

Smart Cities: Implications for traffic control, disaster resilience, data and privacy

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Abstract

This paper aimed to review the available literature on smart cities. Relevant literature relating to urban planning and development to assess the evolution of the concept of smart cities. The example of Barcelona is also taken up and discussed to illustrate the process of planning, collaboration and execution for a model and innovative smart city. Using a set of literature search criteria, many scholarly works were screened and then a smaller number were explored in detail. It was found that with growing urbanisation, limited resources and climate change, there is a need to manage and allocate resources efficiently. This must be done in tandem with improving the lives of city dwellers. Therein lies the value and need for collaboration with multiple stakeholders in an urban space. Despite the importance of developing smart cities for sustainable development, the reliance on technology has made some scholars sceptical. This is due to data and privacy concerns and has led scholars to demand greater transparency and citizen participation at all levels of the smart city planning process.

Keywords: Smart cities, urbanisation, ICT, sustainable development, urban planning, urban science

Introduction

Cities have been the centre of growth and development across the world. This has been true in the case of ancient cities such as Rome as well as today as in the case of New York, London and Singapore, which are all seen as global hubs, synonymous with rapid economic development (Hall (1998); Anttiroiko (2015); and Clark (2016)). Therefore, cities have been centres for employment, better living standards, greater opportunities as well as economic growth. This has meant that over time, the population in cities has steadily risen due to migration, while resources have remained finite. In 2008, it was estimated that half of the total world population lived in cities (Veselitskaya, Karasev & Beloshitskiy, 2019). Hayat's (2016) research found that while cities account for '80 per cent of the global gross domestic product (GDP), they consume around 75 per cent of (the) global primary energy and are responsible for about 70 per cent of the greenhouse gas (GHG) emissions' (Hayat, 2016). In addition to this, the global urban population is only expected to increase and, with it, its capacity to generate pollution and waste (Hayat, 2016). Therefore, the rapid increase in population coupled with the rise in resource use has meant that urban development and planning needed to adapt and respond to calls for sustainable and efficient use of resources in cities. This is not just to manage resources efficiently but also to provide a certain standard of living for the residents in these cities. In recent years, for example, air pollution has been a growing concern in big cities such as London and New Delhi. This has led to a demand for innovative solutions such as promoting the use of electric vehicles to lower the levels of pollution in addition to transitioning to using cleaner fuels for public transportation vehicles. Hence, calls for sustainable development and curbing waste and pollution have demanded urgent attention in these urban centres. It is in this context that the concept of smart cities has evolved and has gained prominence over the years internationally.

While there is no fixed definition of what a smart city is, the defining characteristics of smart cities are that they seek to optimise information and communication technology or ICT in order to improve how cities are governed and how they function. Gutschow (2019) provides a useful definition and describes smart cities as ‘harness(ing) digital technologies to improve infrastructure services, making them more coherent and reactive to citizens’ behaviour, decrease resource use, boost environmental standards, and reduce carbon emissions’ (Gutschow, 2019). This encompasses the multiple facets that come together to address the challenges that cities and urban governance are faced with.

The subsequent section describes the search criteria used. Then the findings of the review and what the various studies reveal about smart cities are described. This is followed by a conclusion that summarises the arguments and discusses the scope for future interventions and research.

Methodology

In order to find relevant literature studies, specific search terms were used in Google Scholar. These were the following- Smart cities, Urban governance, Sustainable cities, and Sustainable urban development.

For each individual search term, 100 results were considered, for a total of 400 results. For these, an initial examination was conducted, using only the most recent research studies that had analysed trends in smart cities, their need as well as the evolution of the concept. This was so that most debates may be studied for comparison and analysis. There was also an attempt to find research papers that would provide case study examples so as to fully understand the concept not just theoretically but also in its practical application. Lastly, the concept was assessed critically so as to not focus only on its positives but also on the concerns expressed by scholars in this field.

Results

Smart cities are a concept that refers to and encompasses the multiple facets of sustainable urban development (Cocchia (2014); Neirotti, De Marco, Cagliano, Mangano, & Scorrano (2014)). In order to do this, it employs ICT for efficient resource management and uses as well as to improve the quality of life of its residents (Veselitskaya, Karasev & Beloshitskiy, 2019). Veselitskaya, Karasev and Beloshitskiy (2019) trace the evolution of this concept and state that the term ‘smart cities’ was preceded by sustainable cities, digital cities and later eco-cities. All these concepts, it is contended, had the aim of improving the quality of life for citizens but in a manner that was in line with the principles of sustainability and development. Therefore, the main components that comprise the ‘integrative structure of (a) smart city are city management, municipal government administration, communications, infrastructure and environment’ (Veselitskaya, Karasev & Beloshitskiy, 2019:86). ICT plays a crucial role in the development of smart cities due to its inter-linkages with developing and enhancing infrastructure capacities. Examples of this may be found in smart traffic and transportation systems with automatic traffic lights as well as online traffic monitoring; smart waste management systems with automated waste collection and e-waste management; smart security system with electronic surveillance via CCTVs and e-governance, which through the use of ICTs, has strived to make government services more accessible to people. In fact, e-governance has proven to be successful in many cities across the world, such as Barcelona and San-Fransisco (Hayat, 2016). In addition to this, Hayat (2016) also suggests that smart cities provide an opportunity for disaster-proof buildings.

Such disaster proofing may be for residential or commercial buildings, wherein they can ensure that disaster resilience is incorporated and that standards are 'audited and certified by the relevant authorities' (Hayat, 2016). Such standards can also be applied to fire protection planning, among its other uses.

The significance of establishing smart cities has been recognised internationally at the global level. Such recognition stems from an understanding that cities face increasing threats from factors such as migration, poor resource use, climate change and an increase in the levels of greenhouse gases. Building sustainable cities have even been adopted by the United Nations (UN) as well, as one of the Sustainable Development Goals, SDG 11, which seeks to make cities inclusive, safe, resilient and sustainable. Therefore, against this backdrop, it is imperative to build smart cities. This is a process that 'requires a holistic approach, combining ecological, economic and social dimensions into a sustainability triangle' (Bach & Loibl, 2016). Bach and Loibl (2016) also recommend that the change towards smart cities should be managed like change management in a company. One step in this direction has been taken by the European Commission's Covenant of Mayors, set up in 2008. The Covenant sought to be together 'local and regional authorities committed to implementing (the) European Union climate and energy objectives and was updated in line with the new (SDG) 2030 targets' (Bach & Loibl, 2016). The authors also make a case for integrated urban planning and management in order to achieve the ambitious aims that have been set out for smart cities (Bach & Loibl, 2016).

While the review paper so far has discussed the need for smart cities, their characteristics as well as the global context for such cities, it may be useful to also use an example in order to understand how these theoretical aspects are put to practice. The example taken here is that of Barcelona, the capital of Catalonia. Veselitskaya, Karasev and Beloshitskiy (2019) state that the city has proven to be a leader with its innovative urban planning policy. This was achieved, they argue, by combining a vision for an efficient city with the wishes of its local residents. The City Council of Barcelona, in 2013, aimed 'to become the first high-tech city in Spain' by 'focusing on creating public facilities in remote neighbourhoods, ensuring a decent level of service in each district, restraining the growth of the city by focusing on redevelopment rather than on (new) construction' and by restoring open spaces (Veselitskaya, Karasev & Beloshitskiy, 2019). After the planning stage, the next was the engagement of stakeholders. This involved, among others, technical leaders, business leaders, entrepreneurs, public sector organisations, the Mayor and City Council and the citizens. After studying Barcelona's innovative planning and execution, Veselitskaya, Karasev and Beloshitskiy (2019) suggest that three conceptual approaches resulted in the success of this smart city - 'cooperation with companies to create the necessary digital infrastructure of a smart city, transformation and cooperation at the local and international levels, (and) functioning of the city as a network of networks - connection of different city networks' such as for energy, transport, etc. (Veselitskaya, Karasev & Beloshitskiy, 2019). Therefore, from this example, it is evident that careful and innovative planning, forward-thinking, collaboration and cooperation are a must in the development of successful smart cities and urban development. The example also highlights the need for adaptive and robust policymaking, which is in keeping with the SDGs, the local demands as well as the changing nature of threats faced by urban spaces.

An interesting aspect of the example of Barcelona, as well as of the other examples studied by Veselitskaya, Karasev and Beloshitskiy (2019), is that they all seek to implement innovative solutions to urban problems through private-public-partnerships or PPP. This has allowed

technology companies to partner with local administrations in providing them with assistance in improving their infrastructure and in addressing their technological needs.

Discussion and Conclusion

The review paper thus far has sought to highlight the need for smart cities as well as their characteristics. This was highlighted with the help of using Barcelona as an example. However, now, it would be useful to critically assess the concept by examining some of the vulnerabilities that have been exposed and the critiques that have been levied against the concept. Hayat (2016) argues that since there is a reliance on ICTs, data sensors and automation technologies in smart cities, 'any disruption or disaster may disintegrate (a) whole string of services and jeopardise (the) smart city ecosystem' (Hayat, 2016). Hayat is not the only scholar to express apprehensions about such a high level of reliance on technology in smart cities. Shelton, Zook and Wiig (2014) are critical of the role big technology companies have played in facilitating smart cities and warn of the large-scale data that is being collected by governments and these corporations. They explain that 'data has historically been mobilised as a kind of depoliticising device, obscuring how data are conceived, collected and legitimised for use in urban politics and policymaking' (Shelton, Zook and Wiig, 2014). Kitchin (2016) employs the lens of ethics to investigate smart cities and raises concerns about privacy and the collection of confidential data in this drive towards digitising services and surveilling urban spaces. These, Kitchin (2016) argues, are extremely urgent issues which must be examined, especially when taking into account that for such surveillance, there is no notice and consent by citizens, thereby reducing these 'cornerstones of data and privacy protection' to empty exercises which may as well be absent (Kitchin, 2016). Lastly, Kitchin (2016) warns that with the intrusion of technology in smart cities, there is a risk of 'predictive policing, where predictive analytics are used to assess likely future behaviour or events and to direct appropriate action' (Kitchin, 2016). Such predictive mechanisms themselves also have both pros and cons, which are outside the scope of this paper. However, it does highlight that there is a need to reconsider the ethics of using one's personal data in relation to smart city technologies.

In order to address concerns of transparency of data usage and privacy, Degbelo et al. (2016) recommend empowering citizens by encouraging deep participation wherein public participation is facilitated at each stage of the decision-making process. This increased level of participation must go hand in hand with increased data literacy among citizens. Improving awareness will, according to the authors, lead to a better-informed citizenry that will be equipped to make better decisions regarding how their data are used and managed (Degbelo et al., 2016). Bach and Loibl (2016) state that one such way of increasing citizen participation is by employing novel technologies such as smartphones, virtual reality devices, websites and social media platforms. This is not just to improve citizens' awareness but also to seek feedback from the residents who will be the beneficiaries of an improved city. Hence, these novel approaches may be used, argue Bach and Loibl (2016), to evaluate which intervention is most suitable for which purpose.

The review has made an attempt to understand the existing literature on smart cities. From the search conducted, it is evident that although the concept is not new, it is timely. In light of rising urbanisation and migration to cities, as well as climate change, urban resources are stressed, and the need for efficient resource management is urgent. In addition to this, since cities concentrate such a large portion of the world's population, not only is it vital to manage and allocate resources efficiently but also to ensure that a decent standard of living is maintained. This means

that concerns about air pollution, wastewater management, etc., must be made a part of urban planning and development. Such robust planning and its execution rely heavily on data and ICTs. The review has highlighted that while there are several advantages to this, such as traffic control, disaster resilience and e-governance, there are also threats to privacy and ethical concerns in how the data gathered is utilised. Additionally, an over-reliance on ICTs could mean that any disruption could be disastrous. The need, therefore, is for further research to study the advantages and disadvantages of smart cities in-depth in order to fully weigh them and understand whether the need for innovative and sustainable solutions outweighs the infringement of citizens' privacy while also paying heed to the ethical concerns.

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