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Chapter 12

A Comparative Framework Analysis of the Strategies, Challenges and Opportunities for Sustainable Smart Cities

Oluwagbemiga Paul Agboola and Meryem Muzeyyen Findikgil

Abstract

The goals of the contemporary environment in this new era of the Internet of Things (IoT), digital technologies (DTs) and smartisation are to enhance economic, social and environmental sustainability while also concentrating on the citizens' quality of life. As these initiatives advance, more determination is required to offer effective approaches to the problem posed by the accomplishment of the Sustainable City Project in Nigeria as a developing nation. To address these problems and facilitate the process for Nigeria's major cities to become 'smart cities', universities, research institutions and other stakeholders must collaborate alongside. This chapter aims to establish a model or framework that addresses urban intelligence, social inclusion, resilience and technological innovation, mobility, urbanisation and residents' quality of life. The reviews of the characteristics and management of smart cities in developed countries were documented to serve as a comparison study of the cities in African sub-Saharan regions. This will assist in building models that can produce predictions about possible smart solutions in the areas of mobility, urban infrastructure and ecological problems brought on by climate change in African cities. This chapter brings attention to the body of knowledge by envisioning the benefits to the government and citizens in making appropriate decisions to enhance sustainable development, a better resilience environment, improved infrastructure, smart city environments and residents' quality of life. The study's implications centre on how the government could prioritise urban features and services as indicated in the smart cities framework.

Keywords: Smartisation; Internet of Things (IoT); digital technologies (DTs); smart cities framework; cities' resilience; sustainable cities

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Introduction

The term '*smart city*' as defined by the European Union makes investments in technologically sophisticated facilities, evolving itself into a place that is financially viable while simultaneously promoting a higher standard of living and the more efficient use of its assets. Additionally, it incorporates various technologies to obtain data and then uses that data to control and manage a wide range of municipal processes. Essentially, these would be cities that are capable of reinventing themselves by utilising technology to create a smart society, economy, governance, habitat and mobility starting with current urban structures. By utilising their limited resources wisely through new technologies and creative strategies, the cities generate answers to the challenges and demands of the future while respecting the environment and its resources. The Internet of Things (IoT) and other advanced technologies give globalisation and urban life a new dimension. Smart cities adopted smart technologies that allow cities to conduct municipal services more efficiently and at a lower cost. Technology is such an integral part of our life that the dependency on its benefits is awesome. Similarly, improved accessibility to information through technology enhances the sustainable expansion of the nation's economy.

A smart city's objective is to build a sustainable, digital and environmentally friendly environment that spans a variety of industries, including transportation, education and intricate networks of structures, roads, bridges and electrical grids. Citizens' quality of life is better enhanced with the advent of smart city models. Through the availability, accessibility and use of digital technology in urban inhabitants' daily lives, this social revolution is gradually changing the configuration of urban space into a smart space. To overcome urban challenges as we transition to a smarter modern city in both industrialised and developing countries, these technologies transform traditional roads into digital information flows, connecting users and with their environment via the internet, social media and mobile terminals (Mahmood, 2018; Moyo et al., 2020). In fact, according to Aurigi (2017), the narrative surrounding smart cities has recently grown to be strongly related to the idea of urban ecosystem sustainability. It relates to urban ecology in developing nations, which includes all elements of urban areas, such as their populations, food and transportation networks, economy and business (Lindley, 2018; Mahmood, 2018).

A smart city is significant in the attainment of urban service systems where information and communication technologies (ICTs) fuses to stimulate sustainable growth through effective resource management. In other words, cities' livability and functional efficiency remain the major focus of smart cities of the twenty-first century. Increasing rapid urbanisation, inadequate physical infrastructures, urban populations, poor quality social services and vulnerability to disasters and climate change are the problems facing most African cities. In view of these problems, little research has been explored in the area of smart city initiatives for better understanding of the connectivity of human and material developments. Therefore, as most African cities are striving to become more digitalised, more research is required to meet the expectation of the citizens and affordability. In support of this assertion, Vainio and Sankala (2022) viewed that accomplishing sustainable development in the modern digital environment, smart city technology is important to urban life. Most of the frontline smart cities in developed countries are rapidly expanding, and the ideas should serve as a general guideline for African cities. To

address some related smart city issues in Africa, adequate research is needed (Hussein et al., 2019; Mahmood, 2018; Moyo et al., 2020). Thus, this research explores a framework to fast-track the journey of African cities towards being more digitalised and responsive. The objective of this chapter is to compare the reviews of the characteristics, status and management of smart cities in both developed and African sub-Saharan regions. This comparison will be illuminating for developing models that can forecast potential smart solutions for issues with transportation, urban infrastructure and ecological issues in Africa caused by climate change.

The findings of the study will advance our understanding of the significance of smart cities and their advantages for the government and all citizens in making decisions to enhance urban sustainable development, a more resilient environment, better infrastructure and the quality of life for citizens across all of Africa. Importantly, this chapter's novelty is vested in its comparison documentation of the significance and uniqueness of smart cities for both developed and developing nations of the world. The study's implications centre on the necessity for emerging nations like Nigeria to give urban amenities and digital revolution technologies a top priority in their long-term development plans.

The Global Development and Characteristics and Framework of Smart City Models

The growth of the smart city started in the 1970s; when urban environments adopted a digital architecture that concentrated on technology and immaterial structures incorporated into the actual city space (Ishida & Isbister, 2000). The focus has recently shifted to more complex innovations, enabled by the network infrastructure and intellectual capacity, guiding the growth of the city (Elmquist et al., 2009; Schaffers et al., 2011). With the use of a smart city framework, towns will be able to create a standardised database system for gathering city statistics, recording them and making it easily accessible for the management of smart city solutions. The latest concepts, frameworks, ideas and benchmarks for smart cities have indeed been explored by Meijer and Bolívar (2016) and Anthopoulos (2015). It was revealed that the outcome of their framework's studies presented benefits to the governance, economy, residents and the environment at large.

Recently, ideas have concentrated on the notion of smart cities in light of worldwide advocacy for changing technology developments. To accomplish a long-lasting and attaining sustainable economy, urban areas must combine all intervention domains based on the contribution of ICT to raise the quality of life for urban actors (Anthopoulos & Tougountzoglou, 2012). The use of smart gadgets has increased as a result of technological developments and even seen the unimaginable potential of the IoT platforms. These avails result in smart environments and infrastructures around the world, due to appropriate actions taken by several individuals and organisations (Giffinger et al., 2007). Such organisations consist of academics, government officials and businessmen and women.

Smart city developments and initiatives have shown various models founded on high-quality qualitative information, which are crucial for creating smart cities. Notably, data from the social, economic, technical and environmental

domains provide clever answers to researchers and decisions for urban development as well as businesses that finance eco-friendly cities. According to Giffinger et al. (2007) and Angelidou (2016), six urban-focused components make up traditional smart city strategies: smart economy (creation of pro-business environments), smart people (networking), smart governance (growth of social and cultural capital), smart mobility (use of technology in transportation), smart environment (use of smart buildings) and smart living (digitalised environment). Other basic infrastructural components of smart cities include: (i) solid waste management, (ii) digital housing, (iii) effective urban mobility, (iv) safety and security, (v) advanced materials and technology, (vii) cleanliness, including waste disposal, (viii) efficient urban transportation, (ix) low-cost housing, (xi) Robust IT networking and digitalisation and (xii) Good governance, including e-governance and citizen involvement. The potential components and initiatives for smart cities are depicted in Fig. 12.1. It presented the plethora of government decisions on diverse regions to prioritise.

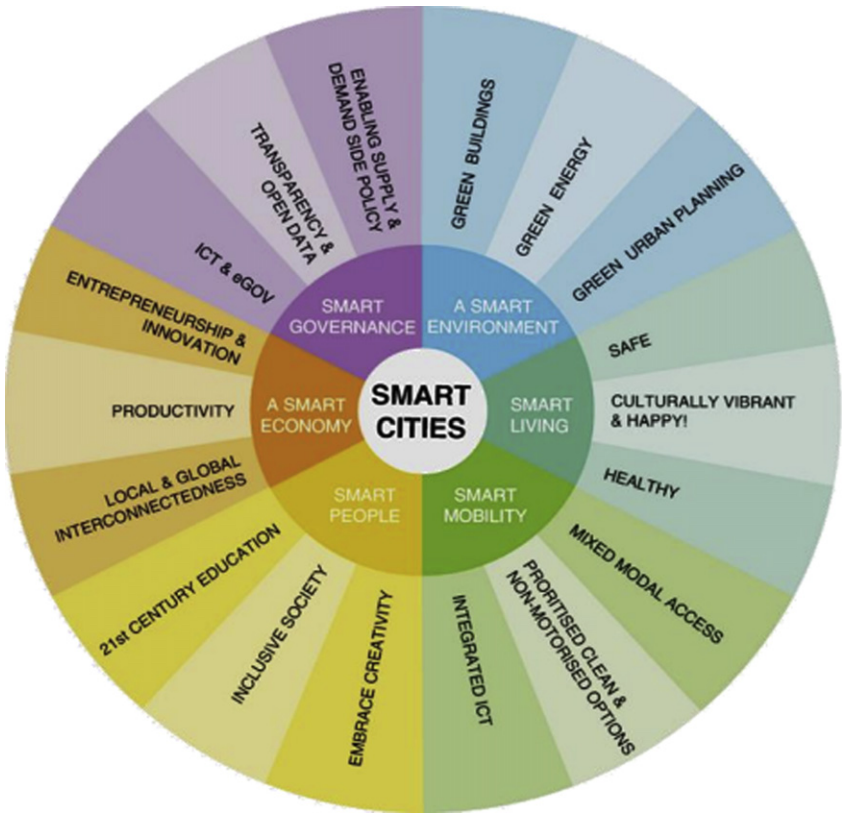


Fig. 12.1. Smart City Initiatives and Features. *Source:* South African Smart Cities Framework (2021).

The six major urban-focused components incorporate the following:

(i) The role of technology in a smart environment

Technology's purpose in a smart environment is to gather, organise and make a large amount of data accessible to city people. Technology's development and accessibility enhance the functioning of cities as they become more thoroughly interconnected detectors and the IoT. When access to information in daily activities is made easier, residents are quite fascinating. While urban people have access to efficient interventions, smart mobility and smart communication, quality of life and utility monitoring, it has also become easier to document admirable ideas and better decision-making activities (Komninos, 2011; Schaffers et al., 2011). As a result, the integration of digital environments contributes to the enhancement of municipal services, enhancing sustainability practices and the creation of a smart city (Angelidou, 2014; Cruickshank & Allwinkle, 2011; Tranos & Gertner, 2012). Characteristics of technology's dominant role in a smart environment are shown in Fig. 12.2.

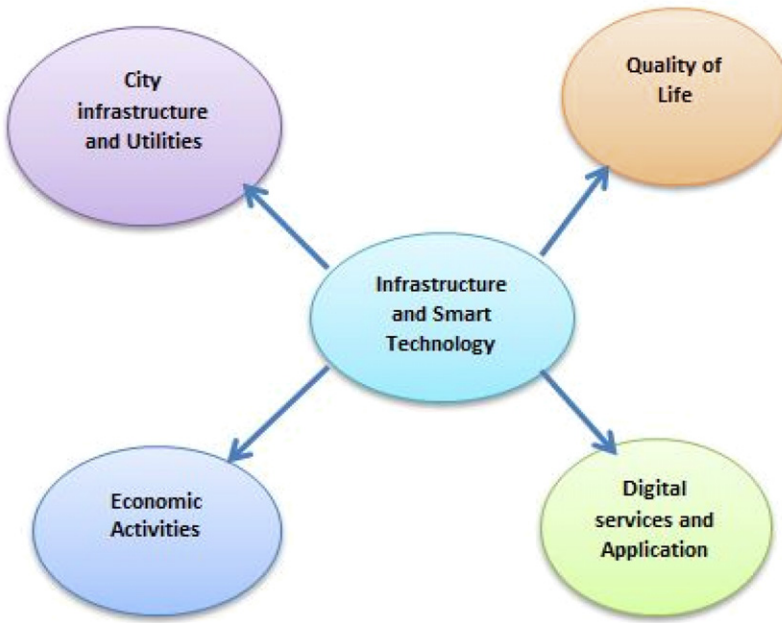


Fig. 12.2. Characteristics of Technology's Dominant Role.
Source: Author's own creation.

(ii) Advancement of human knowledge and social capital

The construction of new modes of innovation, increased involvement and digital literacy and expertise creation and distribution are all ways that smart cities can improve on their second quality. In smart cities, a significant portion of the information that is available is created jointly; intelligence is a resource that results from everyone's input. A competent workforce and highly skilled individuals are attracted to smart cities and desire to employ technology in new and creative ways. This in turn promotes the growth of intellectual ecosystems that are profitable for the metropolis. Additionally, it is now well established that highly talented and creative individuals are the most effective catalysts for urban improvements (Edvinsson, 2006; Florida, 2005; Hollands, 2020), by creating innovative concepts and tactics through online communities (Komninos, 2009; Nam & Pardo, 2020; Whelan et al., 2014). Fig. 12.3 indicated the characteristics of the advancement of both social and human capital.

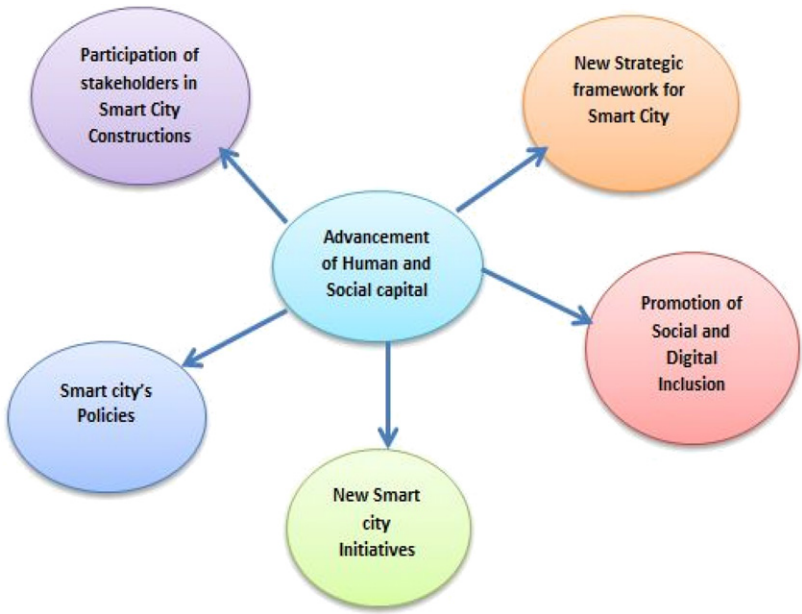


Fig. 12.3. Characteristic in Terms of the Growth of Both Social and Human Capital. *Source:* Author's own creation.

(iii) Smart commerce and business sector advancement

A great track experience in new firm formation and innovative dynamism are all goals of the smart city movement that aim to advance the business sector. Urbanisation is enhancing the adoption of smart enterprise or intelligent market approaches for a balanced economy, and socio-digital innovations are a key factor in this (Mahmood, 2018). Smart governance and business-led urban development are distinctive features of smart cities. By providing entrepreneurs with cutting-edge smart mobility technologies, they hope to create business-friendly surroundings. The socio-digital technology that enables the proper road flow of traffic, internet banking and organizational skills for a low-priced revolution for every resident is the basis of smart mobility (Savithramma et al., 2022; Turetken et al., 2019; Zavratnik et al., 2020). Mahmood (2018) asserts that the incorporation of smartphone services into routine urban interaction enables smart governance since it enables efficient engagement, sustains the business and fosters social ties. Overall, promoting and diversifying urban entrepreneurial environments is a top objective for both the smart city paradigm and European initiatives. The potential characteristics of the expansion of the business sector are revealed in Fig. 12.4.

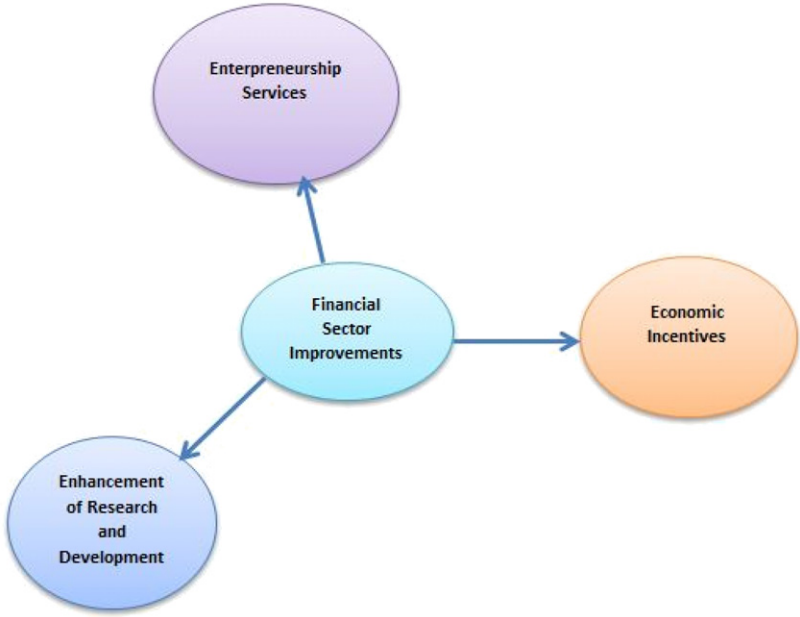


Fig. 12.4. Characteristics of the Expansion of the Business Sector. *Source:* Author's own creation.

(iv) Smart networking

Nowadays, networking is mostly accomplished through online digital media through transnational economic and multinational collaboration, particularly in the area of smart cities. Networking inside and between municipalities and regions is emphasised in the analytical analysis of smart cities to create a positive public image, disseminate best practices, diversify the manufacturing base and provide efficiencies of scale (Fig. 12.5 refers). City officials are under growing pressure to provide more high-quality and innovative services while garnering more public support in today's information-based economy and society. The majority of cities already have these partnerships in existence. Urban metropolis focuses on establishing alliances and collaborative networks to share information and coordinate resources while highlighting the unique and distinctive character of their centre. Approaches for marketing and communicating have made their way into plans for new urban development, including smart cities.

Smart Cities in the African Sub-Sharan Continent

Nigeria, Ghana and South Africa are located in the African sub-Saharan continent (Fig. 12.6), and all are taking steps to enhance different areas of their capital cities to fulfil the smart city requirements. The focus has recently shifted to intellectual capacity, guiding the expansion of the urban metropolis (Elmquist et al., 2009;

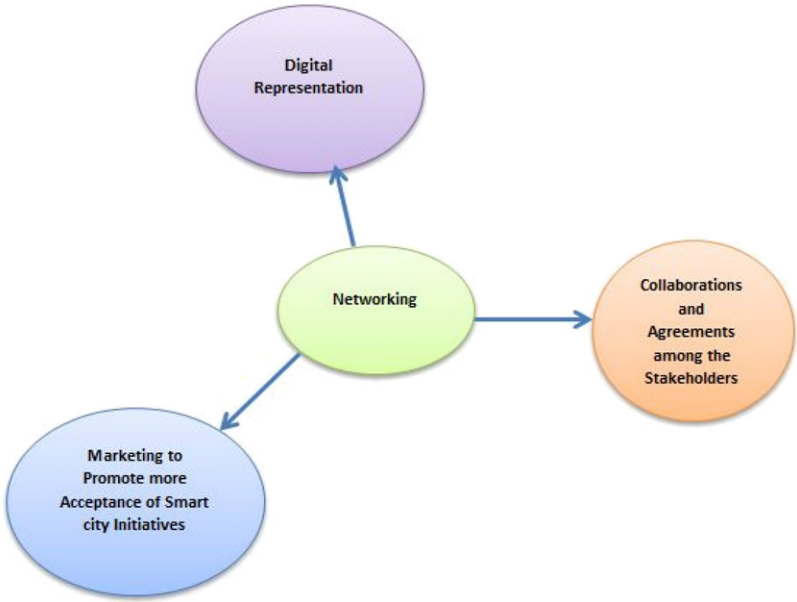


Fig. 12.5. Networking-Related Characteristics. *Source:* Author's own creation.

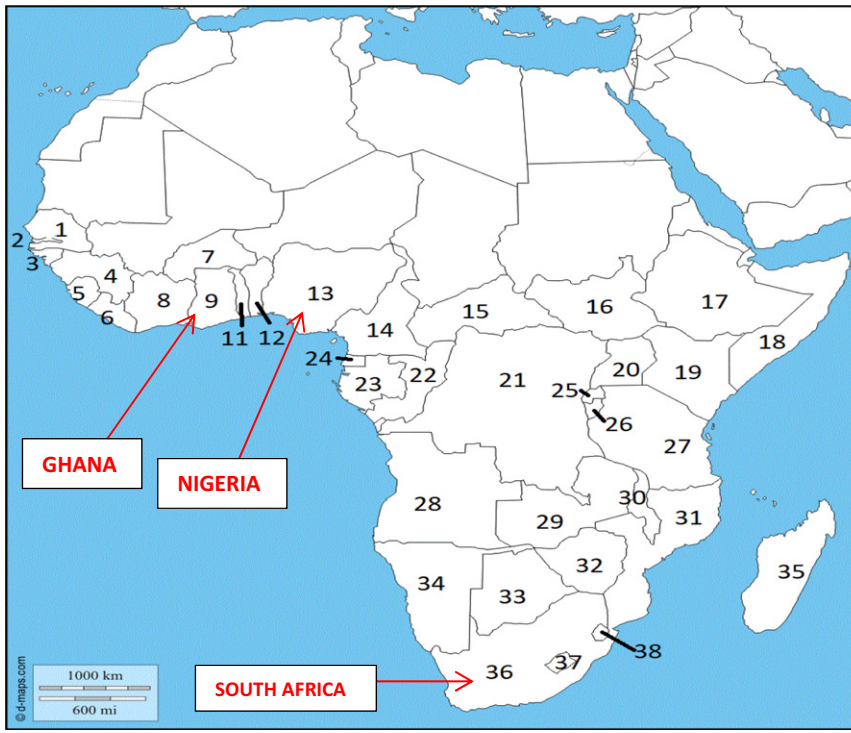


Fig. 12.6. Map of the African Sub-Saharan Continent. *Source:* https://www.googlemap.com/.

Schaffers et al., 2011). This is due to the incorporation of new components in daily life, focusing on one or more factors that support the smartisation process has helped the method for building smart cities grow. By 2050, the United Nations projects that urban and metropolitan areas will house 70% of the world's population which will increase emissions and energy consumption each year. However, smart city programmes in Africa are to overcome some difficulties and create a foundation for a sustainable society. Environmental, social and economic sustainability are all trying to keep up with the rapid increase in urbanisation (Sadiq & Wen, 2022). Stakeholders, government and non-governmental agencies, academics, researchers and related professionals in African countries are worried about implementing smart technology to improve environmental sustainable development in the current face of the global digital revolution (Mahmood, 2018; Zavratnik et al., 2020).

Numerous obstacles are preventing urban centre growth in Africa. This includes, among other things, urbanisation, environmental degradation and global climate change, all of which have had an impact on the commercial development of Africa and indeed the city's sustainable planning initiatives

(Guma, 2020; Vainio & Sankala, 2022). Therefore, including the IoT and digital communication in urban planning would further boost connectedness and socio-economic endeavours, putting the continents on pace with their counterparts in developed nations. African cities are expanding rapidly, as such the sub-Saharan region is among the few industrialised in the world in 2014 along with Asia is currently showing industrialisation and urbanisation rates. According to the United Nations (2014), the African population is expected to reach 2.4 billion within the next several decades, prefer cities over rural regions (Huet, 2022). The crucial aspects include the requirement for transport and access to urban services, safety and policy-related concerns. Therefore, the process of urbanisation can only promote growth if measures are taken to address the structural problems that it brings about, and if attempts are made to establish equitable, secured and viable cities as envisioned by the UN Sustainable Development Goals (SDGs) (Institutes for security studies, 2022).

Framework for Case-Study Evaluation and Synthesis

This chapter employs multiple case study analysis method that has previously been used by Eisenhardt (1989), Yin (2009), Miles et al. (2013) and Angelidou (2014). This style of qualitative analysis summarises and contrasts the key conclusions of qualitative research in a thorough and organised manner. The smart city frameworks, the evolution of smarter cities and smart city strategies were examined. This material included journals, conferences, books, websites and reports. To document the study's search engines related to smart cities, the literature review examined various concepts, initiatives, domains, components and frameworks. Five significant smart cities, Singapore, Istanbul, Amsterdam, Barcelona and Oslo, were studied using a case study review methodology. The pieces of information about smart cities in the developed nations' cities were documented, while the highlight of the countries' strategies in tandem with the African cities such as Nigeria, Ghana and South Africa were presented. The analysis is accomplished by the examination of various case studies using the contents reviewed method. These arrays enable systematic cross-case comparison of findings and examine behavioural trends, similarities and differences. Table 12.1 indicates the adopted scorecard of a smart city. Similarly, a detailed summary of the critical requirements of the smart city needs and requirements are depicted in Fig. 12.7.

Smart Cities' Insights Across Developed and Developing Countries

Most of the world's most important cities have already begun to adapt to the shifts that smart technology adoption is bringing about. While most of the advancements ushered about by smart technology have a positive influence on how people live in these cities. Singapore, Istanbul, Amsterdam and Oslo were chosen because they are all among the industrialised nations with the most

Table 12.1. Adopted Scorecard of a Smart City.

Drivers	Approaches	Features	Literature
Smart economy	Smart commerce and business sector advancement	Entrepreneurship and innovation	Bronstein (2009)
Smart people	Human contact effectiveness in cities	The contribution of ICT to the growth of social investment and human knowledge	Giffinger et al. (2007), Bélissent (2010)
Smart governance	Smart networking and instruments for collaboration	Service integration for improved quality of life	Kolsaker and Lee-Kelley (2008), Maltby (2013)
Smart mobility	The adoption of ICT in transportation	Sustainable and inter-modal transport systems, safe and secure transportation system	Bifulco et al. (2016)
Smart living/ environment	Quality of life satisfaction and effectiveness resources	Natural resource management	Tanguay et al. (2010)

Source: Author's compilation.

advanced cities (Smart City Index Report, 2022). Therefore, the insights from the smart city movements in industrialised nations and developing countries such as Nigeria, Ghana and South Africa smart cities are succinctly presented.

Singapore Smart City

Irrespective of the ranking criteria, Singapore continuously comes out on top as the world's smartest city, which demonstrates the city's dedication to smart technology. In connection with smart technology, Singapore is often recognised and often time takes the lead in smart city initiatives (Fig. 12.8). To increase productivity in the nation's most sophisticated economy, the country is concentrating on digital technologies and projects. The Institute for Management Development and Singapore University of Technology and Design (SUTD) released their yearly report, which rates cities, according to economic and technological statistics as well as residents' opinions of how smart their respective cities are. The existing plans in Singapore involve a shift towards a digital healthcare system by establishing virtual consultations and adopting smart IoT devices to constantly track patients. One aspect of Singapore's continual progressive developments is how the transportation system is evolving and how artificial intelligence (AI) benefits the country.

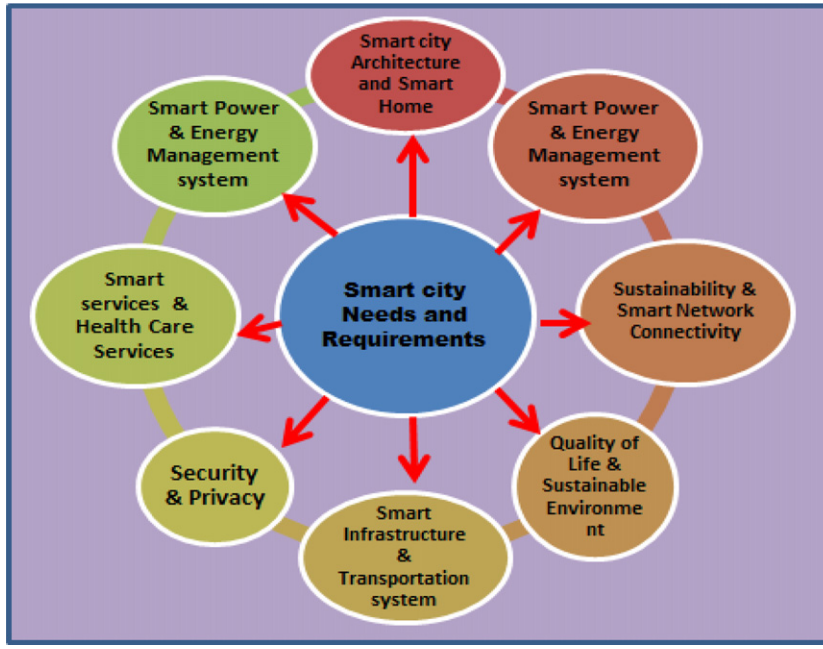


Fig. 12.7. Critical Requirements of the Smart City Needs and Requirements. *Source:* Authors' conceptualisation.

The goal of Singapore is to create the world's first vehicle-free, eco-smart city, which will be built in the western district of Singapore called Tengah. By the year 2030, about 80% of Singaporeans will reside close to a train station. Singapore is recognised as one of the most technologically advanced smart cities in the world for a variety of reasons, namely: (i) the development of a multi-route, (ii) an aerial network for drones that will transport packages, letters and information (iii) automated walking projects for the elderly in which self-driving wheelchairs are anticipated to be better designed and integrated into the traffic system and (iv) the use of facial recognition technology to identify clients as they enter banks or to gain access to offices.

Istanbul Smart City

The Directorate General of Geospatial Informatics, Planning and Coordination, Application and Development was established by the Ministry of Environment and Urbanisation to assist in the development of smart cities in Turkey. This division is in charge of all national smart city applications, including 3D data modelling and city information system software, and has created a National Smart City Strategy and Action Plan for the year 2019–2022. In Turkey, the



Fig. 12.8. Singapore Smart City (2023). *Source:* https:singapore-smart-city.html.

deployment of smart grid technologies has started, and the stages of implementation differ from one DISCO to another, deploying the installation of GIS and SCADA systems. With a population of about 15 million, Istanbul's smart city (Fig. 12.9) is on track to become a permanent member of the world's mega list. Turkey's growing urbanisation is requiring the nation to enter the smart city eco-system as soon as possible (NOVUSENS, 2022).

The Sustainable Cities I and II Projects in Turkey received $133 million and $91.5 million in loans, respectively, from the World Bank in the years 2016 and 2018 (Cakilcioglu, 2022). By giving municipalities access to money for their investments in enhancing services to their inhabitants, this programme seeks to increase the economic, financial, environmental and social sustainability of Turkish cities. The funds help communities by executing infrastructure investments required to meet service delivery standards in areas such as waste management, energy services, public transportation, wastewater systems and other areas.

Amsterdam Smart City, Norway

Through a significant and complementary local partnership, the Amsterdam Smart City project uses a combined approach to sustainable energy and green smart

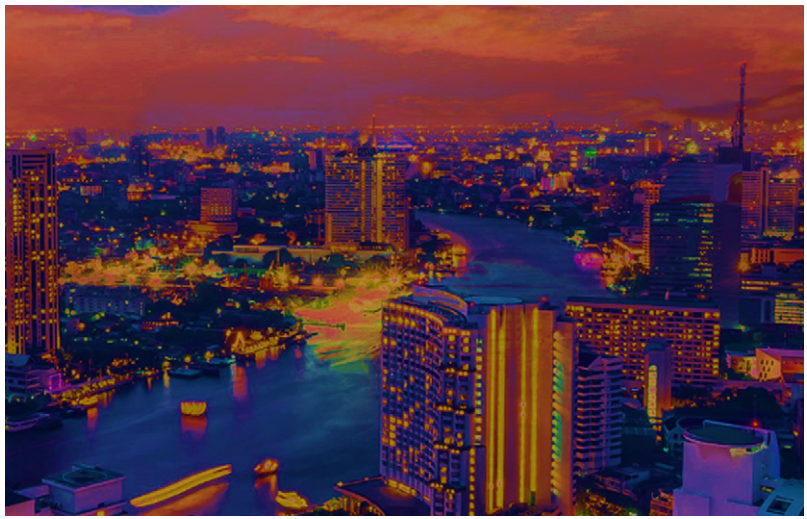


Fig. 12.9. Union of Turkey Smart Cities (2023).
Source: https://smartcity.com.tr/tr/.

technologies. The private sector's involvement is likely to ensure the results' sustainability, and they serve as an excellent illustration of applied innovation for major EU cities seeking to develop in a way that is socially, economically and aesthetically sustainable while having a significant regional impact. The project '*Amsterdam Smart City*', which supports this programme, aims to demonstrate how energy conservation may be achieved while fostering innovation-based economic growth by supporting potential clusters in the West Netherlands (Fig. 12.10).

The Amsterdam Smart City project serves as a springboard for fresh developments in the field of smart energy technologies. Parts of the project's activities include establishing and validating at least 12 test projects in the areas of sustainable housing, employment, mobility and public space; disseminating project information; and building the platform Amsterdam Smart City (Šťáhlavský, 2011). With the ultimate goal of lowering CO_2 emissions, this partnership's objective is to transform the Amsterdam metropolitan region into a smart city. The smart city platform in Amsterdam brings together all of the city's players to generate and put into action shared ideas and solutions to the city's problems. The programme now consists of 32 projects that are spread around the neighbourhoods of Amsterdam and provide fresh concepts and business approaches. Smart and energy-saving technologies were introduced to conserve energy and lessen their carbon footprint (Amsterdam Smart City official website, 2014; Baron, 2012).

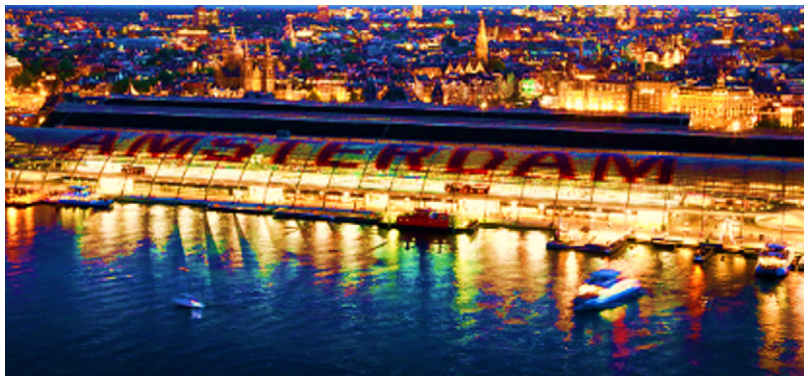


Fig. 12.10. Smart City Amsterdam (2023).
Source: https://www.aboutsmartcities.com/amsterdam-smart-city/.

Oslo Smart City

The population of Oslo, the capital of Norway, is about 670,000 people. The city of Oslo, surrounded by the Oslo Fjord on its South side, is a city that is constantly growing and changing. A vision for urban development called the '*Smart City*' aims to make city life better for residents by being transparent, connected, sustainable and creative. The citizen often time accrues profit from the intelligent application, exploitation and integration of new technology, sectors and services. The Oslo Smart City develops and oversees a city's major area by securely integrating various ICT and IoT technologies.

In Oslo (Fig. 12.11), there is a network of public transportation options, including trains, trams, subways, buses and boats. By 2020, all Oslo public transportation will be powered by renewable energy, and by 2028, all public transportation will be electric. The city's wide range of smart city initiatives includes the testing of electric buses, the creation of zero-emission construction sites, the renovation of existing structures and the creation of green energy and circle-based trash management systems. Oslo's goal of becoming a fossil-free city by 2030 and its aim to be a green capital are both driven by a core Norwegian value known as a connection to nature. The six emphasis areas used to create a city that is more age-friendly include housing, recreation, outdoor spaces, physical exercise, participation in the community and healthcare services. The main goal is to reduce emissions to address both climate concerns and public health and wellness.

Nigeria – Lagos Smart City Context

Internet infrastructure will be required to play a significant part in people's trips from mega city to smart city with the anticipated Smart City Project in



Fig. 12.11. Oslo Smart City (2023).
Source: https://www.theagilityeffect.com/en/case/oslo-leads-the-way-in-green-and-inclusive-smart-cities/.

Lagos (a Mega City in Nigeria with an estimated population of 21 million). Eko Atlantic, Nigeria (Fig. 12.12) is an ambitious multi-billion dollar project that aims to transform Lagos, the country's most populated city. People, smart gadgets and other stationery and moving government assets will all be able to efficiently collect data for residents of the proposed smart city. As a result, social services will be improved, employment will be created, public services will be provided, more people will have access to financial services and the government will produce its revenue. To supply the thousands of systems and devices required to actualise the vision of the smart city, Main-One's Digital Lagos effort aims to build essential internet infrastructure throughout Lagos State.

About 3,000 kilometers of fibre optic cable have already been installed as part of the present first phase of planning for the implementation of the anticipated project. According to Sanwo-Olu, the Nigerian government has given support to more than 20 innovative businesses in industries like agriculture, environmental sciences, educational technologies and small-scale businesses. The administration of Lagos State has generously provided financial support to several researchers so they can carry out roughly 70 research proposals across four academic institutions. In addition, the administration of Governor Sanwo-Olu made it easier to secure money for the Fourth Mainland Bridge project, which is listed in the yearly budget for 2021. Once finished, this bridge will be the longest in Africa. Similar to this, Lagos' technology infrastructure will be modernised by the current administration. Lagos State will soon become Nigeria's high-tech power powerhouse as a result of this smart city-initiated project.

Accra- Ghana Smart City Context

The Accra economy is expanding overall, with the information technology sector leading the way. Ghana has very adaptable legal systems that encourage the



Fig. 12.12. Eko Atlantic, Nigeria (2023).
Source: https://infomineo.com/african-smart-cities/.

expansion of businesses. Accra was awarded a grant from the IBM Smarter Cities Challenge, which will significantly advance the social and infrastructure advancement of the city (Fig. 12.13). In Ghana, a US$50 million Smarter Communities Challenge was introduced in 2014, with the assistance of The International Business Machines Corporation (IBM). IBM sends teams of experts from a variety of fields to assist cities in developing plans to enhance the smartisation process of Ghana as well as to improve the quality of life of its citizenry.

Overall, the government has implemented several policies to encourage and maintain both domestic and foreign investments in the nation to aid in trade. Ghana has fully implemented some initiatives to guarantee that it matches other African nations in launching the smart city project. Numerous laws and regulations have been enacted and are still in effect to encourage innovations and advance national development (The Ghana Smart City Journal, 2022). Notably, Ghana was the second nation in sub-Saharan Africa to have a complete internet connection in terms of ICT in Accra, Ghana, in which about 30,000 people used the internet as far back as the Year 2000. Through the incubation of ICT company start-ups, the Ghana Multimedia Incubator Center has assisted in bridging this gap and boosting ICT Entrepreneurship Development. The recent upgrading of the internet service for the numerous communications technology will further increase the availability of information and technology within the city.

Johannesburg, South African Smart City

The Department of Cooperative Governance (DCoG) created the South African Smart Cities Framework (SCF) to offer municipalities, the federal and provincial



Fig. 12.13. Smart City in Accra-Ghana.
Source: The Ghana Smart City Journal (2022).

governments and other role actors unbiased, factual information regarding smart cities in South Africa (A South African Smart Cities Framework, 2021). The City of Johannesburg's strategy is defined as having modest aims, starting with connectedness with an outline of the city's smart city plan. As part of the implementation Roadmap for 2014, the City of Johannesburg places a strong emphasis on coordinating its smart city strategies with its IDP process. Johannesburg's municipality has developed a Smart City Unit with a programme described by Lawrence Boya, the director of Johannesburg's Smart City Unit.

The City of Johannesburg (Fig. 12.14) is now implementing smart city efforts that include automated and integrated police enforcement management systems, via optical fibre and Wi-Fi. It was discovered that, among other things, a call centre-based system that was inefficient and a lack of route planning were causing delays in the delivery of services. In this vein, the government looked into adopting technology to digitise and optimise business operational processes to boost productivity. The focus was also to enhance customers' process efficiencies through the semi-automation of tasks, lower costs and enhance service delivery. Many precinct cities being developed as smart cities in South Africa have also been the focus of private sector projects in Johannesburg. The most well-known was the Modderfontein project, which promised to create a brand-new urban neighbourhood portrayed with tales of intelligent and sustainable urbanisation.



Fig. 12.14. Sandton Smart City of Johannesburg. *Source:* South African Smart Cities Framework (2021).

Summary of the Smart Cities for Developed Countries and Sub-Saharan African Countries

The goal of the contemporary environment in this new era of the IoT, digital technologies (DTs) and smartisation are really to enhance economic, social and environmental sustainability while also improving the citizens' quality of life. The cities in developed countries are getting smarter every day and this will continue for a prospect as envisioned in their policies. Similar to this, more cities around the world are now relying on IoT-powered smart city solutions to deal with challenges, including traffic congestion and environmental issues as well as expanding urbanisation. This is awesome news for both locals of these places and tourists from other countries exploring them.

A summary of the comparative analysis of the smart city's intervention for developed and African sub-Saharan Countries is presented in Table 12.2. Comparatively, while giant strides have been made by the developed countries in vast areas of smart city initiatives and sustainability, more serious attention is required from the sub-Saharan African counterparts. The Smart City Index Report (2022) specifically supported these scenarios. Using a chosen collection of variables, the Smart Cities Index report offers a fresh look at the performance of global smart cities. The survey listed 31 smart cities from around the world, but none of the African sub-Saharan Cities were deemed deserving of inclusion.

Table 12.2. Summary of the Comparative Analysis of the Smart Cities Intervention for Developed and African Sub-Saharan Countries.

	Smart Cities	Advanced Technology Coverage and Capacity Building	Smart Infrastructure and Transportation System	Smart Network Connectivity	Smart City Legislation and Policies	Funding and Business Models in the Areas of Smart Cities Advancements	Digital and Cyber Security	Smart Power and Energy Management System
Developed countries	1. Singapore Smart City	'F'	'F'	'F'	'F'	'F'	'F'	'F'
	2. Istanbul Smart City	'F'	'F'	'F'	'F'	'F'	'F'	'F'
	3. Amsterdam Smart City, Norway	'F'	'F'	'F'	'F'	'F'	'F'	'F'
	4. Oslo Smart City	'F'	'F'	'F'	'F'	'F'	'F'	'F'
Sub-Saharan African Countries	5. Nigeria-Lagos Smart City Context	'L'	'L'	'L'	'L'	'L'	'L'	'L'
	6. Accra-Ghana Smart City Context	'L'	'L'	'L'	'L'	'L'	'L'	'L'
	7. Johannesburg-South African Smart City	'F'	'F'	'F'	'P'	'F'	'P'	'F'

Source: Author's Compilations.

Note: Level of compliance: 'F'-denotes 'Full compliance', 'P' denotes 'Partial compliance' and 'L' denotes 'Low compliance.

Conclusion and Recommendation

Conclusion

The majority of African cities are striving to become increasingly digitalised; however, this has led to issues with citizen expectations. African cities require more innovative technology in the management of their urban planning, public transit, communication and other areas (Guma, 2020; Hussein et al., 2019; Moyo et al., 2020). In other words, to accelerate the transition of African cities into digitally advanced and adaptive status, more decisive and collective actions are required. In this vein, modern technology has become such a crucial component of modern life to ameliorate the negative effects of environmental and other socio-economic problems. Additionally, increased knowledge accessibility is made possible by technology acting as a potent driver of sustainability and economic progress.

This chapter simply outlined all the key tactics that smart cities must employ to encourage the growth of their technical infrastructure. Given this, the government can enhance its citizens' quality of life with the advent of the concepts of smart cities and the IoT. This makes the widespread adoption of ICTs in African sub-Saharan urban settings essential for their development. It will take bold and ambitious policies on the development of human and infrastructure capacity to realise a smart city in African nations. This chapter identified several obstacles to the development of African smart cities, which includes: (i) the need for advanced technology coverage and capacity building; (ii) the need to resolve digital and cyber security; (iii) issues with legislation and policies; (iv) funding and business models in the areas of smart cities advancements; (v) more infrastructural facilities in areas of energy, water and transportation systems.

As it is understood that for sustainable development, actions must be put in place to strike a balance between social, economic and environmental sustainability. Sustainable cities and communities are the emphases of Goal No. 11, of the Millennium Development Goals. Meanwhile, sustainable development cannot be accomplished without fundamentally altering how we plan, design and maintain our cities. Building resilient societies and economies, safe and affordable housing and business possibilities are all necessary components of sustainable city development. Investments in public transportation, the development of green public areas and enhanced urban planning and administration using inclusive and participatory methods are important.

All stakeholders should be involved in adopting new technologies as tools for smart technology, which goes beyond improving sustainability. Urban intelligence, social inclusion, resilience and technological innovation should all be included in global efforts to concretise smart city initiatives and developments. The effects of providing services will strengthen the bonds between the public sector, people and businesses, influencing society and government in the years to come. Similarly, through appropriate services and incentives, as well as collaboration chances between businessmen, the government and research institutions, smart city policies aim to improve and consolidate connections between the

government and the citizenry. Some smart city ideas offer businesses the chance to display their goods and services while also allowing capital and investment capacity. Initiatives for smart cities will also have a positive impact on global networking and collaboration.

Recommendation

This chapter suggests that socio-digital technology integration should be taken into account for the sustainability of African cities. In other words, the smart urbanism model should be properly taken into account if the sustainability of the cities is to be feasible. In terms of adequate planning, African cities with an emphasis on sustainability should emulate developed nations' concepts for building a new megacity that addresses all aspects of smart cities. It is the responsibility of professionals, decision-makers, urban designers and other related stakeholders to incorporate digital technologies into the conceptualisation of their city. Similarly to this, African authorities should make an effort to regularly tell the public about their smart city plans and to communicate their overall development strategy, concepts, objectives, goals and priorities. Additionally, a platform must be offered so that all stakeholders can share their knowledge of smart cities. This would help establish communities, foster a strong learning culture and increase national capacity for smart city planning and implementation. There must be an effort to incorporate a set of guiding principles and values into African cities' planning procedures for sustainable development.

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