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Smart Cities: The Foundation for Future Citizen Service Delivery in Nigeria

Abdulkadir.A. Adamu, Dong Wang and Abdul-Fatou Adam
College of Information Science and Engineering, Hunan UniversityChangsha, China.

***ABSTRACT**: Smart city initiatives are rising rapidly as a methodology to relieve the issues produced by urban populace development and quick urbanization which urban communities around the globe are encountering. The 21st century is faced with fast urbanization, environmental change, financial turmoil, and growing population, which presents enormous difficulties and pressure on our urban areas. Additionally enormous in the midst of us is technological advancements that can possibly address the issues that challenges each city. Smart city initiative is the future reality of the developing world including Nigeria which is anticipated to add more than 212 million to her urban populace between 2014 - 2050. These urban areas will utilize the concepts of universal correspondence systems, profoundly circulated remote sensor innovation, and smart administration frameworks to deliver services to the residents, unravel present and future difficulties and make novel services energizing. By coordinating smart innovations into everything and wherever in Nigerian urban communities, from heath, transportation, training, services, security, in addition to other things, the difficulties faced by urbanization on our urban areas can be addressed. This paper examines the critical part smart city activity will play in the delivery of service to the citizens.*

***Keywords:** smart cities; services; technology; Nigeria; population*

I. INTRODUCTION

As indicated by the United Nation's World Urbanization Prospect Review (2014) [1], there are a greater number of individuals living in urban regions than in rural regions internationally, with 54% of the total populace dwelling in the urban areas. In 1950, 30% of the total populace was urban, and by 2050, 66% of the total populace is anticipated to be urban. Also, only three nations – India, China and Nigeria – together are required to represent 37% of the anticipated development of the world's urban populace in the vicinity of 2014 and 2050 with Nigeria alone anticipated to include 212 million. It is along these clear lines that urban communities are situated as the development motors without bounds, offering their populaces more noteworthy opportunities for training, business and thriving. Urbanization however prompts to expand weight on the city's accessible assets and infrastructure (water, power, transport, security, correspondence system and lodging) and raises issues of disparity, destitution, unemployment, and service delivery. Citizens are being faced with elevated amounts of air pollution, waste, as well as other natural viewpoints, for example, changes in normal temperature, and moistness levels. Directly the greater part of the world's population live in urban areas and the number will ascend to more than 66% by 2050 [2]. Nigeria particularly is experiencing a phenomenal relocation to urban areas from the rural territories.

Figure 1 illustrates the vision of the envisaged smart city in most urban cities in the world, a city with an obvious outlay of information and communication technology (ICT) connecting people and communities together.

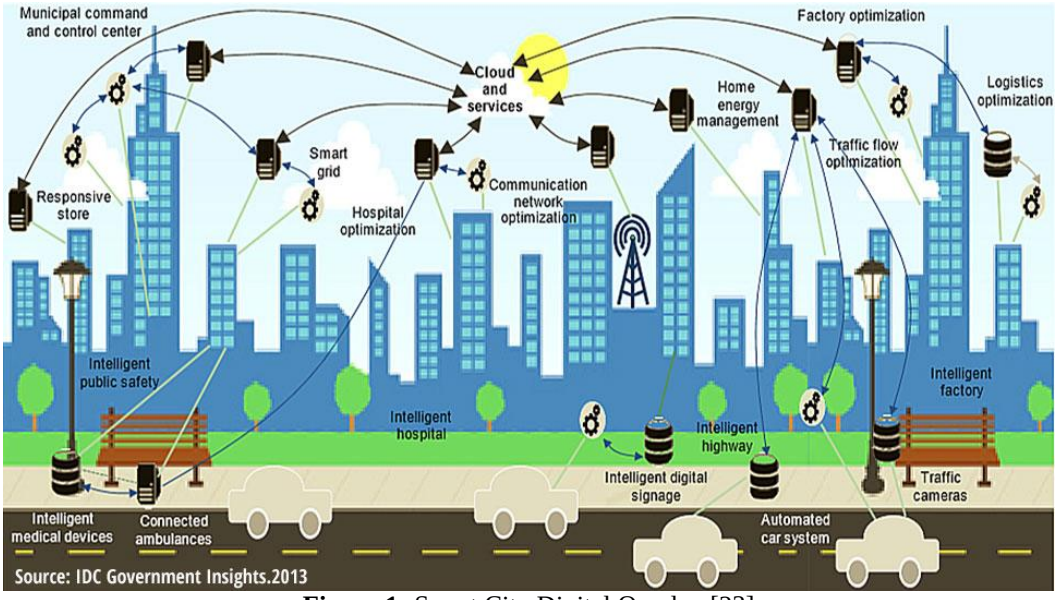

Figure 1: Smart City Digital Overlay [23]

In view of urbanization patterns, future financial development will be dominatingly fixated on urban communities. It accordingly has to be distinctly critical to understand urban areas, keeping in mind the end goal to get ready for the difficulties that will emerge from expanding urbanization [2]. The memorable association between Lagos State and City of Dubai that will guarantee Lagos rise as the primary Smart City in Africa is an appreciated advancement. The Lagos State Attorney General and Commissioner of Justice and the CEO of Smart City Dubai marked the Memorandum of Understanding (MOU) for the Lagos Smart City at the Emirate Towers, Dubai. The Smart City initiative is a developing idea that draws from the achievement of Dubai's creative information based industry experts to engage business development for organizations and learning specialists everywhere throughout the world. The future has a place with Lagosians (residents of Lagos State, Nigeria), as the smart city venture would stamp the principal smart city in Africa when finished.

Those included in the Lagos Smart City initiative need to understand that all urban areas have diverse difficulties amid their development and as a rule, the smart city objectives needs to change as often as possible to adjust to the city's development needs, and interests. Dubai has received its own novel smart city approach. Dubai's desire is supported by the three topics of correspondence, reconciliation, and collaboration. It is this coordinated approach that has helped the legislature to accomplish its goal of turning into a really worldwide smart city. Interestingly, Smart Cities are a future reality for urban communities around the globe. These urban communities will utilize the force of omnipresent correspondence systems, exceedingly circulated remote sensor innovation, and smart services frameworks to understand present and future difficulties and create new services[3].SmartCity initiative will be best embedded in the Nigerian situation by visionary leaders who drive Smart City progress using public-private, public-publicpartnerships to invest in pilot scale projects, smart rules to connect city laws to new digital realities,and technological innovation clusters to create new jobs and very vibrant economies.

The Smart Cities proactively give services and data to citizens, for example, where to find a parking space or another nearby shop or even to screen air contamination or pollutants. Thesetype of arrangementare associated to neighbourhood government and support more straightforward cooperation, communication, and coordinated effort. Furthermore, Smart Cities give arrangements that are financially and ecologically manageable. This is the potential future for each city and town in Nigeria [3,4].The objective of building a smart city is to enhance personal satisfaction by using technology to enhance the effectiveness of service delivery and meet residents' needs. ICT permits city authorities to associate directly with the group and the city infrastructure and to monitor what is going on in the city, how the city is developing, and how to empower a superior personal satisfaction. Using sensors incorporated with real-time monitoring systems, information are gathered from residents and gadgets, then handled and analysed.Therefore, this paper talks about patterns driving smart city activities, the vision for the smart city without bounds, and the development cycle that urban areas can advance through to end up distinctly a smart city to better convey services to the residents. It incorporates some cases of urban areas on the way to a smart city in Nigeria and lays out solid activities that Nigeria can take in completing its smart city plans.

II. SMART CITIES CONCEPT AND SERVICES

The worldwide idea for smart cities is to drive financial development and enhance the personal satisfaction of individuals by enablingdevelopmentin the neighbourhood and tackling innovation that gives smart results. Smart urban areas have the possibilities to change the retail business through smart shopping baskets, lessen city energy costs for streetlights, and change the way cities handle parking spots through a real-time parking spot finder in communication with connected parking spots, amongst other things [5]. In any case, the smart city market has not by any stretch of the imagination taken off yet in Nigeria, for various political, specialized, and money related boundaries [6]. Despite the comparable tendencies, the difficulties faced by developing counties differ from that experience by developed countries in the application of smart city concepts. These difficulties are diverse in size and nature and can be categorized into the following:

1. **Settlement**: Continuing populace development and urbanization are anticipated to add 1.5 billion individuals to the world's urban populace by 2050, with about 90% of the expansion gathered in Africa and Asia. Urbanization notwithstanding the development and pervasiveness of casual settlements within city boundaries increases the request for city services and opens the residents to extreme climate and other common occurrences, for example, floods, and fire – because of absence of "early cautioning" frameworks.
2. **Traffic congestion**: Due to everyday migration of people into the city and surrounding areas, traffic is expanding at a high rate. Breakdown or absence of maintenance of existing street framework straightforwardly impacts on the increase in traffic and the time and cost of every day drive. Additionally related to traffic congestion are constrained or costly parking slots – as a result of high need without supplementing existing infrastructure.
3. **Service delivery**: Failure of governments as well as establishments to provide effective service to the residents which is common in Africa, continuously prompts protests and strikes. These frequently turn rough and influence numerous different parts of the general public and economy. Indeed, even with the pervasiveness of web-based social networking, access to data is generally restricted to residents with money related means. What's more, open recreational zones are restricted and regularly inadequately kept up and risky.
4. **Energ**y: Energy related difficulties are common in the developing world. Communities exist without power, and some very unstable supply. These difficulties influence the general citizen service delivery. The utilization of carbon related devices for heating and cooking are forming the standards in developing nations. This leads to individuals being exposed to the perils of uncontrolled flames and air pollution from which invariably is quite detrimental to health.
5. **Security**: With reference to the basic security dangers in the developing world (energy, burglary, violent car hijack e.t.c) abduction and terrorism are turning out to be more pervasive. These security threats pose great danger to the life of nationals.

In this way, the following presents an outline of some smart city servicesthat when enabled can realize the win–win situation of enhancing the services offered to the citizens in Nigeria and indeed other developing nations, while bringing to board an economical advantage for the city administration in terms of reduction of the operational expenses.

1. Waste Management:

Nigerian urban communities are no exemption to the difficulties of waste administration which is a huge test in numerous current urban cities. Developing and adoptingsmart innovations in this context will altogether lessen the cost of waste administration notwithstanding ecological advantages [7]. A basic situation is having smart waste holders which recognizes the level of load and takes into consideration a streamlining of the collector truck route. To acknowledge such a smartwaste management service, the enabling technologies might interface the end gadgets (smart waste compartments) to a control focus where optimization software processes the information and decides the ideal management of the collector truck.

2. Traffic Congestion

Traffic Congestion is another conceivable smart city benefit that can be enabled by smart innovations in checking the activity clog in the city. Despite the fact that camera-based movement checking frameworks are as of now accessible and employed in numerous urban areas, low-control can give a bulk of data [6].Traffic checking might be acknowledged by utilizing the detecting capacities and GPS installed on present day vehicles, and furthermore embracing a blend of air quality and acoustic sensors along a given road/street. This data is of awesome significance for city authorities and citizens: for the previous to track activity and to send officers where required and for the latter to arrange ahead of time the route to reach the workplace or to better schedule a shopping trip to the downtown or city area [7].

3. Smart Parking

With a smart parking framework, nationals can discover a parking space quicker which implies less carbon emissions from the exhaust streams of the automobiles, lesser traffic blockage, and happier residents. Smart parking administration depends on street sensors and insightful displays that direct drivers along the best way to park in the city. The smart parkingservice can be specifically incorporated in the urban IoT framework, in light of the fact that many organizations in Europe are providing market products for this service. Besides, by utilizing short-rangecommunication technologies, for example, Radio Frequency Identifiers (RFID) or Near Field Communication (NFC), it is conceivable to understand an electronic confirmation system of parking licenses in spaces reserved for inhabitants or disabled, in this way offering a superior service to citizens that can legitimatelyuse those slots which serves as an effective instrument to rapidly spot infringements [8].

4. Smart Lighting

Keeping in mind the end goal to bolster the 20-20-20 directive notably for the Lagos smart city initiative, the optimization of the street lighting efficiency is an importantfeature. Specifically, this service can upgrade the road light intensity as indicated by the time of the day, the climate condition, and the presence of people. With a specific end goal to appropriately work, such a service needs to incorporate the road lights into the smart city framework. It is likewise possible to exploit the increased number of associated spots to give WiFiconnection to citizens. Moreover, a fault identification framework will be effortlessly realized on top of the road light controllers.

5. Energy Consumption

Because of the significance of energy to city service against its shortage (particularly in the developing world), a city service that can screen the energy utilization of the entire city from open lighting, transportation, traffic lights, control cameras, to warming/cooling of public structures, along these lines enablingauthorities and citizens to get a point by point perspective of the measure of energy required by the diverse services is crucial. Thus, this will make it conceivable to distinguish the fundamental energy utilization sources and optimize their behaviour. Keeping in mind the end goal to acquire such an excellent power service, powerconsuming gadgets must be coordinated within the power framework in the city. Furthermore, it will likewise be conceivable to improve these services with dynamic functionalities to control nearby power production structures.

6. Noise Monitoring

Noise can be viewed as a type of acoustic pollution as much as carbon oxide (CO) is for air. States like Kaduna (Nigeria) have as of now issued particular laws to lessen the measure of noise in the downtown area at particular hours. A smart city activity can offer a noise observing service to quantify the measure of noise created at any given hour in the spots that embrace the service [9]. Despite the fact that the establishment of sound detectors or environmental microphones is controversial, by virtue of the undeniable protection concern toward this kind of monitoring, noise observing service can likewise be utilized to implement public security, for example, the noise of glass crashes etc. This service can consequently enhance both the calm of the evenings in the city and the confidence of proprietors of public establishment.

3. How Smart City Technology can Improve Urban Sustainability in Nigeria

The difficulties examined earlier in this paper can be addressed effectively through smart city innovation. However, this approach needs a multi-pronged approach because the issues are diverse. To begin with, researchers should utilize their abilities to break down the tremendous data on information created by urban areas every year. Enormous information analyses will create bits of knowledge that city specialists could use to enhance street and rail transport, lessen crime, enhance social insurance, enhance public service delivery, and diminish wastage of money related assets.

Another innovation that will make smart cities more effective is the internet of things (IoT). This processing term alludes to apparatuses and gadgets associated with the internet. Numerous family unit apparatuses including fridges, clothes washers, vacuum cleaners, locks, lights, and HVAC units can be changed to end up as IoT agreeable. Thus, they could be utilized to monitor and give needed output or play out specific assignments. Likewise, urban cities can deploy this innovation to enhance benefit to users. A decent illustration would be water supply frameworks fitted with IoT sensors to gauge water weight, chemical composition and flux. At the point when undesirable changes happen, concerned experts can take remedial measures quickly helped by real-time information. Urban focuses can likewise profit incredibly by introducing and utilizing energy effective IoT frameworks. Since urban transport frameworks are inclined to bottlenecks, for example, congested driving conditions, innovation would prove to be useful to enhance effectiveness. This would require GPS frameworks, cameras, and traffic light coordination frameworks interconnected by means of IoT to keep

traffic moving. In light of these sustainability trends, this paper proposes a set of factors that are basic to comprehending smart city initiatives and projects. Moreso,it addresses a few inward and outer variables that influence plan, usage, and utilization of smart city initiatives. These factors are as follows:

1. Management and organization:

Just a few studies in the scholastic writing on smart city initiatives address issues identified with administrative and hierarchical variables. In contrast, a wide array of past research on IT activities and projects has highlighted these issues as imperative achievement or significant difficulties. Therefore administrative and authoritative worries in smart city activities should be talked about with regards to the broad writing on e-government and IT project achievements [8,9]. Smart city activities may vary from more broad e-government activities in the unique situation and in a portion of the attributes of particular undertakings, however there is much in like manner between those two sorts of activities in light of the fact that most smart city activities are additionally determined by governments and utilized by the concentrated utilization of ICTs to better serve citizens[8].

2. Technology

A smart city depends, among others, on a gathering of smart computing technologies connected to basic infrastructure. Smart computing alludes to "another era of coordinated equipment", programming, and system advances that furnish IT frameworks with real-time awareness of this present reality and progressive investigation to help individuals settle on more insightful choices about alternatives and activities that will optimize business procedures and business accounting report ". ICTs are key drivers of smart city activities. The mix of ICT with development projects can change the urban landscape of a city and offer potential opportunities; they can improve the administration and functioning of a city. Without a doubt, ICT can enhance the personal satisfaction of citizens, yet they can likewise expand disparities and promote a digital divide. Hence, city managers ought to consider certain variables while executing ICT as to asset accessibility, institutional ability in addition, respect to imbalance, digital divide and changing society and propensities [10,11].

3. Administration

A few urban communities in Nigeria, notably Lagos State, have begun transformational undertakings and activities called smart city activities to better serve residents and to enhance their personal satisfaction. These activities include numerous partners or stakeholders. In this way, a few urban communities have felt an expanded requirement for better governance to manage these projects and activities. Scholl et al. contemplated difficulties of e-government key undertakings, and found that partners' relations is one of the basic elements to decide achievement or disappointment of such tasks. "Partner relations" alludes to four primary issues: the capacity to participate among partners, support of authority, structure of unions and working under various jurisdiction [9,11-13]. A few urban areas have profited from the rise of ICTs that enhance their governance. This ICT-based governance is known as smart governance. It broadly speaks to a gathering of advances, individuals, arrangements, rehearses, assets, social standards and data that communicate to bolster city governing activities.

4. Policy context

Change from a common city to a smart city involves the cooperation of innovative cooperationbetween political and institutional segments. Political segments speak to different political components (city council, city government, and city major) and outer weights, for example, political and legislative issues that may influence the results of IT activities. Institutional availability, for example, expelling legitimate and administrative boundaries is vital for smooth execution of smart city activities [14,15].The policy context is basic to the comprehension of the utilization of data frameworks in fitting ways. Thus, an imaginative government focuses on the adjustment in strategies, in light of the fact that a legislature can't enhance without a standardizing drive addressed in the policy. While advancement in innovation for a smart city can be moderately and effectively watched and extensively settled upon, consequent changes in the policy are more uncertain. The policy setting portrays institutional and non-specialized urban issues and makes conditions empowering urban advancement [17,18].

5. Economy and the built infrastructure

Economy is the significant driver of smart city activities, and a city with a high level of financial aggressiveness is thought to have one of the properties of a smart city. Also, one of the key markers to quantify developing city rivalry is the limit of the city as an economic hub [19]. Giffinger et al. [12] recommend a smart city structure comprising of six fundamental parts (smart economy, smart individuals, smart administration,

smart portability, smart condition, and smart living). Their operational meaning of a smart economy incorporates factors all around financial competitiveness, business enterprise, trademarks, efficiency and adaptability, and in addition, the mix in the national and worldwide market. A progression of studies [20,21] discharged by the IBM Institute for Business Value recognize business as one of the centre frameworks of more quick witted urban communities, which involve city administrations, subjects, business, transport, correspondence, water and energy frameworks. Capacities with respect to smart business frameworks incorporate ICT use by firms, new smart business procedures, and smart innovation divisions. The smart city activities are intended to create data innovation limits and build up a plan for change by industry activities and business development.Creating an environment for technological advancement is essential to a smart city. The economic outcomes for smart city activities are business creation, work creation, workforce advancement, and positive changes in productivity [20,21]

The accessibility and nature of the ICT framework are critical for smart urban areas. In reality, smart systems assume a vital part in making smart urban communities a reality. ICT framework incorporates remote foundation (fiber optic channels, Wi-Fi systems, remote hotspots, stands), which benefits service-oriented information systems. The execution of an ICT foundation is central to a smart city's advancement and relies upon a few variables identified with its accessibility and performance [22].

III. REALIZING THE SMART CITY INITIATIVE

It is very important to note that realizing the smart city initiative is key to the success of a nation in modern times. In this way Nigerian cities with a will should note the following with a view to actualizing the smart cities of their dreams:

1. **Innovation**: Nigerian cities should analyse, attempt new thoughts, go out on a limb, and work together with various divisions and partners outside of government. This, obviously, conceivably exposes leaders to shortfalls. Nonetheless, urban areas must start to grasp a procedure that expands upon triumphs and disappointments keeping in mind the end goal to figure out what truly works.
2. **Financing**: Cities need to contemplate subsidizing Smart City activities. Urban areas have a solid propensity towards nothing new around the budget planning procedure. Long-standing projects are financed without audit or alignment with Smart City initiatives, and offices frequently need to battle for spending plan without a command of interconnection or joint effort with different divisions. Conventional method for financing, similar to grants from focal governments, mean urban communities depend on the vision of these administration offices to figure out what sorts of activities are subsidized. This restrains urban areas from financing the tasks that they need to and that best fit into their unique vision.
3. **Services**: Along with the uncoordinated planning and subsidizing process, numerous city offices are overseeing duplicate resources. To bring speculations into alignmentacross offices, urban areas require pioneers who will advance a computerized end-all strategy that traverses the whole city. Building a computerized ground breaking strategy ought to be one of the primary services a city considers for its Smart City advancement. This is not just a 10-year spending arrangement; rather, it requires a base up perspective of the key difficulties the city is confronting and the services expected to address these difficulties.

In light of the examples of overcoming adversity and difficulties of other worldwide urban communities, there are a couple of basic achievements, aside from setting up the important foundation, taking Lagos State Nigeria as a case study, which are fundamental for Lagos to change itself 'sagaciously'. These elements include:

1. **Leadership and vision**: The smart city change program needs a long haul vision and has to be upheld by the administration. Lagos state must set up a dynamic administration structure to screen development in a planned way. This is a vital driver for the achievement of this activity.
2. **Policies and controls**: Policies, directions and legitimate systems give a solid stage to all partners and market players contributing towards the success of the smart city. The state House of Assembly must be appropriately arranged to think of essential legitimate structure to drive the activity.
3. **Integration**: One of the most essential elements that will impact the achievement of this activity will be the organized approach of government divisions and experts in offering smart services at a similar pace. Government policies in Lagos must digitize to offer smart administrations to Lagosians.
4. **Innovation and dexterity**: The vision of a smart city requires Lagos State government to be light-footed and grasp development, especially industrial development, with a specific end goal to enhance its services and in the long run the personal satisfaction of its occupants.
5. **Phasing**: Both the 'enormous bang' approach and the "staged" approach have focal points and drawbacks to the execution of undertakings under this activity. Lagos should precisely watch and gain from the progress of other smart urban communities.
6. **Private sector partnerships**: The interest of the private sector can possibly deliver astounding framework and services at lower costs, making them a fundamental component of Lagos Smart City project. In any case, the driver of this project must realize that the achievement of private sectorpartnership will rely on the capacity to characterize concrete, quantifiable objectives in mutually benefiting risk-reward relationships.

IV. CONCLUSION AND RECOMMENDATIONS

Smart technologies for the most part have enormous advantages. For instance, urban areas that introduce smart transport frameworks will acknowledge reserve funds of around billions of Dollars yearly from 2030 onwards. What's more, smart innovations will make it less demanding for crisis responders, fire-fighters, law implementation officers, and traffic control specialists to offer better services – making Smart Cities favoured spots for individuals to live and work. These dynamic communities will use information technology as the foundation for new and better services, improved stakeholder collaboration, and greater efficiency. These communities will bolster manageable development, urban engagement, and smart economic development. As laid out in this paper, numerous urban areas around the globe are as of now actualizing a Smart City vision and urban areas not yet considering the energizing capability of Smart City change risk being left behind. In addition, specifically for urban areas in Nigeria who are confronted with every one of the difficulties talked about in this paper (urbanization, environmental change, waste management, energy, and so on) amidgrowing security threat, there is no preferable time over now to grasp the idea of a smart city.

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