Smart Cities - Policy and Regulatory Frameworks

Mahmoud El Khafif(✉) and Nora Salem(✉)

The German University in Cairo, Cairo, Egypt
{mahmoud.elkhafif, Nora.salem}@guc.edu.eg

Abstract. The paper aims at highlighting the policies and regulatory frameworks of smart cities. For that purpose, the paper will first outline the international framework, including Goal 11 of the United Nations Sustainable Development Goals (SDGs), which aims at making cities inclusive, safe, resilient and sustainable. The latter necessitates the development of smart cities, since highly sophisticated ICT-based applications and services will not only contribute to greater energy efficiency but also improve the safety and well-being of inhabitants through for instance automated streetlights and better transportation solutions. Considering that more than 55% of the world's population lives in urban areas, the switch to digital technologies allowing for smarter and more inclusive cities, where waste, resource consumption and environmental impacts are significantly reduced, is imperative to reach the SDGs. The paper will then investigate the existence of an internationally recognized definition for smart cities and different international assessment mechanisms. Hereinafter, the paper will look at the implementation of various initiatives at the national level of different countries, among them Egypt. The paper will close with addressing the critical question of dealing with highly sensitive data in an ethically responsible manner in the scope of smart cities. Against that background, the European Union's legal framework for data protection in the virtual space will be assessed against a global citizen-driven initiative on promoting digital rights in smart cities.

Keywords: Smart cities · Regulatory · Assessment · International framework · National initiatives

1 Introduction

With a considerably growing number of smart city developments, a global policy and regulatory framework for smart cities that provides a definition for smart cities, identifies Key Performance Indicators as well as unified standards for compliance and comparison becomes increasingly vital. For that purpose, this paper aims at investigating existent frameworks at the international level (2), highlighting different national smart city initiatives at the regional level (3) and outlining data protection regulations and initiatives (4).

Against this background, the paper will first outline the broader umbrella of smart cities, namely Goal 11 of the United Nations Sustainable Development Goals (SDGs), which aims at making cities inclusive, safe, resilient and sustainable (Sect. 2.1). The

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latter necessitates the development of smart cities, since highly sophisticated ICT-based applications and services will not only contribute to greater energy efficiency but also improve the safety and well-being of inhabitants through for instance automated streetlights and better transportation solutions. Considering that more than 55% of the world's population lives in urban areas, the switch to digital technologies allowing for smarter and more inclusive cities, where waste, resource consumption and environmental impacts are significantly reduced, is imperative to reach the SDGs. The paper will then investigate the existence of an internationally recognized definition for smart cities (Sect. 2.2) and different international assessment mechanisms (Sect. 2.3).

Hereinafter, the paper will look at current national initiatives towards developing smart cities at the regional level, including South-East Asia –Singapore, Seoul, Shanghai– (Sect. 3.1); North America –New York, Boston, Montreal– (Sect. 3.2); the MENA Region –Dubai, Egypt– (Sect. 3.3); and Europe –London, Helsinki, Barcelona– (Sect. 3.4).

Section 4 addresses the critical question of dealing with highly sensitive data in an ethically responsible manner in the scope of smart cities. For that purpose the paper outlines on the one hand a regional intergovernmental legal framework for data protection in the virtual space and on the other hand a global citizen-driven initiative on promoting digital rights in smart cities.

2 International Framework

2.1 United Nations Sustainable Development Goals

In 2015, Heads of all 193 United Nations (U.N.) Member States adopted the Sustainable Development Agenda, which includes a total of 17 Sustainable Development Goals (SDGs) with numerous indicators to building a more sustainable, safer, more prosperous planet for all humanity by 2030. The goals cover a range of key areas including poverty; hunger; health; quality education; gender equality; clean water and sanitation; affordable and clean energy; decent work and economic growth; industry, innovation and infrastructure; reduced inequalities; sustainable cities and communities; responsible consumption and production; climate action; life below water; life on land; as well as peace, justice and strong institutions.

In order to achieve the ambitious agenda, the UN Development Programme (UNDP) provides support to countries, monitors the agenda's progress, collaborates with partners, fosters cooperation and facilitates funding [1].

Goal 11 aims at making cities inclusive, safe, resilient and sustainable. To this end, common urban challenges such as congestion, minimal funds for the provision of basic services and energy, a lack of adequate housing, declining infrastructure and transportation systems as well as rising pollution continue to exist. These challenges will further amplify considering that the 4.2 billion people (55% of the world's population) living in urban cities today are estimated to reach 6.5 billion people by 2050, while cities occupy merely 3% of the Earth's land. [2] 90% of the rapid urbanization will take place in the developing world.

The challenges can be addressed through the inclusion of highly sophisticated Information and Communication Technology (ICT) - based applications and services which can contribute to greater energy efficiency, resource consumption, improved safety - through for instance automated streetlights or better transportation solutions - and thus to increased well-being of inhabitants and economic opportunity. Developing smart cities is subsequently imperative to Goal 11, but moreover also to the remaining 16 SDGs given that all goals are interdependent, meaning achieving one goal contributes to the achievement all other SDGs.

2.2 Definition

While a definition of what constitutes a smart city would be of great value, the debate around an internationally commonly agreed definition is still subject to controversy. [3] This is due to multifactorial reasons, inter alia the resistance of national governments to agree and consequently submit themselves under one exclusive paradigm. However, the most commonly referred to definitions include:

A smart city is "when investments in human and social capital and traditional (transportation) and modern (ICT) infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory government." [4].

"A smart sustainable city is an innovative city that uses information and communication technologies (ICTs) and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social and environmental aspects." [5].

"A new concept and a new model, which applies the new generation of information technologies, such as the internet of things, cloud computing, big data and space/geographical information integration, to facilitate the planning, construction, management and smart services of cities. […] Developing Smart Cities can benefit synchronized development, industrialization, information, urbanization and agricultural modernization and sustainability of cities development. The main target for developing Smart Cities is to pursue: convenience of the public services; delicacy of city management; livability of living environment; smartness of infrastructures; and long-term effectiveness of network security." [6].

These definitions entail at its core common elements, including of usage of ICT, for the purpose of improving infrastructure to ensure economic, social and environmental sustainability.

2.3 Assessment Mechanisms

Against this background, multiple intergovernmental organizations, industry organizations and academic institutions have adopted different systems to measure a city's smartness. Those include but are by no means limited to the (1) International Organization for Standardization (ISO); (2) the "United 4 Sustainable Smart Cities Initiative" under the umbrella of the UN Economic Commission for Europe, International Telecommunication Union and 15 UN bodies; and (3) IMD's Smart City Index 2019.

2.3.1 International Organization for Standardization (ISO)

The ISO has developed international standards, principles and requirements for performance metrics related to smart community infrastructures in 2015 (ISO/TS 37151). The technical specifications outlined in ISO/TS 37151 assess the smartness of community infrastructure –such as energy, water, transportation, waste and ICTs– along the lines of using enhanced technological performance that is designed, operated, and maintained to contribute to sustainable development and resilience of the community. [7] The technical specifications aim to measure the performance of smart community infrastructures for the purpose of enabling community managers, infrastructure operators, development agencies and investors to plan cities as well as to evaluate and compare the performance consistently.

2.3.2 United 4 Sustainable Smart Cities Initiative

The UN Economic Commission for Europe, UN Habitat, International Telecommunication Union and other stakeholders created the "United 4 Sustainable Smart Cities Initiative", which developed a methodology for key performance indicators (KPIs) for smart sustainable cities in order to establish the criteria to evaluate ICT's contributions in making cities smarter and more sustainable, and to provide cities with the means for self-assessments. [8] This intricate assessment mechanism outlines 3 main dimensions with numerous sub-dimensions: (1) Economy with 42 sub-dimensions; (2) Environment with 17 sub-dimensions; (3) and Society and Culture with 29 sub-dimensions. [9] The sub-dimensions range from access to Wifi in public areas, water and electricity supply ICT monitoring, e-Government, public transportation and bicycle networks, pedestrian infrastructure, air pollution, solid waste treatment, renewable energy consumption, student ICT access, gender income equality, resilience plans, emergency service response time, to cultural infrastructure.

2.3.3 IMD Smart City Index 2019

The IMD's World Competitiveness Center in collaboration with Singapore University of Technology and Design issued its first edition of the IMD Smart City Index 2019. [10] It compares 102 cities worldwide along the usage of technology in 5 key areas, each of which entails various indicators: (1) health and security; (2) mobility; (3) activities; (4) work and school opportunities; and (5) governance. The indicators range from online reporting of city maintenance problems, free public Wifi, website monitoring air pollution, arranging medical appointments online, car-sharing Apps, online ticket sales for public transport, online purchasing of tickets for cultural events online access to job listings, teaching IT skills in schools, to online voting for governmental processes [11].

3 Initiatives of Smart Cities Around the Globe and Their Specific Approach

The ranking of cities around the globe with regards of their smart developments differ with the rating agencies and their assessment criteria. Thus, various rankings exist.

The following examples of cities from different parts of the world that have embarked to become a smart city is therefore only a mall selection among many. The choice is mainly based on differentiating criteria and objectives and does not necessarily represent the technical advance.

3.1 South-East Asia

- **Singapore**

The IMD Smart City Index ranks Singapore as the smartest city in the world.
Singapore rating show a strong performance in infrastructure, public safety, lifelong learning opportunities, availability of green spaces, and online services through governmental portals as well as overall and efficient adoption of technology for the benefit of its citizen. A cashless payment system has been introduced which is now widely used.

Singapore's government has launched the Smart Nation Initiative by end of 2014; the 2017 budget included 2.4bn$ to promote this initiative, mainly through purchases from their start-ups, i.e. by actively supporting the own economy rather than granting subsidies [12, 13].

Another component of Singapore's initiative is the installation of a large network of wireless sensors on 110,000 lamp posts which are designed to collect for urban planning, maintenance and security [14].

- **Seoul**

The South Korean government with its "Global Digital Seoul 2020" plan focusses on offering efficient and comprehensive services to its citizens and intends to employ leadership through the beneficiaries. In 2013, the Mobile Seoul website has been launched that offers 60 real-time services in 11 categories which include transportation/mobility, culture and e-government as well as information on employment, real estate and others. Other websites and apps offer emergency alerts and services for elderly and disabled citizens [15].

- **Shanghai**

The approach in Shanghai differs from the previous ones. It is mainly technology-driven and uses Big Data to enable and enhance an intelligent urban management system and deliver digital public services. The city is equipped with a full-coverage fiber-optics network. Governmental departments work with data sharing and via cloud. Big Data is used for public services and health data analytics [15].

3.2 North America

- **New York**

The development of smart city components started in NYC in 2007 and the city plans forward into 2040, using data as the base to improve the handling of energy, climate change, air quality, etc. The One NYC initiative objectives are diversity, inclusivity,

equity, growth, resiliency and sustainability for its citizens as well as the delivery of governmental services in a spirit of collaboration and interdependency [15].

- **Boston**

The Boston approach considers the citizens' ability to define what 'smart' means to them and their urban environment to create. Citizens shall feel being part of the team that creates a modern community rather than being recipients of services that have been designed for them for the purpose of efficiency and cost savings. Government aims at more positively interact with its citizens [16].

- **Montreal**

Montreal puts democratic principles at the forefront of its approach to the smart city development by introducing sharing of accessible and transparent data as well as public spaces to attract the participation in decision making of urban issues. Forums for public discussions have been established on the city's policy decisions [16].

3.3 MENA Region

- **Dubai**

The "Smart Dubai 2021" initiative aims at creating the happiest city and has been transforming Dubai by e-government with over 100 smart initiatives and 1,000 smart services by more than 20 governmental departments and their private associates in less than 3 years to make Dubai a world-leading city through technological advance and a personalized approach to its residents and visitors.

Terms like 'efficient', 'seamless', safe' and personalized' characterize Dubai's approach that looks at the collaboration between all public and private stakeholders to streamline all its resources for maximum efficiency for residents' benefits and business by customer, financial, resource and infrastructure impact. Smart Dubai defines 6 strategic objectives as smart living, smart economy, smart governance, smart mobility, smart environment and smart people that are measured by KPIs.

- **Egypt**

In Egypt, the establishment of smart cities is being discussed in connection with the government's Sustainable Development Strategy 2030 and its initiative to implement new urban centers, among which the New Administrative Capital, aiming at inclusivity and sustainability. The formulation of an "Egyptian Smart City Code" is under consideration.

"In order to be smart, cities need to be sustainable and inclusive" was the key message of a conference in March 2019, organized by the UN-Habitat Egypt Office and the Egyptian Ministry of Housing, Utilities & Urban Communities during which ideas on aspects like smart urban infrastructure, smart economy, smart energy, smart mobility and smart urban governance were discussed [15].

3.4 Europe

- **London**

The renewed "Smart London 2.0" initiative and its "Vision 2020" concentrates on citizens' services, especially for the vulnerable population. For an inclusive digital service, the city has established a fast network of free Wifi access and offers educational services for digital skills.

- **Helsinki**

Becoming the world's most functional city to serve its citizens stands at the forefront of Helsinki's smart city vision. For this, a policy of open government and transparency has been adopted to identify the needs of the population and have the citizens participate in the decision making process. "Kalasatama", Helsinki's smart innovation district, has become a model for citizens' participation and attracts visitors as well [15].

Together with 5 other cities a common Six City Strategy has been formulated.

- **Barcelona**

Barcelona strongly uses the Internet of Things (IoT) in its approach to become a smart city. The application of IoT-based services has led to significant savings in resources like water, has helped in job creation, supported a healthier environment and improved the city's income situation, e.g. through parking revenues. Barcelona targets to improve and simplify its IoT portal to enable more citizens to participate through better connectivity.

4 Regional and Global Data Protection Regulations and Initiatives

An issue of present and future discussions will be where to draw the line between the State's access to sensitive personal data and individual privacy rights, namely data protection rights, within the scope of using ICTs when developing smart cities.

The European Union's (EU) General Data Protection Regulation (GDPR) is a recently adopted regulatory framework for data protection from misuse by public and private actors. [17] The GDPR regulates the processing by an individual, a company or an organization of personal data relating to individuals in the EU and attributes considerable financial sanction in case of violation. The right to data protection stems from the universally and regionally acknowledged human right to privacy from interference by public authorities as outlined for instance in Article 8 European Convention on Human Rights (1953), Article 17 of the International Covenant on Civil, Political Rights (1976), or Article 12 of the Universal Declaration of Human Rights (1948). With the technological advancement, many States and regional and universal human rights mechanisms recognized the necessity of expanding the space of protection beyond the physical space at home to the virtual space [18].

The far reaching data protection regulations entailed in the GDPR are a positive step on the path of dealing with highly sensitive data in an ethically responsible

manner. However, these EU regulations merely protect individuals residing in the EU, thus other individuals remain without protection. Similar data protection regulations at the global level continues to be hoped for, while it is assumed that such endeavors will result in broad resistance as these obligations might be presumed to slow down Smart City projects [3].

However, beyond the scope of enforceable conventions and regulations, citizens and local government-driven initiatives are coming into existence. The three cities of Amsterdam, Barcelona and New York have launched in 2018 the initiative "Cities Coalition for Digital Rights" aiming at protecting digital rights of residents and visitors. [19, 20] This initiative is based on 5 shared principles to create policies, tools and resources in order to promote and safeguard digital rights. The 5 principles serve as a base for policy discussions in coordination with the UN Human Settlements Programme (UN Habitat) and include (1) universal and equal access to the Internet, and digital literacy; (2) privacy, data protection and security; (3) transparency, accountability, and non-discrimination of data, content and algorithm; (4) participatory democracy, diversity and inclusion; and (5) open and ethical digital service standards. [19, 20] This digital rights initiative is based on the idea that individuals are entitled to human rights when accessing/using the internet and digital technologies/services the same way people enjoy human rights offline. The digital society should therefore protect these human rights to safeguard its participants from the risks of pervasive technologies in real and virtual spaces as well in their interactions with private and public institutions and administration [16, 19].

5 Conclusion

When assessing the selected smart city initiative (Sect. 3), it can be concluded that most of the cities mentioned –which are as said only a representative selection without prejudice to other smart city developments– have developed smart city components in line with the core elements of the definition of a smart city (Sect. 2.2).

However, the approaches which define the objectives of the developments differ, mainly between the cultural regions. Some developments –mainly those in South East Asia– target foremost technical efficiency and security through the application of technology, data creation and data management. Others –mainly the cities from the Western hemisphere– clearly put the service to their residents at the center of the smart development. Citizen rights and protection of privacy and individual freedoms form part of their objectives.

As for the measuring and assessment systems (Sect. 2.3), a unified and generally acknowledged approach would be helpful to guide cities in their process of becoming smart. A financial incentive system with easier funding –possibly through organizations like the World Bank, the International Monetary Fund or the regional/national development agencies– would benefit from such unified assessment system.

Thus, one recommendation is a unified global assessment systems spearheaded by global policy makers, such as UN Habitat; as well as greater cooperation between industry and policy makers, in order to achieve a common standardization and its practical implementation.

While new smart technologies offer a wide range of opportunities for communities with more efficient use of material and non-material resources, more sustainability, more comfort, safety and security, it should be noted that technology represents a powerful tool with possible side or negative effects, e.g. through misuse of its functions. Therefore, a responsible use of smart technologies, an appropriate regulatory framework and the protection of civil rights and freedoms need to be part of every approach to smart cities. This will, in turn, promote a wide acceptance and active participation through residents which is the essential base of successful implementation and further progress.

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