Smart Cities: The Future of Mankind?

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1. Introduction

We've all heard the word smart added as a prefix to everything nowadays – smart speaker, smart businesses, smart plugs, smart air purifiers, and you can even buy a smart fridge.

There are also smart cities.

Smart cities are a relatively recent breakthrough in urban planning and design, and for the past few decades, have seen proponents far and wide from individual planners to governmental organisations, global tech firms, and billionaires.

With the current global population sitting at 8,036,344,468 at the time of writing, and with 4.4 billion people (56% of global population) living in urban areas as of April 2023, cities are at the forefront of tackling global issues, as a majority of the world's population lives in urban areas. With rural to urban migration showing no signs of slowing, and with widening inequality in cities worldwide, the city of tomorrow is becoming more and more of a concern, arguably an issue, with which we need to deal with now, lest we forsake our descendants, and leave them a depleted, uninhabitable, planet. [1] [2]

Smart cities are one of the foremost defences against modern global issues, however currently they remain largely a theoretical concept, often confused with other urban design principles, and hence their application in the real world has been varied in success and support.

2. Definition

This is partly because there is no clear definition of what a Smart City actually is. Multiple definitions have been put forward over the years, all revolving mostly around the ideas of connecting the physical, digital, and business infrastructures of a city with the aim of improving the efficiency of city services [3].

IBM – a leading innovator in the field of the development of smart cities worldwide – defines a smart city as "one that uses technology to transform its core systems and optimize the return from largely finite resources. By using resources in a smarter way, it will also boost innovation, a key factor underpinning competitiveness and economic growth." [4]

However, recently, the understanding of what a smart city is has been confused with the emergence of related terms – intelligent cities, digital cities, and green cities.

2.1 Green Cities

Green cities are becoming more and more widespread across the world, as the threat of climate change is prompting many to seek less ecologically damaging methods to

achieve a harmony of the built and natural environment. Green cities are defined as "urban enclaves whose design, construction, and operation prioritizes the preservation of the natural world alongside the economic, social, and physical health and wellness of the city's inhabitants" [5]

East London's own Olympic Park, with its green roofed apartment blocks, vast open spaces, and eco-friendly bike infrastructure comes to mind when thinking of examples of green cities, along with Curitiba in Brazil – the birthplace of the BRT (Bus Rapid Transit) system, that allows for integrated bus travel across the city, thus greatly reducing congestion and emissions.

Many cities worldwide such as Dubai in the UAE brand themselves as "green cities" using it as a buzzword to generate interest when in actuality, under the surface of fancy CGI renders and sleek architecture Dubai and many other cities fall short of their idealised vision of a green-utopia – the Burj Khalifa for example lacks a connection to the sewage system – instead relying on a fleet of polluting trucks to relocate the 15 tonnes of sewage a day.

2.2 Intelligent Cities

Intelligent cities are the most closely related term to smart cities, and from an outside perspective may appear to describe the same concept – however they differ in key aspects. Intelligent cities are "the technological computing and management network required for the smooth urbanization of physical urban components,

residents, and other city participants." [6]

Intelligent cities, when compared to the definitions laid out for smart cities, generally overlook citizen-centric aspects such as cultural features and citizen knowledge.

2.3 Digital Cities

In a similar vein, the term 'digital city' is often used to refer to smart cities too, due to it having almost the same criteria in its definition – "a developing city model of urban technology related to the creation of cultural, social, economic, and educational data related to citizens." However, the digital city is remiss in placing sustainability as part of its criteria in the definition. [6]

2.4 My Definition

I have decided to lay down my own definition of a smart city, which combines both the digital city and the environmental policies of green cities along with sustainability - as defined by the United Nations Brundtland Commission as "meeting the needs of the present without compromising the ability of future generations to meet their own needs." [7]

Thus, smart cities are cities that merge the physical (built) environment with the natural environment, to further the connection with the social and economic environments of the city, through transformative technologies such as IoT (Internet of Things), applied to all aspects of city life, with the aim of creating a more economically and environmentally sustainable fabric for

urban human habitation and development.

So, what does a smart city actually look like, and what does it mean for residents?

3. *Examples – Santander + Oslo*

Currently, intelligent cities are the most common version of smart cities found worldwide. Santander, for example, has 12,000 sensors already installed that provide a range of data, fed to a central control hub, that can change variables within the city, to allow for an increase in the quality of living in the city centre. [8]

Figure 1 – A Map showing IoT Infrastructure around Santander – (Credit: Smart Santander)

Sensors embedded in the tarmac of parking lots across the city detect available parking spaces, and thus, through IoT technology, this data is transmitted to large panels located by the city's main intersections, and thus can direct motorists to the nearest available parking space. On average, 30% of driving time is spent looking for a place to park, and hence as cars produce 4.6 metric tons of CO_2 per year, if this 30% was reduced through these parking sensors, then emissions

could be cut down to almost 3.3 metric tons of CO_2 per year. [9] [10] [11]

Furthermore, sensors are also placed in rubbish bins across the city that can notify waste disposal services when these bins are full, and hence can help to decrease littering, and prevent the piling up of rubbish on the streets. [10]

Sensors placed in streetlights also feed pedestrian and traffic volume data back to the central hub, which can then dim or brighten the streetlights depending on the need. This use of sensors to create a smart streetlight system was first pioneered in Oslo in 2004, and the systems were found to have the effect of reducing energy used by streetlights by 70%, the equivalent of 1440 tons of CO_2 emissions per year for 10,000 streetlights, or 144kg of CO_2 per year per lamp, if all the energy for the streetlights was generated through fossil fuel means.

Figure 2: LED Streetlights in Oslo – (Credit: Cisco)

As it costs between $0.05/kWh to over $0.15/kWh to generate electricity from oil, and the energy savings are

estimated at around 5 gigawatt hours per year (which is equal to 5,000,000 kWh per year), the cost saved for generating electricity ranges between $250,000 to $750,000 every year, for an implementation cost of $16 million in Oslo. This means that, aside from the obvious ecological advantages, the scheme repays in terms of cost saved in 32 years, with each individual streetlight saving city authorities between $25 and $75 every year. [10] [12] [13]

With calls from the UN to reduce "Vampiric overconsumption" of water worldwide, overconsumption of water is another area that smart cities can help to tackle. Santander has implemented 50 different sensors in several parks across the city to help monitor moisture in the soil, along with humidity and temperature of the air, and by sending this data to the central hub in Santander, algorithms can take this data and switch sprinklers in these parks on or off depending on the need, and thus water costs can be cut by 50% [14] [9] [10]

These design choices adopted by Santander and Oslo embody the technological IoT aspects of intelligent cities, but also account for sustainability, as these technologies such as the smart streetlamps ensure that the needs of the present – lighting the streets – are met without compromising the ability of future generations to meet their own needs – in this case, the reduction in CO2 emissions allows for future generations to still have a prosperous and habitable planet in the future – thus merging the built and natural

environment, with an environmentally sustainable method, ergo achieving the criteria of a smart city.

So, are smart cities effective as a sustainable solution to the future of urban development?

Certainly, the spread of the idea of a smart city worldwide appears to back this view in that if these ideals are being adopted worldwide, it must be for a valid reason. However, many cities have tried to adopt these smart city policies and even with large funding behind them have failed to achieve both the sustainable aspects of a smart city, and the merging of the physical and built environment.

3.1 Example – Toronto

In 2017, a subsidiary planning company of Google – called Sidewalk Labs – announced an initiative known as Sidewalk Toronto, which would construct an entirely new smart city from scratch – as opposed to the previously mentioned examples where the pre-existing built environment was retrofitted with IoT technology. [15]

This $1.3 billion investment by Sidewalk labs "aimed to advance a new model of inclusive urban development along Toronto's eastern waterfront, striving for the highest levels of sustainability, economic opportunity, housing affordability, and new mobility." [16]

Figure 3: The City of the Future? Plans for the controversial Sidewalk Toronto – (Credit: Sidewalk Labs)

One of the key headlines of this project was the installation of sensors across the project to help improve the waste, transport and other associated systems that came with the 12-acre development. And herein lies one of the primary criticisms of smart cities – privacy of an individual.

These highly advanced smart cities require thousands of sensors – Santander has 12,000 alone – that collect data- not just about the environment (both built and natural) but also about people and their movements and habits - to help reduce energy or water consumption, for example, to help the cities run efficiently and thus deliver on their goals of sustainability. [8] [17]

The data collected by a large majority of these sensors is usually encrypted, or in the case of Toronto's Sidewalk development, anonymised before being available for public access. However, there were major concerns that this data will not actually be private or anonymised, and instead sold on to third party bidders. Sidewalk Labs themselves said that it "will not sell personal information, not use personal information for advertising and not disclose personal information to third parties without explicit consent." [15]

Despite this, the project was criticised by Roger McNamee – a founder of a leading global technology investment firm Silver Lake Partners – who called the project "Surveillance capitalism", and stating that "It is a dystopian vision that has no place in a democratic society." This followed the resignation of two members of the advisory panel to Sidewalk, one of whom, Ann Cavoukian – the former privacy commissioner for Ontario – called out the development, saying "I imagined us creating a Smart City of Privacy, as opposed to a Smart City of Surveillance." [18] [19]

Eventually, the project ended in May 2020, with Sidewalk Labs citing the "unprecedented economic uncertainty brought on by the Covid-19 pandemic". [15]

4. Failings of Smart Cities

2020 seemed to be the year that tech giants worldwide realised that smart cities are not necessarily the solution to all our current urban developmental problems. Cisco, who had attempted to digitise cities worldwide, by offering specialist software services for local authorities, abandoned this idea in 2020, again citing the pressure caused by the pandemic on the company's bottom line. [21]

While IoT technologies such as sensors, apps for residents and specialist operating systems certainly could help to create a more

sustainable and efficient framework for urban areas – as demonstrated by Oslo – questions will always inevitably be raised about how to go about creating this urban utopia in a democratic and fair way. [17]

With recent cybersecurity breaches of institutions in the UK such as British Airways and the BBC, where employee data including bank details may have been stolen, it is entirely understandable that potential smart city residents, ordinary people who lack access to as advanced cybersecurity as these companies, are worried about their personal data being stolen, and will be reluctant to allow IT giants like Cisco to collect data on their movements and behaviours. [20]

With all this in mind can we ever feel safe and secure enough to give away control of the places we live to the closed, empty-minded logical management of algorithms and computers?

And what of advanced AI? How long will it be until one of these tech giants decides that one of their new smart city developments should be run by an advanced AI that can control and monitor incoming data and adjust parameters in a sensible manner to help increase the efficiency of the city? Italy recently outlawed ChatGPT on data protection grounds, suggesting that if AI were to merge with smart city development, a potentially dystopian 1984-esque surveillance society may not be too far off. [22]

5. Concluding Statements

In conclusion, although these smart cities may be an effective solution to solving many of the issues at the forefront of the global spectrum, there is still a long way to go until these policies may be seriously considered to be viable.

Many cities, seeing the buzz generated around the theoretical idea of a smart city have tried to implement their own take. Often, due to the conflicting and confusing definitions of what a smart city is, many authorities simply invest in thousands of sensors, and cease there – this in fact is what Santander, mentioned earlier, has done. Further investments into training people to maintain the sensors, or constructing a viable roadmap for the next 20 years is needed. [23]

The word smart has been used far too loosely, and as a result, cities are suffering in the long term due to the buzz around this miracle solution. What is even more worrying than the privacy and AI concerns behind the methods in which smart cities deliver on their goals of bettering and optimising urban development and habitation, is that some cities may fall behind on investing in what Mike Anderson calls "sensible cities".

By measuring the smartness of a city based solely on sensors and IOT technology – due to the conflicting definitions – incentives are provided for cities to invest in these technologies as opposed to essential aspects of a city that are crucial in providing for the needs of the present

and future too – education, healthcare, public spaces and housing – all of which fall under the umbrella of the sustainable aspect of my definition of smart cities. [17]

The core idea of smart cities remains as a solid foundation for urban development for the cities of the future – sustainable for residents and the environment - the definition needs to be clarified, and the way that IoT technology is applied needs reassessment before this idea can be fully explored on a global scale.

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