Smart governance of urban data

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Abstract. This paper focuses on the smart governance of urban data. Recently, the idea of an intelligent city has gained increased attention among technologists, urban scientists, stakeholders, companies and policy makers in the last decades. The new paradigm of the cities in the 21st century and what it entails is seen by everyone, including the authors of this article, as a viable response to the unprecedented rate of urbanization most nations are experiencing. Advanced smart cities are beginning to go beyond infrastructure and to use big data. The whole idea behind smart cities is to harness intelligent technologies and data-driven contextual governance models to mitigate and prevent the challenges that arise when an estimated 2 billion people move to urban areas. This is why collecting and analysing urban data becomes a key priority in this field. The development of Big Data analysis using the Artificial Intelligence (AI) becomes the domain of urban governments and stakeholders. This research contemplates over these issues and provides many examples from around smart cities around the world that can be used as reference points or inspiration for the policy-makers engaged in the smart city governance and urban planning.

Keywords: data management, urban network, artificial intelligence, urbanization.

1 Introduction

Smart governance, by contrast, has a wider reach in an urban context, because it is not limited to typical planning problems, but instead, to organizational and management problems [1, 2]. For intelligent governance developments it means that something else must be involved. Meijer and Bolivar [3] note that smart governance in practice includes technological support for organizational and internal bureaucratic processes as well as organizational-external processes (for example, the participation, cooperation and management of cities). Although some studies have identified interactive governance as an essential component of smart cities, they have failed to examine it in more detail [4, 5]. This lack of knowledge led to the current attempt to contribute to the smart city discussion by examining how smart governance interacts with different fields of study. A systematic analysis of literature offers an opportunity to map what is known about smart governance and its effects and to offer a

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realistic perspective on the value of such an approach for cities [6]. This demonstrates the applicability of smart urban governance framework to a wide range of smart city cases [7].

We need a deeper understanding of the forces acting as barriers, encouraging local governments and citizens to engage and support cooperation in order to accelerate sustainability and urban transformation. The rapid development of smart city technologies has the potential to harness the power of big data urban cities, sensor networks and urban data analysis to govern cities [8, 9]. Technology innovation is driving the implementation of smart governance as a result. However, we need more empirical data about the relationship between smart governance and sustainable development.

For example, Taipei established the Taipei Smart City Project Management Office (PMO) also known as the Taipei Smart City to implement governance and develop smart cities. In 2016 the city started the Smart Taipei project. The main idea was to change the culture of the city hall so that the government could adopt new ideas and concepts, or so-called mechanisms [10]. In 2015, the Manchester CityVerve project was selected as winner of a government-led technology competition and awarded for developing a smart city demonstrator for the Internet of Things (IoT). Launched in July 2016 by a consortium of 22 public and private organisations, including Manchester City Council, the project was implemented to meet the city's continuing decentralisation commitments. Build an innovation platform that combines resources from industry and government to develop smart solutions that meet public demand [11].

Examining the adoption of data-driven policies frameworks and platforms by city governments various countries represents a very insightful field. Researchers use open data platforms, open-source methods and competitive competition to encourage citizens to develop innovative solutions to urban problems [12]. Other smaller initiatives have private companies taking over the generated data. Real-time IoT datasets are increasingly integrated into open data platforms. While 65% of the open data platforms we study have updated sensors regularly, only a few have working IoT datasets for public areas of high consumer interest such as public transport, transport and the environment [13]. Cities provide developers with support by providing application programming interfaces (APIs) that allow citizens to access live data so they can develop solutions in addition to government data.

2 Smart cities policies digital infrastructure

Facilitating the knowledge generated by smart urban systems users can be part of data processing and improve the platform for collaborative networking. Integrating digital tools into city daily work promotes a transparent, data-driven culture of innovation and continuous improvement [14]. Focus on customer service by integrating user-centred design principles and service technology platforms into city governance. Using sensor technology in urban streets and infrastructures can help to explore mobility apps on demand to reduce greenhouse gas emissions [15]. Reinventing cities as laboratories and platforms for effective, transformative technologies that shape our lives and work in the future is also a good initiative. Creating a race between leading urban authorities and local businesses to improve energy and water efficiency by using data to measure progress, perform analyses and identify best practices is also a must. A smart city uses data and technology to improve efficiency, sustainability, economic development and the quality of life of people living in and working in cities [16]. According to the definition of a smart city by Caragliu et al. [17], cities are smart investments in human capital, social capital and urban infrastructure that foster sustainable growth, improve the quality of life and facilitate participatory governance. Smart cities are urban areas where different electronic methods and sensors are used to collect data. An alternative use of smart city technology was found in Santa Cruz, California, where local authorities analysed historical crime data to predict police needs and maximize police

presence when necessary [18]. Technological elements are seen as paving the way for the transformation of urban conglomerates capable of providing efficient services, sustainable mobility and energy programmes, the availability of health resources, social cohesion and new economic models in the face of these challenges. This means that Asia and Pacific smart cities can and will adopt widespread cloud technologies and high-speed connectivity, adopt digital trust and privacy policies, adopt new security and data protection standards, build efficient knowledge management practices, address bureaucratic issues in the public sector, adopt agile procurement models, streamline cumbersome processes and continue efforts to develop human skills [19, 20]. Most cities, counties and states are taking the first steps to move from strategic and technical awareness of the possibilities of smart urban technologies to testing and implementing solutions. These cities will expand and later test smaller applications in various areas to integrate new innovations such as AI, IoT, remote services and network management in new cities [21].

High-speed connectivity is an American imperative, and digital infrastructure is essential for smart cities. Despite the efforts of the federal government to rely on these guidelines, led by the Federal Communications Commission, the persistent poor state of broadband connectivity in the United States today speaks for the limits of lightweight policy. It is a pledge of the Biden Administration to provide free broadband for every American citizen [22]. COVID-19 has exacerbated the problems facing cities and put them under greater pressure to drive innovation, enable digital inclusion and support the fight against climate change [23]. Whether it is socioeconomic inequality, making cities more local, transforming cities with a view to future generations or ensuring gender equality and diversity when it comes to developing and implementing smart urban technologies. While COVID-19 exacerbated these problems and helped cities cope with the second major economic crisis of the last 15 years, the pandemic has also forced authorities to change quickly and effectively. In June 2020 the City of Toronto released an 85-page advisory report on data governance and digital infrastructure produced by a Montreal-based non-profit research organization called Open North. As a detailed and broad-ranging assessment, it provides a 360-degree overview of the unresolved political, legal and technological issues facing the city as it tackles the kind of change that city like Barcelona are pursuing [24]. The Netherlands has a more pragmatic and optimistic outlook on smart cities, with Dutch researcher Albert Meijer pinning smart city technology research on data, data infrastructure, digital governance another related topic with mixed results. Dutch academic Albert Meijer, who has written extensively on smart city technology, data infrastructure, digital governance and other related topics, has developed a systematic methodology for assessing the success of such investments. He concludes that there is not much evidence that smart city technologies deliver value for money - a fascinating result given the size of the smart city technology sector. Small, concentrated systems that deliver results are ambitious in one way or another but not the other way around [25]. In addition, many researchers found that the public sector was the natural owner of 70 percent of the technology applications they studied, while 60 percent of initial investment needed to implement the full range of applications came from private actors [26].

3 Cities as engines of data economy

Cities represent the engines of data economy. Recent released estimates by the United States Census Bureau show that the nation's largest cities have experienced uneven growth over the past decade. Between 2010 and 2018 the 41 cities in our study showed an average growth of population of 23.2%, compared to 6.8% for the United States average metropolitan area [27].

Today, 55% of the world's population (4.2 billion inhabitants) lives in cities. By 2050 the urban population will double and 7 out of 10 people will live in a city in the world. By contrast, Africa will remain predominantly rural, with only 43% of its population living in

urban areas [28]. Urbanization contributes to sustainable growth by driving productivity gains and generating innovation and new ideas with cities generating more than 80% of the global GDP. Today, nearly half of the world lives in urban areas and urbanization is shaping the course of global growth in an unprecedented way. One of the strongest economic trends of today is the rise of urbanized suburbs as the beacon of opportunity. Many suburbs and neighbourhoods are becoming engines of economic mobility helping more people to realize their urban success dream. It is important that cities today are different and can take responsibility for the future. Much of modern life would not exist without cars, plastics and drugs – all made possible by oil refineries. The flow of data creates new infrastructure, new companies, new monopolies, new politics and a new economy. Thanks to technologies such as Internet of Things, online platforms and data analysis, the list of things that count as digital goods and services is part of the digital economy and is growing at a rapid pace [29]. The distillation of data centres drives all sorts of online services, as devices become increasingly connected in the real world. The ten cities with the highest gross domestic product per capita (GDP) in 2035 are widely known. This advantage has grown as the coronavirus pandemic has enhanced the experience of remote work and exodus to densely populated cities including the rise of the COVID-19.

It is clear that, for example, United States is a suburban nation and it needs more suburban cities for jobs, urban facilities, and a growing population of diverse communities to welcome everyone. But consider cities like London, which understand that a circular environment brings many environmental, social and economic benefits. With one-third of city dwellers struggling to find adequate housing, such an approach could provide vital housing for the millions of people waiting for permanent housing. Cities around the globe are put to the test during the COVID-19 pandemic. The pandemic was a huge challenge and cities are at the forefront, rich and poor alike. Hence, the support for researchers, start-ups and industry experts who are willing to rethink the social contract around data should be provided. The proper support would enable them to conduct policy research on the data including exploring how data policy frameworks balance competing conflicts of interest between different stakeholders, identify areas where digital start-ups can challenge incumbents with novel and responsible business models and ensure the protection of individuals' privacy and personal data. They should also be helped to build a knowledge base on how best to perform data stewardship. The data from social networks and individuals can be used to draw conclusions about people who choose to keep their data private. Sometimes data can be extracted from specific groups such as the poor and people of colour who are subject to systematic persecution from governments and financial institutions [30]. At other times, certain groups are absent from data sets such as facial recognition systems that identify only people of colour when trained on data from white male faces and people who look like them.

4 Data-driven platforms for smart cities

Thence, combining complex multidimensional mobility index data with simple visual metrics provides authorities with evidence-based insights to adapt urban governance and policies to public movements [31]. For example, in order to address the COVID-19 crisis, valuable data resources should be developed which can be used by existing smart city systems, IoT sensors and machine learning to provide timely insights into real-time policy decisions [32]. Automated collection and curation of smart city data where mechanisms already exist to access and download data via Application Programming Interfaces (API) can improve user-friendliness, but further data integration, analysis and visualisation require a specific lens on COVID-19 Impact. Big data is a huge amount of data that companies can analyse to make appropriate strategic actions and business decisions. Big data analysis can be used to study large amounts of data, uncover patterns and insights and extract valuable information [33].

Smart city managers can use big data analysis to monitor urban phenomena in new ways by incorporating sensors into urban infrastructure and creating new sources of data, including citizens and their mobile devices. The concept of data-driven smart cities uses data analysis technologies to transform how citizens live and work. Smart cities for big data value innovation and create new work environments. Smart cities have sensors and connected devices that collect and analyse data from various Smart city gateways across the city for better decision making [34].

The Big Data revolution will explode in smart cities, the most sustainable cities in the world. Cities across India are at the forefront of the fight against COVID-19 with more than 460 million city dwellers [35]. As cities adopt all kinds of ICT forms, including infrastructure platforms, systems, devices, sensors, actuators and networks, the volume of data generated by cities increases and diversifies, providing a rich and heterogeneous flow of information about the urban environment and citizens.

Analysis, modelling, knowledge extraction and such data are key factors for understanding urban environments, improving efficiency of urban mobility, air quality, thermal management, smart buildings, grids and other forms of sustainable development. This flood of data enables the analysis of different urban systems and interconnected data from different urban areas at real-time, provides a detailed overview of the relationships between different forms of data and can be used to drive different aspects of the urban environment through new modes of operation, planning, design, development and governance in the context of sustainability, and provides raw materials for the vision of sustainable, efficient, resilient and liveable cities [36].

Smart cities and big data analytics can help utilities increase operational efficiency. In this context, data-driven sustainable smart cities developed using a kind of integrated real-time urban data analysis and analysis centres, dashboards and applications offer a powerful tool for not only designing, living and managing cities in meaningful ways, but also for planning them in terms of relevance and sustainability. This includes designing future scenarios of how cities will develop on the basis of data-driven technological solutions. Cities will not become wiser until the right people are empowered to make good decisions. Authorities and citizens are starting to think rationally about using resources rather than exhausting them. Large networks of old systems combined with new IoT-based sensor systems make it difficult for smart cities to manage various data sources and convert data into useful, actionable information. Providing a common and actionable context for data from these different sources creates many opportunities to improve performance, improve safety, reduce life cycle costs and improve citizen "quality of life".

By sharing multiple interconnected data sources on a single platform, information can be retrieved and used for citizens' benefit. Making this information available to groups planning to improve urban services is exactly what they need to start. When this data is accessible to citizens, private companies and government agencies, it can be used to visualize urban services, model accurate projections, fill information gaps and highlight services that need improvement. The Urban Data Platform (UDP) is an important part of any smart city ecosystem that collects data from government sources, private companies, non-governmental organizations and the public and helps deliver data-driven solutions that benefit everyone. It maps, combines and stores data from a variety of sources and processes it to find practical solutions to citywide problems. It serves as a supporting pillar for many smart city applications [37]. Cloud platforms and analytics applications provide a cost-effective means of implementing transport data solutions and create insights that enable more efficient and safer traffic on existing roads. They bring together the entire smart city ecosystem on a single platform – including end-user service providers such as power and water companies, governments, sensor and network providers, data providers and developers [38]. The catalyst is a fast-fire member-driven proof-of-concept project that connects ecosystem actors to find

innovative solutions to common industry challenges. There are various indicators of cities' readiness to implement data-driven cities and the concept of smart urbanism. These indicators are linked to the technical and institutional aspects of urban competence [39]. The rapid deployment of smart grids enables the analysis of real-time data on electricity generation and consumption [40]. Information context is an urgent requirement for smart and connected cities of today. It means providing the right people with the right information at the right time, which can be understood in actionable terms. Analyses of the habits of citizens and industrial objects in energy use can help predict the need for future electricity supplies. With big data, smart cities can develop protection strategies and contingency plans to make our future not only smarter, but also more durable and secure.

5 Conclusions

All in all, cities of today are becoming smart cities and they are constantly fed with the urban Big Data that needs to be promptly processed and analysed. The Connected Citizen program of the Waze navigation app, which operates in many cities including New York, provides real-time traffic data such as user input on accidents and potholes and exchanges data on road closures and construction projects. Toronto has partnered with Alphabet subsidiary Sidewalk Labs for the Smart City pilot project in the Quayside neighbourhood, which will enable the company to collect and analyse sensor data. This partnership triggered a considerable public debate on the exchange and management of data, and may have contributed to the programmes being phased out later this year. Other smaller initiatives, have private sector partners stealing the generated data. Thence, the main aim of e-government is to optimise services in urban areas, which goes hand in hand with measures to improve quality of life. In turn, governance plays a key role in placing this in the context of smart cities initiatives. As we move from connected infrastructure to smart things, tomorrow's smart cities engage governments and citizens, visitors and businesses in a smart and connected ecosystem.

Governments worldwide will evolve as solution providers and businesses become more participatory, and a growing body of citizens will co-create the smart cities of the future that are connected, connected and cooperative. There will be many experiments through partnerships and ecosystems as cities become smarter in the coming years. Smart cities will remain and governments will play a crucial role in this process.

The United Nations Economic Commission for Europe (UNECE) has launched a global initiative called the United Smart Cities (USC) that is integrated into the UN Sustainable Cities Implementation Program of Smart and Sustainable Cities. USC helps cities develop smart and sustainable urban solutions by working with international organizations, businesses, governments and high-level policymakers. Through USC it has helped cities around the world become smart cities. Such traits as the democratic culture, active civil society and bottom-up decision-making have enabled many cities to overcome their sustainability challenges through a broad cooperation between government, business, citizens, and research institutions.

Moreover, governments are able to create a platform for political intelligence by acting as a facilitator of the collective decision-making process, where stakeholders can contribute to policy orientation and improve governance and policymaking processes. In the area of governance, smart cities require different actors, including citizens, to participate in planning and decision-making processes, to share control over the development of initiatives, to address problems, to set priorities and to establish commitment and ownership of the final planning results. Additionally, an effective role of governments in smart cities governance is crucial as they can play the role of coordinators, donors and regulators to bring together different interests and stakeholders, provide funding for infrastructure and demonstration projects and ensure that common standards and regulations are in place. The dynamic

interplay of actors, interests and power roles can fluctuate and influence the outcome and sustainability of smart cities initiatives. Building an innovation platform that combines resources from industry and government to develop smart solutions that meet public demand is the possibility. Moreover, there is enormous potential to use big data to address many of the problems in smart cities through analytics for deeper insights and better decisions making practices. Cloud provides additional opportunities to implement and deploy ICT solutions in smart cities and to support collaboration between different smart cities applications. According to the consensus of industry analysts, the global smart cities market is worth enormously. Several actors, including technology giants, telecommunications companies and government, are working on initiatives to make cities more efficient. The massive advances in ICT, cloud computing, information technology and big data gives cities more opportunities to be as smart as possible in a short amount of time. From various complementary perspectives, Smart Cities include efficient, progressive, sustainable and inclusive cities. Dimensions of collaborative governance should be proposed to facilitate the participation and engagement of government and to analyse smart city data-driven initiatives.

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