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Building sustainable smart cities and the green building agenda

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Abstract

Sustainable development has been at the centre of most actions in developing and first-world countries. Most African countries are still developing and the challenge of infrastructure is really a big issue in most of the countries looking at their background and state of development. There have been agendas and development strategies or visions for cities around the world: From sustainable, responsive, green development, resilient South Africa, and many other development strategies, that were adopted by many countries to bring about development in their cities. The smart city concept could be an evolving concept or something which was combined from many ideas and strategies or agendas which were developed before. The smart city concept is basically about improving the work environment and turning communities into more technologically advanced cities which is something that many developing countries have been working on under certain concepts/agendas such as e-governance and T-governance. The smart city concept could also be coupled with the 4th Industrial Revolution concept. How do we merge the concept of smart cities into the sustainable development agenda, and can a smart city not be sustainable and green? The paper will look into the past development initiatives and compare them with the current initiatives under the smart city concept to understand the gap and come up with a vision of what the future smart cities would look like and what we could be missing in the process of having sustainable smart cities and also uncovering how the green building concept is being merged to the concept.

Keywords

Sustainable development; Smart cities; Green buildings

1. The smart city concepts

The smart cities' concepts were first introduced in the early 1990s to define the introduction of ICT to city projects and planning. The Smart city is not a concept that existed before, but the first literature was produced in 1997. Smart cities literature development was initiated in 1994 in Amsterdam through the development of a virtual city that was on the World Wide Web(www) and existed as analogies. Community members were consulted or included in the virtual cities to get the information required for the implementation of the idea. The virtual city concept also assisted in terms of enabling communication between politicians and community members (Antonopoulos, 2017).

The smart cities concept is about building technology-friendly urban areas. The concept was developed at the end of the twentieth century, and it's concerned with the development of smart towns and cities. Smart cities should provide high-quality life, resource efficiency, progressive economy. The focus includes improvement in technology in all fields of life from transport, environment, public participation, and governance. The focus is on the entire city system

instead of single projects and strategic planning and forward-thinking system which will be implemented in a process in order to achieve sustainability and integration of city systems. The world is highly affected by a need to change technology and improve standards of living, labor force, and institutions functioning in order to compete with other countries. Smart cities use a high amount of data collected through intelligent infrastructure, people, and vehicles to generate new ideas and possibilities of investments, improve safety and security in the city and reduce susceptibility to disasters, economic growth, access to information, and ability to participate and take decisions in the city. Smart cities are not only limited to ICT infrastructure but also the invention of intelligent systems that will help create safe and resilient infrastructure (Anthopoulos, 2017).

According to Das, 2019, the pillars of smart cities include smart people, smart economy, smart environment, smart governance, smart mobility, smart environment, and others. The approach to smart cities also looks at the level of economy in the city which can be a developed economy or an Emerging economy. It can also be approached based on the type of innovation the city wants to focus on, and the level of city development, Smart cities are evolving and are being seen as engines for the future growth of cities. Policies on smart cities are being reviewed over time to factor in the necessary issues of growth (OECD, 2020). Policies must be developed and reviewed to allow for the implementation of the smart cities principle and also they ensure that policies do respond to the needs of the cities.

The model of smart cities adopts high usage of technology and information technology to ensure citizens have high-quality life that is sustainable. The idea of improved quality of life is created through building and connecting intelligent infrastructure and vehicles in the city to capture information about the city services to enable people to have access to information about city services and for responsible officers to capture and analyze necessary information for planning and service delivery. The information provides a new outlook on how the city can be reshaped to achieve greater security, an improved economy, and responsive quality services (GSMA,2013).

According to Deloitte, 2019, the word smart cities generally refer to a technology-intensive city that has sensors installed everywhere and offers highly efficient public services using information using real-time by means of an interconnected system of devices. Smart cities are economically vibrant and are on the edge of implementing high technology infrastructure that will enable smooth and effective functioning of the cities, administration of municipal councils should be of high-level technology and communicate effectively with its citizens. The council of cities is responsible for the day-to-day functioning of the area, the communities will need services (such as water, sanitation, roads, and electricity) daily from the municipalities and in a changing world of high efficiency. Cities have developed smart transportation which includes efficient and fewer emissions which include buses, sidewalks for bicycles, and rail-over bridges or subways. This mode of transport caters to fewer emissions and less traffic. These modes of transport (sidewalks, bicycle lanes, rail bridges,) are also integrated with other strategies in the city which encourage fit health. According to Das, 2019, there is no universally accepted definition of the smart city concept, but the foundation of it was on utilization of ICT to improve people in urban areas. Many countries have pulled from that idea and come up with other innovative ideas of how technology can be used to achieve smart and fast-growing cities.

2. Cities

Cities are experiencing a high level of emissions in many African countries. Cities in third-world countries are developing at a fast rate, it is, therefore, important for them to plan their development accordingly to avoid the consequences of climate change. Industries are being developed and the increase of emissions and greenhouse gases has increased and contributed to three-quarters of the world's emissions. Cities are faced with the challenge of improving economic development in the cities, building quality infrastructure, good governance, maintaining the environmental balance, improving socioeconomic standards, and improving quality of life (Anthopoulos, 2017).

Our cities, mostly in third-world countries are largely hampered by poverty which included, a lack of shelter, income, employment opportunities, service delivery, land tenure, etc. (Mishra, 2017).

Our cities lack relevant data for planning, monitoring, and implementation of projects. A quick reference is a COID-19 pandemic where most cities as they are more populated and the spread of the virus could be very, city management had to be exposed to more relevant data which is easily accessible for decision-making and to ensure that the spread is reduced, and people are being assisted. The data needed include people's movements, usual activities,

demographics, and areas likely to experience a high level of spread. Regulations had to be put in place based on the data collected and the improvement of infrastructure that is relevant and fast in capturing and processing data is very much decisive. Cities with up-to-date infrastructure were able to respond quickly and effectually so (World Economic Forum, 2021). Most cities are likely to be suitable as they have certain technology and infrastructure or ecosystem in place which allows for easier integration of communities and

3. Urbanisation

More than half the world's population already occupies urban spaces. The amount of people in urban areas is estimated to increase by two-thirds by 2050. (Alkandari, Anaasheet, & Alshekhly, 2012). This increase in people in urban areas also leads to an increase in demand for resources and services from the government. The increasing population leads to an increase in waste, and this affects the environment negatively councils must come up with less expensive and effective or high-capacity systems and services that will be able to process and capture all the waste produced and follow all the necessary environmental prescripts of recycling and reusing of waste material to produce new services.

Information technology is very important for the organisation and linkage of resources to people and the as the growing number of people in urban areas is linked to the demand for services. This has led to the development of smart cities which are believed to be able to respond to the quality of life of people in the cities. Information communication technology is very necessary for city development (Al-Hader, Rodzi, Sharif & Ahmad, 2009b as cited in Alkandari, et.al. 2012).

The sanitation system must also be of capacity to handle the current number of households and be able to connect new households in a simple and efficient manner. It should not be costly and give people difficulty in connecting to the old and the new system in a smart city. The old cities with old and dilapidated infrastructure must replace and install new smart infrastructure that will cater to the communities in a better way to improve their socio-economic status. Industries should come up with high-level technology to reduce the levels of waste and pollutants produced and reduce the amount of waste produced and implement new systems for the production of advanced technology goods and services that will be effective.

The high level of urbanization is threatening the achievement of sustainable development in cities. Urbanization leads to expansion in urban populations leading to urban sprawl and reduces the availability of land for settlements, industries, and any other use. This amount of urbanization will lead to a high number of informal settlements, poverty, lack of jobs, and lack of housing, water, and electricity (Roll & Carriero, 2015).

4. Energy and the environment

Reducing the amount of waste in the environment provides a safe environment for everyone. The building in the city must be of excellent design and building material that complies with the smart city strategy to ensure building that saves energy and contributes less to environmental pollution (Pinaki & Mahesh, 2015).

Work in cities is produced through the available energy and it can either be kinetic, chemical thermal, or potential. The has been fear of depletion of energy sources which has led to green energy, sustainable energy, renewable and smart energy. These energies are different in efficiency and impact on the environment, solar and wind energy are sources of green energy, sustainable energy is not human-made and renewable energy is manmade. Sustainable and renewable energy can be regenerated faster, and they last longer. Smart energy is a broader concept that includes technological innovation into the existing forms of energy through smart grids which improve the efficiency and sustainability of the environment (Mohanty, 2016).

City lighting and the production of electricity can be very expensive to most cities around the world, the introduction of smart LED lights will decrease the city expenditure by 50 % and that will make cities more efficient and financially viable. Cities require public street lighting for the safety of the community and lighting inside their building. The building in the cities must also be designed in a manner that they do not consume a lot of energy that will harm the environment (Simpson, Rocque & Phillips 2017).

A survey was carried out by Simpson. et.al, 2017 show that half of the cities believe in having sustainable smart cities and the main concern is water and energy usage. Most need to improve on that and water is already a scarce resource that is used also for the generation of electricity in some countries like South Africa. Cities are growing every day, and citizens need water there should innovative ways for cities to manage water usage. Most cities in the south have adopted smart metering projects which increase efficiency in the monitoring of usage of water and electricity in households and businesses since old systems led to the wastage of resources and poor revenue collection.

The change of economy from agriculture to an industrial-based economy has led to a lot of pollutants including land, noise, and air. These have threatened the sustainability of our cities (Sonya, Joseph & Kelemen, 2013). Cities are growing at a very high rate and most of the city's population will reside in cities by 2050 human activities in those cities contribute largely to greenhouse gases which damage the environment or contributes to climate change and global warming. The economy depends much on water and energy for it to run effectively. Smart cities should efficiently use technology to manage natural resources in a better way. Natural resources such as parks, and waterways are some of the infrastructures necessary for sustainable development. If these resources are well-managed cities become smarter (Chourabi, Nam, Walker, Gil-Garcia, Mellouli, Nahon, Pardo, Scholl, 2012; Alkandari et al. 2012).

5. There approaches to smart cities development

The smart city concept is a strategy adopted to solve the challenges of increased population and urbanization in developing countries (Chourabi, et.al. 2012), The smart cities projects look at improving the standards of living in cities through the improvement of urban environments to modify buildings standards, water and energy usages, and ICT. Governance of cities must also be improved for inter-sectoral cooperation, alignment, and integration of local, national, and provincial departments. Social capital such as education, social and gender equality, economic conditions poverty alleviation, and employment generation and for citizens to enjoy their systems in urban and have great experiences (Roll & Careiro, 2015).

Cities are classified into four categories which first is the new city, the existing city, and the shrinking city. The smart cities in new areas are largely new cities' large-scale projects that are starting from scratch. On this one, the focus is mainly on having a project on building a new city from scratch that is planned in a way that it will allow for continuous adaptation to new development and forces or disasters which may affect the city. It's about building a city ecosystem that will have innovative industries and provide city solutions.

The second type of city is one that exists and will need to be re-assessed to identify key problems and come up with possible strategies to approach the upgrading of the city looking at all sectors of the area. Thirdly there are shrinking cities that are not developing anymore, but are decaying and need to be redeveloped and renewed. This kind of city required a lot of funds to invest in repairing the broken infrastructure and coming up with a new or another plan to build the city.

The approach to sustainable smart cities is very imminent. Cities must ensure that the approach they choose is very applicable to the cities' standard of development and will be a successful and resilient project. The challenge to the smart cities concept is that there is a lack of interest in some of the government sectors to implement any projects they need. There is also no integration between different sectors. The other challenge of the smart city concept is that people worry about their data and privacy due to the high usage of technology which can capture even the data they do not want to expose, or data can be lost or exposed to the wrong audience. The data could also be (World Economic Forum & Deloitte, 2021; Chourabi e.t.al. 2012).

There should be an integration of all key investors and sectors in the process of developing smart cities. The private sector, and technology companies such as Cisco, Siemens, and Cisco are very imminent in the development of smart cities as they are working towards introducing new technologically smart products all the time (Das, 2019; Chourabi et.al. 2012). The IBM company in south Africa has developed some of the few devices which can help municipalities deliver services in a better way. The devices include "Blaza" which is a streetlight that allows community members to connect to it via Wi-Fi, the device produces information on the amount of air and noise pollution that is produced

around the city and compares them with each other. The communities can monitor and report incidences where the noise is above the required standards.

South African cities are experiencing a high level of informal settlements which are very much exposed to disasters such as fire, flooding, the spread of diseases, poor services, and other challenges. The 'Scova' device was identified and implemented in informal settlements to detect fire hazards and communities can press a panic button to report to the nearest fire station. ''diTsebe'' meaning ears, is another device that is implemented on an existing streetlight to detect noise from churches and clubs and reports to the municipality. Other devices among others include 'Fiyela' and 'Echostone' which Fiyela assists the general workers in the municipalities to report illegal dumping and EchoStone for monitoring the theft of tombstones. These devices use high-level technology (IoT, GPS, Wi-Fi) to produce the relevant data needed on time and use solar energy which is less costly and environmentally safe (http://www.smartcity.co.za/).

Different countries are implementing their own projects and competing for successful implementation of the smart city ideology and becoming better cities across the world. The success of implementing the smart city concept differs from city to city, the City of Luxembourg was ranked the best city in Europe on how they implemented achieved high economic performance, and some cities like Danish and Scandinavian performed well in terms of smart governance. Australian cities are performing well in terms better in terms of smart living and governance. There are many pillars of the smart city concept and each city will excel differently based on strength and capability (Das, 2019).

According to Penrose, Tamley, calise & Thurstone, 2016) Smart cities are not that smart for everyone as some people (the disabled) cannot have access to transport because of the design of the infrastructure. Smart cities should come up with an inclusive way to cater to the disabled and look into other groups in society who might be left out. The innovation must cover both physical and digital access as some of the community members might not have access to certain resources such as mobile broadband, money for gadgets, and access to venues and parks for recreation that will allow them to connect with other people. Urban poverty does exist, and those people must be taken out of poverty. The smart city concept must also allow for information sharing among communities about the satiation and the environment that they are operating in, for social cohesion and to continue networking and capacitating each other about the development that is taking place.

Governance is one of the key factors which can improve the implementation and function of cities. E-governance has been a challenge when it comes to implementation. Challenges to implementing smart city policies or strategies in some countries include a lack of understanding of the concept, budget limitations, conflicting goals, and resistance to change. The greatest challenge has been stakeholder relations. Stakeholders in governance include the private sector which can invest money in the projects to be implemented. Communities also play a huge role in decisions and taking care of the resources after implementation. Structures, leadership support cooperation are the most important elements of good governance. Good governance includes judicial and administrative rules, laws, and prescripts which support or prohibit the production of a certain good or product (Simpson et.al. & Chourabi et.al. 2012). The implementation of smart cities has been successful in some countries and the greatest indicator of success has been a public-private partnership. Communities can be very resistant to change or find it hard to adapt to innovation mostly if not well informed or consulted before.

6. Green buildings and smart cities

Green buildings are the most sufficient way to build healthier and resource-eco-friendly buildings (Radwan, Kashyout, Elshimy & Ashour, 2015). The concept of green building has existed for some time it generally applies to the use of raw materials such as clay, sandstone, and gravel to erect buildings. The green buildings are in compliance with Sustainable development principles. The building uses less water and lighting which are scarce resources in urban areas. The green buildings allow for the harvesting of rainwater which increases the availability of water, unlike conventional building which promotes run-offs and uses lots of light due to the materials that are used. Green buildings also limit the amount of urban heat due to the use of natural resources which do not keep too much heat or contribute to many greenhouse gases. The green building idea is mainly about reuse, recycling, and reduction of waste. The green building concept is linked to the smart city concept in the sense that it provides a healthy life for

citizens and it contributes less to environmental challenges in the city (Mulchandani & Nahata, 2019). Smart buildings are very different from green buildings. On the concept of smart cities, smart buildings are also of key importance as smart cities are described to be more sustainable and advanced than green buildings. Green buildings are focused on reducing carbon dioxide emissions by reducing water and energy usage and smart cities are more about improving the structure of buildings in the cities. The smart building may contain a set of sensors that will allow the building to collect data from outside and the buildings next to it. Smart cities promote data-driven decision-making, low-cost operation, reduced capital and operational costs, risk identification and management, and sustainability (Mohanty, 2016).

The building makes up the city and the building provides shelter, office space, shopping space, parking, and others for people. The quality of buildings will determine the quality of life of people. The complexity of the building includes cooling and lighting systems, ventilation, and security. These systems do not work well in conventional buildings, but they save too much energy and water when using smart buildings, The smart green buildings are best when it comes to three economic indicators such as lifecycle cost analysis, discounted payback period, lifecycle cost analysis and saving to investment ratio (Ernst and Young and Honeywell, 2015). The goal of having a smart building is to ensure that the owner is happy and safe. Smart buildings have intelligent lighting systems. The cooling and heating of the home or office are provided by energy and temperature controls. The building may contain a security system that requires codes for one to enter the building and, temperature and movement sensors can provide great safety and security measures in the building (Alkandari et.al. 2012).

7. Conclusion

The idea of the smart city is still new to the planning and management of urban areas. The smart city concept is very much innovative it strives at improving the lives of people in urban areas. The smart cities agenda introduction has led to many changes and improvements in the cities. The world is advancing in technology every day from 4Gs to 5Gs, robotics, sensors, and other projects which come with the 4th industrial revolution. People will have to adapt to technological innovations learn and develop themselves from them. There is still a lot of work to do in planning and ensuring that the smart cities concept is well understood, and people can differentiate it from other technological innovations such as E-governance/services. Smart buildings are also a new concept that uses a lot of technological equipment to ensure sustainable development, safety, and security of residence and empower the people's quality of life. Partnerships are important as understanding the gap between green building and smart building and sustainable/resilient cities and smart cities. Smart cities are at an advanced level in terms of technology and scope.

The green building agenda did not disappear instead it was modified and upgraded on the smart cities concept for it to be more sustainable. The achievement of sustainable smart cities is very much possible through the commitment of leadership, having the right resources, and understanding of what needs to be done.

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