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Smart Cities, Urban Sustainability and Climate Change: A Conceptual Review

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Abstract

Smart cities are potent instruments to mitigate climate change and foster urban sustainability. This is because smart cities exploit the benefits of advanced technologies and "Internet of Things" (IoT), which makes varieties of information available on issues, thereby easing strategies for tackling them. It therefore, becomes possible to make informed and precise choices that enact change to sustainably enhance survival. The aim of this article is to provide a conceptual evaluation on the implementation of smart cities in solving global climate change and urban sustainability concerns. This paper concludes that, even though smart cities can take major local intervention on climate change and urban sustainability, they will continue to depend on domestic governments to invest in critical infrastructure including defence, power, water supply, communications, and fast transit. Smart cities also need the private sector, through transparent and responsible taxation, to improve their attractiveness, generate wealth and jobs, and boost municipal finance resources.

Keywords: Smart cities; Climate change; Urban sustainability

1. Introduction

In recent times, IoT and the Industry 4.0 (fourth industrial revolution) have led to fresh discussions among world leaders on climate change (Demuzere, et al., 2014). These talks are still

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open and ongoing, with inquiries on who assumes liability, the level to which man contributes to these issues, and what can be accomplished to manage the emergency. The focus should, however, be on what can be accomplished to resolve our planet's negative environmental crisis. Although the consequent challenges of climate change are not noticeable at regional level, they accelerate more rapidly than humans can manage at global level (IPCC, 2015). Considering the advent of global warming, the trend has stepped forward over the past 50 years, with the hottest years in history recorded since 1990. From scientific perspectives, if current rates of all activities (burning of fossil fuels and unsustainable manufacturing, among others) are not halted, the normal worldwide temperatures may ascend to between 3 and 9 degrees in the later stretches of the 21st century (IPCC, 2018). This will prompt rising ocean level, drought, rising tempests, flooding, rapidly spreading fire, and warming up sea flows with the most perilous results affecting human life.

It is important to know how and in what direction to act. It is essential to find out the faults in current urban schemes to know how and from where to start. Estimates from the U.S. Department of Energy reveal that 39 percent of America's carbon emissions are from residential and commercial buildings and 33 percent of the emissions are from passenger and freight transportation services. Overall, 70 percent of carbon emissions in cities come from the use of modern urban infrastructure. More specifically, research shows that while traveling between home and office, commuters around in many cities in the world, use and emit more energy than they do when it comes to cooling, heating, lighting, and self-preservation (Giorgi, Field, & Barros, 2014).

Piro, Cianci, Grieco, Boggia and Camarda (2014) note that many smart cities are springing up around the world. These cities are fuelling their infrastructure with technology to birth smarter living. Nevertheless, the purpose of fuelling must be to use newer sustainable technologies to clean up societal consequences of earlier-adopted techniques and this must be achieved prudently. In fact, smart cities are potent instruments to reduce the earliest coal and greenhouse gas emissions. According to Ramos, Trilles, Andrés Muñoz and Huerta (2018), given the availability of varieties of information on issues that may harm the environment, the concept of a smart city makes it possible to make informed choices and precise choices that enact change to enhance survival.

Meneguette, De Grande and Loureiro (2018) point out that the more self-conscious, or smart an urbanised area is, the more the engagement with it. This is directly related to contemporary technology, which is a more effective solution to environmental and sustainability development challenges in urban areas. Considering, for instance, a city fitted with traffic streamlining technology, knowing the routes most road-users are at a given time, and where traffic is the heaviest, streamlining technology can correctly direct others through an area with lesser traffic gridlock (Anthopoulos, 2017). From a narrow point of view, this may not seem to do more than enhance effective use of commuters' time. Nevertheless, it does reduce emission scores because cars spend less time on the highways. It decreases traffic times, which also decreases the likelihood of accidents. It also lowers the use of conventional fuels (diesel and gasoline). Therefore, a straightforward scheme like this can assist to sustainably promote living standards of urban inhabitants. Therefore, the aim of this article is provision of a conceptual evaluation on the implementation of smart ideas in resolving challenges posed by global changes in climate in term of sustainable urban habitation.

The rest of this paper is, therefore organised as follows; section 2 focuses on the review of the concepts of climate change, global warming, urban sustainability, and smart cities, while section 3 relates the concepts one to another. The next section concludes the paper and draws some policy implications.

2. Literature Review

2.1 Climate Change

Climate change (CC) is basically the result of man's adoption and use of non-renewable energy sources, which emits carbon dioxide and other air-polluting gases into the atmosphere (IPCC, 2015). Gases trap heat in conditions that impact on territories and habitats in many ways including expanding ocean levels, grave variances in climatic conditions and droughts as well as rapidly spreading fires. There is wide accord among mainstream researchers that climate change is genuine(O'Neill, et al., 2017), contrary to some popular thoughts that the phenomenon could be a myth. The real reason for climate change deals with consumption of non-renewable energies, such as coal and oil, that discharges greenhouse gas into the atmosphere, with carbon being the most common of the gases (Giorgi, Field, & Barros, 2014). Other human activities capable of altering atmospheric balance include excessive land cultivation and deforestation, which are able to release compounds capable of harming the ozone layer and inducing climate change. According to Piao, et al. (2019), CO_2 concentration in air never increased beyond 300 parts per million (ppm) since the emergence of human advancement until 1900. Carbon concentration within the atmosphere currently stands at about 400ppm, a point not attained in more than 400 years. This implies that the slightest rise in temperatures related to the earth's atmosphere can have extreme effects on the world. Earth's average temperature has risen to 1.4°F over the past years and is projected to reach 11.5 °F in the next 10 to 20 years. There must be positive steps taken to reduce this (Vitasse, Signarbieux, & Fu, 2018). This probably will not sound like much, yet usual temperature of the previous Ice Age was about 4° F lesser than its current state.

Rising ocean levels due to deliquescing of polar ice heightens stormy perils; warming sea temperatures are connected to increasingly incessant storms; additional precipitation prompts flooding and other harm, especially during extreme climate occasions, while fire compromises lives, environments and residences; and warm waves lead to humming. While agreement among analysts, governments, scientific organisations and researchers is that climate evolvement is a resultant effect of individual action (Quan, Li, Song, Zhang, & Wang, 2019), a minority of stakeholders question the credibility of such assertion. Climate change refuters constantly insist that the on-going alterations linked to human action could be seen as features of diversities in global atmospheric ambience, alongside seeming difficulty in constructing instantaneous connection between climate change and any singular weather condition, for instance, typhoon (IPCC, 2018).

Climate change is a worldwide problem without border barriers and combating it requires unified efforts across nations. However, reliance on undependable sources and false information have thrived in its wake. For example, two conceptualisations are popularly misconstrued to mean the same. They are climate change (CC) and global warming (GW). Climate change is an outcome of global warming. Global warming is the foremost foundation for climate change, with numerous hostile effects on physical, organic/biological, and anthropological structures asides further impacts (Thornton, Steeg, Notenbaert, & Herrero., 2009). Global warming is triggered by greenhouse influences, a regular course where the air holds some of the Sun's heat, letting the globe

sustain essential natural process to support life on the planet. Typical temperature of the planet devoid of greenhouse effects lies at -180C (Margulis, et al., 2009). However, everyday human activity result into the greenhouse impact, leading to an even higher temperature on the planet.

Experts agree that the Industrial Revolution was the primary driving force promoting the rising discharge of greenhouse gases in the atmosphere. The origins of this complete shift are smaller demographical, agricultural, transportation, technological and financial evolutions, developing fresh paradigms of consumption and production (Quan, Li, Song, Zhang, & Wang, 2019). From then on, population increases, explosion of resource use, growing material demand, and energy creation, mostly from fossil petroleum, all propelled the World into what scientists refer to as the Anthropocene era, a new geological age characterized by people's effects on earth. Birch (2014) explains that the foremost influence was the upsurge in temperature of the earth, which has increased by 1.1°C since then, notwithstanding it is projected that culmination of the current centennial may see the temperature possibly upswing by 2.7°C, regardless of whether state or domestic emission decline commitments are achieved.

The upsurge in global temperatures has devastating concerns that threaten the existence of global vegetation and living creatures including human beings. The most significant climate change impacts include melting ice at the polar regions, which propels greater surges and sea altitude and engendering floods. Coastline terrains are also being rapidly eroded, putting low-lying areas and beaches in jeopardy of vanishing completely (Piao, et al., 2019). Climate change likewise escalates the advent of situations such as, famine, rapidly extinct plant and wildlife breeds, fire outbreaks, overflowing lagoons and streams and devastation of nutritional and economic inputs, especially in less developed economies (Vitasse, Signarbieux, & Fu, 2018). First, it is essential to acknowledge that it is not possible to avoid climate change. Related impacts and adaptation to such ramifications can only be mitigated, so by applying policies that support the reduction of its impacts, we can combat it. These activities are considered as measures to mitigate climate change. Unless we know the broader image of these challenges, however, we will only end up mitigating issues or offering superficial alternatives that may not promote or create urban sustainability.

2.2 Urban sustainability

Development specialists generally agree that cities should meet current requirements without sacrificing future generations' capacities to satisfy their own requirements. Human settlements require use of natural resources in their quest for food, water, energy, waste disposal and industrialization. This can impose significant adverse effect on the environment. Huge portions of agricultural land can be converted to grow edible products for a society's individuals, lowland plains can be submerged to reserve and distribute water, and landfill areas utilised for litter disposal (Yigitcanlar & Teriman, 2015). Sustenance of urbanised areas is the concept which signifies that without excessive dependence on the surrounding landscape, a town can be organised and powered by renewable energy sources. This is aimed at creating the least trace of environmental mark and producing the least possible amount of contamination through effective use of soil, composting materials, waste to energy conversion and minimising the general vulnerability of the city to climate change. It is projected that more than half of global populace nowadays dwells within metropolitan regions, rising to 70% by 2050. This is a tremendous shift that will affect both the millions of individuals moving in and the cities they are moving to. Such a shift creates a challenge for planners and developers. Nonetheless, communities further provide opportunities, since humans are social animals who flourish in urbanised locations, thereby fostering socialisation(Koch, Kabisch, & Krellenberg, 2018).

Seto, Parnell and Elmqvist (2013) opine that despite what some individuals believe, urban establishments can have higher ecological tenability over local towns or suburbs, where individuals can be distantly away from themselves, working buildings and crucial amenities. When individuals and resources have extreme proximity to each other, the efficient location of facilities and transportation could save energy and money. Cities are additionally advantageous to nations by uniting individuals in a comparatively tiny region where ideologies could be readily produced and enhanced (Alberti & Susskind, 1996). Some specialists believe that towns would be future development propellants, amplifying both economic demand and supply. The material resources needed for a city's development offer possibilities for employment and financial attainment. However, cities can also substantially affect the ecology adversely in contexts of poorly coordinated systems; vast energy quantities could be used that have been manufactured unsustainably, they can damage the land and pollute atmospheres(Homsy & Warner, 2014).

Technology has a major role to play in releasing cities to achieve beneficial results. Today's solutions will be indispensable in ascertaining that constitutes tomorrow's cities favourable and maintainable growth. Urban cities that support the population do so as the population grows. Urbanisation leads to enhanced environmental effect; cities' "ecological footprint" is spreading. There is a need to find a way to manage development over time, emphasising the sustainability location. Urban sustainability needs an evolution in the way urban regions carry out operations such as resource use and human and products motion. In order to recognise the difficulties of development, physical infrastructure and social and economic procedures must develop (Seto, Parnell, & Elmqvist, 2013).

2.3 Smart City

A smart city is a municipal region that utilises diverse kinds of devices for the electronic Internet of Things (IoT) to acquire data for handling resourceful assets proficiently (Allam & Newman, 2018). This comprises details obtained from persons, instruments, and resources managed and evaluated for surveillance and management of transportation and congested structures, water supply networks, waste management, crime detection, power plants, hospitals, libraries, educational centres, water supply and informational networks, among other societal infrastructure (Ekman, 2018). Smart city machinery permits city administrators to relate directly with society substructure, track what is going on within the city and how cities are changing. ICT helps to improve the standards, effectiveness and interactions of urbanised services, minimise expenditure and resource usage, and boost communication between individuals and government (Nagy & Simon, 2018).

The term 'smart city' itself, however, is quite unspecific and thus vulnerable to divergent explanations. A new wave of intelligent apps is changing how day-to-day operations are now being approached as the world becomes increasingly interconnected and technology dependent. Utility devices such as smart fridges, personal assistants such as Alexa from Amazon or smart home security apps generate possibilities for more effective living (Meneguette, De Grande, & Loureiro, 2018). While "smart cities" concepts have been suggested as the future of urbanism, the issue remains how to connect this new technology for the eventually "efficient" community.

Smart cities combine infrastructure and technology to enhance citizens' quality of life and enhance their interaction with the urban setting. However, it is relevant to understand how information can be incorporated and used efficiently from fields such as public transport, air quality meters and power manufacturing (Ahuja & RCDD, 2016). The Internet of Things (IoT)

might have some of the answers. Created as part of the motion of intelligent technology, the IoT allows different objects and entities to interact through the internet (Perera, Zaslavsky, Christen, & Georgakopoulos, 2014). By establishing a network of objects capable of intelligent interactions, the gate is opened to a broad range of technological developments that can, for example, enhance public transportation, provide precise traffic reports or provide information on energy consumption in real time (Piao, et al., 2019).

By enabling more technology to communicate across platforms, IoT produces more information that can assist and enhance different elements of everyday life. Cities can recognise real-time possibilities and difficulties, reduce expenses by identifying problems before they emerge, and, more appropriately, allocate funds to maximise effect (Piro, Cianci, Grieco, Boggia, & Camarda, 2014). Smart cities can be design areas where individuals want to spend more time by investing in public spaces. For example, by applying a network of fibre optics across the town, the town of Barcelona has embraced smart technologies, offering free high-speed Wi-Fi that promotes IoT. Barcelona saved €75 million in town funds by incorporating intelligent water, lighting and parking management. It also generated 47,000 new employments in the intelligent technology industry (Habibzadeh, Soyata, Kantarci, Boukerche, & Kaptan, 2018).

A smart city is a model mainly consisting of information and communication technologies (ICTs), to advance, organise and encourage sustainable development methods in order to tackle increasing problems of urbanisation (Zanella, Bui, Castellani, Vangelista, & M. Zorzi, 2014). Citizens use mobiles and smartphones, likewise linked vehicles and houses to communicate with intelligent city ecosystems in a multitude of ways. A city's physical infrastructure and services can be combined with appliances and information to cut costs and improve sustainability (Hancke, Silva, & Gerhard P Hancke, 2012). With the use of IoT, municipalities can enhance energy allocation, limit waste gathering, reduce traffic jams and even enhance atmospheric quality. Connected traffic lights, for example, obtain information from sensors and vehicles that adjust light modulations and timing to react to actual traffic and thus reduce congestions (Marpu, Tuia, & Mallet, 2018). Interlinked electric vehicles are able to connect to the closest accessible place with direct drivers, EV charging docks and parking meters. Smart trash cans spontaneously relay information to refuse administrative firms and plan pick-up as required. Moreover, smartphones now exist as people's identity cards, mobile driver's permit, indicators of speeding and simplifiers for location public facilities (Kumar, 2018).

To maintain pace with the fast development that challenges the resources of cities, environmental, social and sustainable financial development is essential. Fortunately, more than 190 nations have agreed on sustainable growth objectives, suggesting that smart city technology is essential for achievement and fulfilment of these objectives (Ramos, Trilles, Andrés Muñoz, & Huerta, 2018). Safeguarded wireless connectivity and IoT techniques transform localised aspects of urban livelihood – such as highway lights – into smart lighting mediums with extended functionality for the next generation (Witanto, Lim, & Atiquzzaman, 2018). High-power integrated LEDs alert traffic-related commuters, deliver austere weather cautions, and give head-ups when fires occur in the environment. In addition, streetlights can identify empty parking spaces as well as EV charging docks (Ramos, Trilles, Andrés Muñoz, & Huerta, 2018). In some places, charging could even be possible from the lamppost itself (Ruhlandt, 2018). These environmental, economic, and technological evolutions have spurred attention concerning how smart societies address on-going global concerns, including climate change and urban sustainability.

3. Relating the Concepts

3.1 Smart City and Climate Change

A worldwide debate is on-going on the benefits of ICT, which can also be considered in the light of climate change (Betsill, 2010). ICT is an evolutionary forum which supports renewable/low energy consumption. Lindseth (2007) reported that Ericsson Mobility research observes that ICT possesses abilities of reducing planetary greenhouse gaseous emissions by 15% in 2030. This estimate was approximated to surpass the full carbon landmarks of Europe and U.S. About 70% of electricity is lost before getting to production sites (Lindseth, 2007). ICT-facilitated solutions via smart meters intelligent grids have more potentiality of producing energy with superior effectiveness. Thus, energy utilisation and proficiency in households and commercial buildings can be considerably increased (Socolow & Pacala, 2004). Smart grids provide power through renewable sources such as wind and solar. Therefore, energy optimisation can be achieved, lessening high demand and necessity for more grid facilities. Microgrids render energy to places which remain unreachable through traditional energy production practices (Lindley, Handley, Theuray, Peet, & Mcevoy, 2004). Smart meters, conversely, expand awareness of consumption about the amount of energy and ways of optimising usage(Liua, et al., 2012).

Likewise, it is possible to apply ICT to urban mobility and transportation, making travel more efficient. Renewable fuel and low power usage have enormous opportunities because they favour complete elimination of carbon emissions in smart cars or smart vehicles. According to Kim, et al (2016), the United States Green Building Council (USGBC) studies have suggested that buildings could save over six million metric tons of carbon dioxide yearly if new commercial enterprises were built to consume 50 percent less energy. It is estimated that more than one million cars can move off the roads annually. Energy-efficient building resolutions are based on the inclusion of natural air circulation, solar functioning grids, insulation, high ceilings and day lighting – component of green construction rating network. The USGBC also argues that LEED-certified structures adopt an average of 32% less electricity, conserving 350 metric tons of carbon dioxide discharge per year (Kim, Kim, Song, & Lee, 2016). This natural process has cooling impacts, resulting in reduced electricity consumption (particularly for heating) (Demuzere, et al., 2014).

The benefits of trees and plants in the preservation of a wealthy landscape cannot be underestimated. However, more carbon dioxide is now building up in the atmosphere than can be absorbed from existing carbon sinks, such as forests, due to widespread deforestation and other activities that destroy carbon sinks (Dean, 2019). Preserving our farms and forestlands, which are an important component of every country, could assist in decreasing atmospheric GHG. In addition, we must preserve wild creatures and pastoral regions at the centre of nature's conservation. It is also necessary to put an end to the suburban sprawl if we really want to decrease carbon emissions(Geneletti & Zardo, 2016).

City officials show more active involvement than the domestic governments in addressing global warming locally. Mayors from London to Beijing focus on additional challenges of climate change as their development outlet. The T-charge for moving diesel cars off the highway was launched by London and Beijing to continuously deploy city-wide pollution objectives (The T-Charge legislation enforces all vehicles driven in central London to meet a minimum Euro emission standard)(Rafael, et al., 2016).

Private businesses and sectors, together with the public sector, should collaboratively come forward and address the global climate challenge. This is due to the reality that it benefits their client base and company economy. Microsoft announced in 2017 that it will commit $50 million over five years to deliver artificial intelligence (AI) technology to organisations working on climate change, biodiversity, agriculture, and water. The choice is encompassed within the firm's recently launched 'AI for earth' programme and has already granted over 40 grants to people and organisations among over 10 nations. The previous grant recipients include Tropical Agriculture International Center, Chesapeake Conservancy Project and Southern California Coastal Water Research Project Setaih, Hamza, Mohammed, Dudek, & Townshend, 2014). Given environmental concerns that are currently faced, science informs us that majority are results of the industrial revolution. As the Fourth Industrial Revolution of world technologically fuelled transitions commences, it is compulsory to not just advance with technology, but also optimise the technology of this age to evolve historically and build greater futures, emphasising the position of smart cities in sustainability promotion(Bulkeley & Betsill, 2010).

3.2 Smart City and Urban Sustainability

Sustainability is a strong force in our globe for beneficial change; one that drives conversion, innovation, and enhancement across all parts of culture. Sustainability now includes a wide variety of problems, not restricted to conserving natural resources, such as urban expansion, carbon footprints, transportation and work-life equilibrium of people (Mori, 2011). Sustainability is now the target for futuristic-reasoning towns and cities since global population is anticipated to grow by about 33% by 2050, with almost 70% of persons residing in urban settings (UN DESA, 2018). IoT and smart city technologies together constitute successful pathways in this area. Indeed, there are predictions that half of all smart city goals will focus on climate change, sustainability and resilience by 2020.

The worldwide intelligent cities market is forecast to achieve $3.6 trillion by 2025, as against 2016 figure of $773 billion, with anticipated growth speed of over 19 percent each year (Hammer, Kamal-Chaoui, Robert, & Plouin, 2011). According to Hammer, Kamal-Chaoui, Robert and Plouin (2011), innovative companies and municipalities see the opportunity and work together on programmes that shed light on what smart cities can do to fulfil worldwide sustainability objectives. Smart cities are constructed on complicated and smart configurations of all-pervading digital apparatus that connect people, governments, and items that transmit and obtain information simultaneously. Cloud-based software programmes are receiving, managing, analysing and transforming this information into real-time intellectuality, which will eventually enhance manners of operating, living and traveling(Abdoullaev, 2011).

Smart waste disposal solutions, for example, are redefining and optimising waste management in smart city contexts. The World Bank according to Hall (2014) predicts that worldwide expenses managing landfills alone will increase to $375 billion by 2025, which is not sustainable on long-term basis. Hall (2014) also notes that smart solar-powered waste bins have the capacity to interact when the bin is full in actual time, avoiding excesses wastes and eradicating unplanned pick-ups, thereby saving fuel, depreciation and time spent on the highways. However, the sustainability reach of IoT goes far beyond management of smart city waste. For example, Quayside in Toronto, comprising 12-acres covered by IoT sensors by Google's Sidewalk Labs to monitor and optimise procedures across the town.

City authorities can oversee traffic movement, noise intensity, air quality, transportation trends

and energy use in real time using embedded sensors (Schrenk, Popovich, Zeile, & Elisei, 2012). Such perceptions enable companies, residents, and government to quickly appraise and implement modifications to enhance facilities in town. The installation was intended to address urban development problems and attain fresh sustainability requirements. Likewise, Belmont, an initiative connected with Bill Gates, was conceived as a durable, technologically sophisticated society constructed in the Arizona desert from the ground up. This new city is leading the way for sustainability. It arises from a foundation for infrastructures and communication, which includes highly advanced technology, rapidly fast digital structures, data centres and independent automotive to optimise patterns of livelihood. Although these initiatives may seem fragmented, it is not hard to envision a tomorrow where all towns and cities have comparable IoT detectors integrated with their infrastructural gadgets to decrease the environmental footprints of people and enhance the manner we live (Anthopoulos, 2017). Scalability, however, is always a problem like any growing industry.

Governments and companies need to overcome all obstacles to realise the achievement and expansion of these initiatives to effectually impact town, countries, and possibly worldwide horizons. The government plans to construct 100 new smart cities in China, for instance, by 2020, with a focus on information-intensive infrastructures and innovativeness. Nevertheless, absence of infrastructure investment or confidence in safety is often quoted as holding back courageous projects like this. This is often due to the lack of significant commitments made on ROI to decision-makers (Angelidou, Gountaras, & Tarani, 2012). The way to tackle this issue is to demonstrate that people are genuinely demanding sustainability initiatives (Schrenk, Popovich, Zeile, & Elisei, 2012). Governments and companies can execute better knowledgeable choices regarding technological investments with commitment by the public. For example, Barcelona has a long-established reputation as a metropolitan area with leading edge in technological inventions and has lately re-examined its smart city plans to ensure that it maintains its people at the core of its agenda. Smart bins or smart lighting are solely useful when individuals indeed utilise them. True illustrations of community achievement are already evident. The meteoric rise of Copenhagen to attain the global lead of smart cities is traceable to its ecosystem of intelligent societies and sustainability. With smart road lamps and solar-powered charging stations, San Diego's smart city movement has revolutionised communal attitude to climate change, sustenance and green inventiveness.

Nevertheless, while infrastructure offers the capacities of smart cities, open data and, notably, confidence in their usage and safety, it buttresses a sustainable city's future (Komninos, 2011). History has revealed all governments, businesses, and people keep their information close and share as little as possible. Formerly, issues about privacy and dread of security infringement greatly surpassed the importance of sharing data. It is not possible to blame people for this absence of confidence. With safety threats that transmit shockwaves all over the globe, it is rational that concepts of revealing information publicly is not constantly embraced rapidly. Only when citizens trust the city and the individuals who are responsible for information protection can this resistance be overcome. That is why every government and company have to collaborate on models that are constructed with information safety and citizen gain (Carlo Ratti, 2011). Initiatives like UK's Open Data Institute are going in the direction of creating trusted information ecology. However, there is need to move deeper. Safe solutions spanning from information anonymity to digital identity, intelligent encryption and the detection of intellectual threats, will be essential to boosting people's emotional comfort in disseminating their information.

Modern inventions and smart technologies show the enormous possibility which smart city techniques retain to satisfy joint aspirations for a sustainable globe. However, the sole avenue of maximising the ability of intelligent cities to deliver on this depends on the combination of trust among people, companies, and governments. Without it, we risk deployments that are patchy and underwhelming. There are many ways in which technology introduced in a smart city can enhance sustainability. An example is public transport. 'All Aboard Florida' is an excellent instance of sustainability-enhancing contemporary tech. In the state of Florida, it is an environmentally friendly railway that enhances transportation for all. Big data or 'intelligent' information was leveraged during construction to decrease vibrations and noise, track cultural impacts and resource consumption, decrease fuel expenses and consumption, and discern the effect on the quality of air and water in neighbouring fields. The state will also be able to monitor correctly how transportation and commute times are affected by the railway. 9

In addition, a smart city could accomplish feats like measuring water levels, average consumption, and weather patterns like drought to more efficient supply processor. It could even monitor the patterns of waste to assist in optimising recycling and in reducing the quantity of waste that is used in a community. Both situations would involve continuous monitoring and information collection by the smart city (Anthopoulos, 2017). All that information is what we call 'large data,' and that is what would make the town sustainable and responsive. Hitachi is working on a project called Social Innovation, which will use IT and infrastructure to drive company and make smart cities safer. With big data, the system will be able to respond more fluidly to occurrences around the city. The system will warn law enforcement when metro platforms are overcrowded – due to its distinctive sensors and the authorities can respond accordingly.

4. Conclusion

This paper provides a conceptual analysis of smart cities' functionality in tackling climatic changes and the prospects for urban sustainability. Climate change and urban sustainability trends will simultaneously involve very intelligent and innovative alternatives. Therefore, to provide a more sustainable urban future, a smart city agenda is needed. However, to tackle the scale of the shift ahead, cooperation between all levels of government and alliances with multiple stakeholders are required. As cities develop, so do their natural resource consumption and dependence on the natural systems of earth for prosperity. Red alert days in mega-cities for severe urban pollution signal a complicated connection between mega-cities and regions. As cities develop, their wealth and technology will make them stronger and more independent and economically autonomous. While smart cities can take major local intervention on climate change and urban sustainability, they will continue to depend on governments to invest in critical infrastructure including defence, power, water supply, communications, and transit. Smart cities also need the private sector, to improve the attractiveness of cities, generate wealth and jobs, and boost municipal finance resources. Where national strategies align with local intervention, more can be accomplished.

While smart cities are growing stronger economically, collaboration and partnerships will stay essential to mitigating climate change, urban sustainability, and the transformation needed for a more sustainable future.

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