G.Weir-Smith, and J. Mafukidze. (2005) Poverty Pockets in Gauteng: *How migration impacts poverty.* Report to the Gauteng Intersectoral Development Unit. Pretoria: Human Sciences Research Council.

[13] Encyclopedia Britannica (2014) – Architecture and Green Urbanism Definition

Adiukwu, Fidelis Onyekachi, Adedeji, Afolabi, Adiukwu, Fayokemi Funmilola-
**Architecture and the Green Urbanism of Africa's Urban Built Environment:
The Omen towards Smart Cities in Africa**

[14] Evans, P. 2002. Political Strategies for More Livable Cities: Lessons from Six Cases of Development and Political Transition. In *Livable Cities? Urban struggles for livelihood and sustainability*, ed. P. Evans. Berkeley: University of California Press.

[15] Garland, Allison, Mejgan Massoumi, Blair A. Ruble, and Joseph S. Tulchin. 2007. Urbanization in Latin America and the former Soviet Union: From poverty toward inclusion. *Georgetown Journal of International Affairs* 3 (2): 5–11.

[16] Goodland H. (1995). "The Concept of Sustainability," Annual Review Ecology and Systematics, vol. 26, 1–24

[17] Halfani, Mohamed. 2007. The Urban Face of Poverty: Innovation and New Approaches. Presentation at the Conference, Why Is Urban Assistance Important? Inserting Urban Issues into the Development Agenda, Comparative Urban Studies Project, Woodrow Wilson International

[18] Hall, R. E. (2000). "The Vision of a Smart City," In Proceedings of the 2nd International Life Extension Technology Workshop, Paris, France, September 28

[19] Harter, G., Sinha, J., Sharma, A., and Dave, S. (2010). "Sustainable Urbanization: The Role of ICT in City Development," *Booz & Company Inc., available at http://www.booz.Com/media/uploads/Sustainable Urbanization. Pdf*

[20] Hirt, S. 2005. Planning the Post-Communist City: Experiences from Sofia. *International Planning Studies* 10(3-4): 219–40.

[21] Komakech, D. (2005). "Achieving more Intelligent Cities," *Municipal Engineer*, vol. 158 (4), 259-264

[22] Komninos, N. (2006). "The Architecture of Intelligent Cities," *Intelligent Environments,* 13–20

[23] Mahizhnan, A. (1999). "Smart cities: the Singapore case," *Cities,* vol.16 (1), 13–19

Adiukwu, Fidelis Onyekachi, Adedeji, Afolabi, Adiukwu, Fayokemi Funmilola-
**Architecture and the Green Urbanism of Africa's Urban Built Environment:
The Omen towards Smart Cities in Africa**

[24] Mostashari, A. et al. (2009). "Smart Social-Technical Power Grids: Towards A Resilient and Trade Optimized Design," NSF NETSE Project Proposal

[25] Nam, T. and Pardo, T. A. (2011). "Conceptualizing Smart City with Dimensions of Technology, People, And Institutions," *presented at the 12th Annual International Conference on Digital Government Research*

[26] Njoh, A. 2003. *Planning in contemporary Africa: The state, town planning and society in Cameroon.* Aldershot: Ashgate.

[27] Reiche, D. (2010). "Renewable Energy Policies in the Gulf countries: A case study of the carbon neutral "Masdar City" in Abu Dhabi," *Energy Policy*, *38*(1), pp. 378-382

[28] Simone, A. 2004. *For the city yet to come: Changing African life in four cities*. Durham,

[29] UN-HABITAT (2012). Urban Patterns for a Green Economy (four series), Nairobi, Kenya.

[30] UN-HABITAT. 2006. *State of the World's Cities 2006/7.The Millennium Development Goals and Urban Sustainability: 30 Years of Shaping the Habitat Agenda*. London: Earth scan for UN-Habitat

[31] Winters, J. V. (2010). Why are Smart Cities Growing? Who moves and who stays. Journal of Regional Science, 20(10), 1-18.