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Smart Cities: Can Data-driven ecosystems successfully replace traditional ways of living? A study on innovation management towards a balance between old and new.

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Introduction

Smart cities are increasingly gaining importance in today's world as both a concept and a policy approach. A smart city differentiates itself from traditional cities in that it places people at the core of urban development and makes services and networks more efficient by use of digital technologies. A shared view in literature is that this modern ecosystem addresses the needs of institutions, businesses and especially citizens by acting on a number of interconnected aspects of a city's functioning[1]. These include questions of governance, economy, energy, mobility, well-being and environment. Building a smart city, therefore, means putting into place initiatives aimed at improving citizens' quality of life, supporting innovation and making a city more competitive, attractive and resilient. Over the course of the past decade, the smart city has become a mainstream idea as a governance and urban management trend[2]. The role of citizens as end-users of public services and generators of data and information will be a key focus over the course of this thesis. Therefore, putting this topic into an innovation management perspective, my analysis aims to understand how citizens can become co-creators of city solutions and to what degree they are effectively empowered to engage in smart city initiatives. It will inquire about the gaps that have been identified in citizens' involvement and the possible avenues for achieving greater engagement of all stakeholders of smart cities[3].

To provide a comprehensive overview of the topic, I will first explore the main issues and challenges that may arise in developing smart cities. These challenges may occur in the fields of: economy, digital education, security, privacy and citizen participation. In terms of economic performance, budgetary constraints may present challenges in building smart solutions as their implementation requires adequate funding to respond to citizens' needs. Secondly, this

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[1] -Visvizi, A. (2019). *Smart Cities: Issues and Challenges: Mapping Political, Social and Economic Risks and Threats*. Elsevier Gezondheidszorg

[2] Pham, L. T. (2017). *Empowering citizens in the development of smart cities: the Cork case* (PhD Thesis). https://cora.ucc.ie/handle/10468/7035

[3] Pham,

transformation rests upon the digital skills of highly competitive individuals who are able to operate the infrastructure of smart cities. Operators of smart cities must possess strong technological capabilities in order to apply growingly sophisticated systems. Thirdly, security and privacy are fundamental issues to consider when operating a smart city. Indeed, huge quantities of data are generated by billions of interconnected cyber-physical devices[4]. Since these data are collected and manipulated instantaneously, problems of confidentiality, protection, integrity and privacy may arise. As identified by literature, some of the main dangers in smart cities are: poor software security and data encryption, insecure legacy systems and poor maintenance and lack of cyberattack emergency plans[5].

Lastly, central to my thesis is the challenge of citizens' active involvement in smart cities development. Indeed, as previously stated, crucial to this analysis is understanding to what degree the smart city is a people-centered ecosystem where citizens can influence public policies in a way that improves their economic and social lives[6]. Furthermore, this rather swift transition to digitalized services begs the question of whether the positives of traditional ways of interaction and participation will be lost. To become smart, a city should not only consist of Information Communication Technologies (ICTs), transport and energy infrastructures. It should rather be "about smart citizens, who participate in their city's daily governance, are concerned about increasing the quality of life of their fellow citizens, and about protecting their environment"[7]. In other words, citizens should be motivated to become actors of smart cities by being involved in their evolution. More specifically, this thesis will assess whether an innovation scenario like that of smart cities is actually able to address all the inefficiencies that a traditional city presents. It will question, from the point of view of innovation management, whether this data-driven, interconnected ecosystem will effectively enhance aspects such as civic engagement, urban design, and criminal justice or not. On the other hand, after

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[4] Visvizi, pages 2-3
[5] Visvizi, pag. 5
[6] Visvizi, pag.7
[7] JRC European Commission. (2014). *Citizen Science and Smart Cities*.
https://publications.jrc.ec.europa.eu/repository/handle/JRC90374

evaluating some case studies, it will determine whether this transition to a more techno-centric system strips away the positives of tradition and whether other viable alternatives should be sought.

This analysis will depart from considering the effects of the 2020 global Covid-19 pandemic on digitalisation. Indeed, the outbreak of this sanitary emergency in 2019 has accelerated the digital transformation of cities within a short time-frame. It has rapidly changed our way of living and it has given us a preview of what we can expect from the digital transformation in the near future. In general, the aims of this study are the following:

1. To understand how the current sanitary crisis has served as a "laboratory" to observe the potential drawbacks of excessive digitalisation.

2. To assess whether and how smart city solutions are an improvement in the following fields: governance and citizen participation, urban planning, environment, business transformation and security.

3. To gauge the involvement of citizens and their empowerment in the creation of smart city initiatives.

4. To explore whether other viable alternatives are needed within an innovation management perspective.

5. To provide a comprehensive overview of whether a techno-centric ecosystem like that of smart cities is preferable to pre-existing ways of living and working in cities.

I will conduct this study on smart cities by following a number of steps.

In the following section, number two of this thesis, I will provide a literature review to understand the main theories, frameworks and current debates regarding smart cities. Section three will provide an in-depth explanation of the smart city concept and will showcase the dimensions commonly understood to constitute smart city development. It will outline the main initiatives currently undertaken in the transformation towards smart cities to understand the common trends.

Successively, in section four, I will highlight the outcomes and the potential areas of development within the new digital reality brought about by the global Covid-19 pandemic of 2020. In section five, I will undertake case study analysis to assess whether the smart city ideology is effectively a project to radically reshape cities or if it is limiting itself to a technocentric view of future living. This section will hence provide a balanced overview of the current initiatives to showcase the benefits as well as the potential risks in terms of economy, security, privacy, societal and individual wellbeing. The transformations toward smart cities affect most activities and, in this section, I will focus on the ongoing innovations in the following fields:

1. Mobility

2. Network Infrastructures

3. Civic Engagement

4. Urban Planning

The conclusion of this thesis will draw from the findings of the previous chapters to provide a final discussion on the aforementioned themes. It will develop recommendations on possible ways forward in the creation of smart cities.

2. Literature Review

In this section, I will expose the theoretical approaches to the smart city concept. These will provide a useful framework to understand how the smart city ideology has been interpreted in manifold ways. The theoretical discourse on smart cities is indeed a key starting point for my analysis as it helps recognize how governments, corporations and the multitude of stakeholders involved are seeing this relatively new phenomenon from very different, often conflicting viewpoints. It will hence serve to guide discussion on the complexity brought about by the new digital era and on the divide it

produced between more traditionalist and human-centered schools of thought and more techno-centric ones. There is general agreement that cities should be made smarter if this leads to more effective solutions to a broad range of societal issues. However, it is not yet universally acknowledged that technology alone will not make a city smarter. Indeed, as found in the literature, city managers should gain a political understanding of technology, "a process approach to manage the emerging smart city and a focus on both economic gains and other public values"[8].

A starting point in understanding disparity in opinion is provided by Richard Florida's work about creative cities. It stresses global competition between cities, and his perspective is in conflict with Charles Landry's insight that local politicians and city managers should not aim to be "the best city in the world but for the world"[9]. Landry indeed contends that, as cities are the core of economic development, city administrators and politicians should not aim at solving all the problems in cities but rather strengthening the capacities of urban systems to address a wide range of problems[10].

The divide in viewpoints is further shown in regards to the concept of smart city governance. There is widespread agreement on the idea that government policies have a pivotal role in promoting smart cities[11]. However, contributions from the field of public management emphasize that solving societal issues is not simply a matter of implementing good policies but rather a managerial question of "organizing strong collaboration between the government and other stakeholders"[12].

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[8]Meijer, A. and Rodriguez Bolivar, M., 2015. Governing the Smart City: a review of the literature on smart urban governance. *International Review of Administrative Sciences*, pages.1-18.
[9] Meijer and Rodriguez Bolivar, pages 12-13
[10] Meijer and Rodriguez Bolivar, pages 14-15
[11] Meijer and Rodriguez Bolivar,pag. 17
[12] Torfing, J. and Triantafillou, P., 2014. What's in a Name? Grasping New Public Governance as a Political-Administrative System. International Review of Public Administration, [online] pp.9-25. Available at: <https://www.tandfonline.com/doi/abs/10.1080/12294659.2013.10805250> [Accessed 29 April 2021].

2.1. Three Ideal-Types of Smart City

In the literature I analysed on smart cities, I found three distinct types of ideal-typical definitions. The first one has a more technological focus and views smart cities as cities that use smart technologies. The second one focuses on human resources and sees smart cities as the result of smart people. Finally, a third stream of opinion focuses on governance, seeing smart cities as cities with smart collaboration[13]. I analysed the papers to assess whether most perspectives identify with one of these ideal-types or rather with a combination of the three.

2.1.1. Technology Focus

Authors identifying with the first definition put an emphasis on the possibilities offered by new technologies to improve the urban system. Within these publications, technology becomes the defining feature of a smart city. Here, the technology considered ranges from sophisticated energy technologies like smart grids, to traffic regulation systems and transport systems[14]. As argued by Aurigi, even though different perspectives on smart cities exist, at the core of every perspective is the idea that ICT is fundamental to the operation of future cities[15]. Many authors within this stream of thought point to social issues such as the social inclusion agenda, the importance of social capital in urban development and urban sustainability[16]. The defining feature of this approach is that technology constitutes the basic assumption for reconceiving all the above mentioned issues.

2.1.2. Human Resources Focus

Publications focusing on human resources do not disregard technology but consider smart people to be central to the operation of smart cities. They view human capital and human resources as the primary feature of smart cities. In this definition, smart cities are identified as "metropolitan areas

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[13] Meijer and Rodriguez Bolivar, pag.16
[14] Meijer and Rodriguez Bolivar, pag. 13
[15] Meijer and Rodriguez Bolivar, pag.17
[16] Meijer and Rodriguez Bolivar, pag. 17

with a large share of the adult population with a college degree"[17]. At the core of this conception of smart cities are ultimately smart inhabitants with their characteristics, especially their educational grade, which is seen as a main driver of urban growth.

2.1.3. Collaboration Focus

The publications centered on governance emphasize the interactions between different stakeholders in the city as the defining feature of smart cities. Within this framework, smart cities are viewed from a user-centered perspective with a special focus on citizens and other stakeholders[18]. This interpretation of smart cities points to the importance of connecting knowledge centers to the actions of various actors in the city in order to create "innovation hubs"[19]. The idea of collaboration is a crucial point and central to this view is the development of "productive interactions between networks of urban act

2.1.4. Three Perspectives Combined

The three elements- smart technology, smart people and smart collaboration- have also been combined in a number of papers. As Hollands asserts, smart cities require both sophisticated information technology and the input of various groups of people[20]. A very explicatory definition is given by Caragliu et al, who define a city to be smart "when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance"[21]. Therefore, a comprehensive definition would incorporate all these aspects. Meijer and Bolivar provide a definition which encompasses all three aspects and highlights that smartness is a gradual concept: "the smartness of a city refers to its ability to attract human capital and to mobilize

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[17] Meijer and Rodriguez Bolivar, pag. 18
[18] Meijer and Rodriguez Bolivar, pag. 18
[19] Meijer and Rodriguez Bolivar, pag. 16
[20] Meijerand Rodriguez Bolivar, pag.18
[21] Andrea Caragliu, Chiara Del Bo & Peter Nijkamp (2011) Smart Cities in Europe, Journal of Urban Technology, 18:2, 65-82, DOI: 10.1080/10630732.2011.601117

this human capital in collaborations between the various (organized and individual) actors through the use of information and communication technologies"[22].

2.2. Four ideal-types of smart governance

The authors identify four ideal-typical conceptualizations of smart city governance: (1) government of a smart city, (2) smart decision-making, (3) smart administration and (4) smart urban collaboration[23]. These four aspects are the result of different theoretical viewpoints on the role of government in modern society. The first conceptualization shows that governance of smart cities does not require a transformation of governmental processes and structures. Indeed, smart governance simply means governance of smart cities, hence making right policy choices and implementing them efficiently and effectively[24]. According to Winters, urban governments shall only promote "centers of higher education" to make a city smart[25]. The second conceptualization of smart governance focuses on the need for implementing smart decision-making processes.

The third stream of smart governance is considered to be smart administration. As Gil-Garcia asserts, "a 'smart state is a new form of electronic governance that uses sophisticated information technologies to interconnect and integrate information, processes, institutions, and physical infrastructure to better serve citizens and communities"[26]. From this view, it is possible to see how smart governance reaches a higher level of transformation as smart administration means rethinking the internal organization of government. Hence, to be smart, an administration should be innovative in order to meet the requirements of differentiated policies[27]. As highlighted by Batty et al., smart

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[22] Meijer and Rodriguez Bolivar, pag.14
[23] Meijer and Rodriguez Bolivar, pag.16
[24] Meijer and Rodriguez Bolivar, pag.15
[25] Winters, J., 2010. Why are Smart Cities growing? Who moves and who stays. Journal of Regional Science, [online] Available at: <https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1467-9787.2010.00693.x> [Accessed 29 April 2021].
[26] Meijer, A., Gil-Garcia, J. and Rodriguez Bolivar, M., 2015. Smart City Research: Contextual Conditions, Governance Models, and Public Value Assessment. *Social Science Computer Review*, [online] (Vol 34, Issue 6). Available at: <https://doi.org/10.1177/0894439315618890> [Accessed 3 May 2021].
[27] Meijer and Rodriguez Bolivar,

governance is a "stronger intelligence function and a structure that brings together traditional functions of government and business"[28].

Lastly, the most transformative idea of smart governance is given by the fourth concept, that of smart urban collaboration between different actors in the city. A number of insights, like that of Baˇtaˇgan, led me to understand smart urban collaboration to be the highest degree of transformation. Indeed, Baˇtaˇgan contends that "smart governance means collaborating across departments and with communities, helping to promote economic growth and at the most important level making operations and services truly citizen-centric"[29]. In a similar vein, Tapscott and Agnew assert that smart governance is the widespread adoption of a more "community-based model of governance" where greater connectivity is made easier by new technologies[30].

This analysis showed that, while some authors emphasize the importance of citizen participation and open forms of collaboration, others suggest strengthening the legitimacy of urban governance by way of effective policies regarding wealth, sustainability and health. Questions of power and democracy are at the core of the debate on the smart city as a process giving legitimacy to urban governance. Hence, this view has at its core the active engagement of stakeholders and citizens in urban governance. However, authors ascribing to this view do not see this engagement to be political. They rather see it as a learning process, where citizens can "tap into the intelligence of all urban actors" to generate a smart, knowledge system[31]. As argued by Dir and Pasher, governments in a smart city should enable the conditions which foster innovation, creation and knowledge exchange.[32]

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[28] Batty, M., Axhausen, K. and Giannotti, F., 2012. Smart cities of the future. *The European Physical Journal Special Topics*, Vol 214(1), pages 481-518.

[29] Batagan, L., 2011. "Smart Cities and Sustainability Models," Informatica Economica, Academy of Economic Studies - Bucharest, Romania, vol. 15(3), pages 80-87.

[30] Tapscott, D., & Agnew, D. (1999). Governance in the Digital Economy - The Importance of Human Development. *Finance & Development - IMF*, (Vol 36(4), pages 34-37. Retrieved 3 May 2021, from. https://www.imf.org/external/pubs/ft/fandd/1999/12/tapscott.htm

[31] Meijer and Rodriguez Bolivar, .

[32] Dvir, Ron & Pasher, Edna. (2004). Innovation engines for knowledge cities: An innovation ecology perspective. J. Knowledge Management. 8. 16-27. 10.1108/13673270410558756.

2.3. The Open Data Debate

Ultimately, the idea of smart cities as an improved learning environment also opens up the debate on open data in relation to the governance of a city. Open data are generally viewed as a means to improve collective intelligence of citizens by empowering innovators, companies and citizens to derive value from these data. However, as found from the literature, smartness does not equal open access to anyone. As Walravens contends, "governments should promote open data systems but the responsible government body should carefully consider the terms under which this data is opened up and to which actors"[33]. These statements show that smart cities can improve urban governance also by means of appropriate management of urban intelligence. This would mean strengthening more democratic forms of government by way of direct citizen participation as citizens of a smart city are informed and aware of how data is used.

In conclusion, this overview on the current debate on smart cities and their governance showed that there exist quite heterogeneous views on the matter. As shown in this literature review, the main divide is between publications with a technical focus and others with a focus on city inhabitants and their level of learning and education. Other publications aim at a combination of these two aspects in a socio-technical standpoint. The socio-technical perspective is arguably the most comprehensive and provides useful theoretical groundwork for this analysis in the aim to explore other multidimensional and more balanced alternatives to one-sided smart city systems.

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[33] Walravens, Nils. (2012). Mobile Business and the Smart City: Developing a Business Model Framework to Include Public Design Parameters for Mobile City Services. *Journal of theoretical and applied electronic commerce research*, *7*(3), 121-135. https://dx.doi.org/10.4067/S0718-18762012000300011

3. A Comprehensive Overview of Smart Cities

3.1. Introduction: When does a city become "smart"?

In this chapter, I will provide a comprehensive background on the concept and practice of smart city development. Framing this study within the current scenario of smart city development is pivotal as it provides a point of departure to explore future avenues of this transformation. I will provide definitions to the concept and guide understanding on how the smart city differentiates itself from the traditional city. I will ultimately explore the standard six dimensions of a smart city. These dimensions are commonly agreed to be the building blocks of a smart city and they consist of: Smart People, Smart Economy, Smart Mobility, Smart Governance, Smart Environment and Smart Living.

As defined by the European Union, the Smart City is "a place where services and traditional networks are made more efficient through the use of digital technologies and telecommunications, to the benefit of citizens and enterprises"[34]. In elaborating this definition, I made reference to the conceptualization of smart cities offered by ICT consulting company Between S.p.A. According to one of their reports, a city becomes smart when it is able to mark a clear boundary between "before" and "after"[35]. More specifically, when it is able to make citizens understand the following:

1) That it has a vision for its future

2) That it has undertaken a roadmap towards that vision and it is able to make changes

3) That it is able to make innovation tangible and widespread within the city

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[34] Lisitano, I. M. (2019). *Dalla città digitale alla città con elevata qualità della vita: un percorso nelle definizioni della smart city*. Ingenio.
https://www.ingenio-web.it/23477-dalla-citta-digitale-alla-citta-con-elevata-qualita-della-vita-un-percorso-nell e-definizioni-della-smart-city
[35] Between S.p.A. (2013). *Smart City Index: Confrontarsi per diventare Smart* (pp. 2-6). Retrieved from
http://www.futurosostenibile.org/wp-content/uploads/2013/07/Between_SmartCityIndex2013.pdf

For a Smart City to emerge, it has to make innovations visible and services available. The Smart City Index, developed by Between, provides a ranking of "smart cities" based on some fundamental elements which set it apart from other rankings. The Smart City Index measures the features that are already "smart" within cities. As also found from the literature, the common denominator that characterises smart initiatives is the use of information and communication technologies. Despite this not being the only defining element of a smart city, it acts as a catalyst thanks to which it is possible to define strategies at a political level in order to improve the quality, sustainability, and liveability of the main urban centers. Moreover, what is often taken into account is a project's degree of innovation, or the possibility to replicate an initiative from a pilot zone to broader territorial contexts. The Smart City Index is a dynamic indicator which identifies nine subject areas: Smart Health, Smart Government, Smart Education, Smart Mobility, Renewable Energy, Energy Efficiency, Broadband, Natural Resources, Sustainable Transport. Giffinger offers a more simplified yet exhaustive classification based on six elements: Smart People, Smart Economy, Smart Mobility, Smart Governance, Smart Environment and Smart Living[36]. This classification is evidence of the attempt by some cities to prioritize one or the other "smart" dimensions.

3.2. The Six Dimensions

Having an in-depth knowledge of the six dimensions of a smart city is an important premise to this study. Indeed, throughout the course of this thesis, I will show how these six aspects should always coexist in smart city projects. They indeed provide useful groundwork for the following chapters of this thesis, where I will demonstrate empirically whether they have been considered holistically in the actuation of smart city projects.

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[36] Giffinger,R. et. al. (2007) , Smart Cities - Ranking of European medium-sized cities. Vienna University of Technology

3.2.1. Smart People

In order to talk about Smart Cities, as previously seen in the literature, considering the human dimension is key. It is thanks to the free interaction between city administrators and citizens and to their participation, involvement and dialogue that a city can be termed "intelligent". The city therefore becomes a joint project where the citizen, thanks to the importance given to participatory processes, becomes co-author of public policies by influencing them and at the same time promoting the development of other policies. This process would not only upgrade citizens' role in these dynamics, but at the same time would allow for their needs to be met effectively and efficiently.

Within this human dimension of smart cities, public actors and technology-producing firms are no longer bound to each other through a buyer-producer relationship. New partnerships take place among the public sector, the private sector and people in the form of open alliances. These synergies, made of three subjects (public institutions, private companies and citizens), open up new opportunities also for the actors working in the ICT world. From these arise truly Human Smart Cities where governments commit to the involvement of their citizens, are willing to be involved by them and are able to coordinate joint planning processes towards socio-digital innovation in an equal relationship with citizens.

Lastly, it is important to highlight the role of human infrastructures, human capital and the role played by education in the development of an urban reality. When discussing urban development, it is key to understand the concept of smart person as having features such as: the ability to learn, ethnic and social plurality, flexibility, creativity, an open mind with respect to diversity and the propensity to partake in public life. Ultimately, the best approach towards the creation of a smart community is that of finding synergies among various subjects (government, enterprises, schools, non-profit organizations and the individual citizens). This would have to be accompanied by the creation of specific services for improving the liveability of the city and advancing skills and collective abilities.

3.2.2. Smart Economy

The second aspect commonly identified as making a city more intelligent is Smart Economy. A number of initiatives characterize smart economies: investing in research and development, favouring internationalization, promoting creative talent or sharing knowledge. Creating a smart economy means investing in Knowledge Economy[37]. Smart economy is the most cross-sectional approach as most interventions concerning other dimensions always have an impact in terms of occupation, the formation of human capital or accessibility to information networks. These factors together influence economic development in cities.

A virtuous reality from an economic and financial point of view is one where smart economies stimulate innovation, are able to attract talent and to promote interaction with scientific research. This would also entail cross-contamination between smart economies and research through, for example, incubators where to create innovative start-ups and support the growth of entrepreneurship, hence favouring the origination of new ideas and their successive development through technology. Ultimately, a smart economy should be founded on growth and competitiveness, in order to look to the future in a smart perspective with special regard to employment[38].

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[37] An expression coined by Peter Drucker which refers to the use of information to create value, with a special focus on the nature, creation, diffusion, transfer and use of knowledge in all its forms. Knowledge from an organizational point of view is a scarce resource which allows those who possess it to gain competitive advantage. If applied to problem solving, it is considered to be a potential source of revenue. (https://en.wikipedia.org/wiki/Knowledge_economy#:~:text=The%20knowledge%20economy%20(or%20the, as%20well%20as%20accelerated%20obsolescence)

[38]Buratti, R. (2018). *Scenari per Parma Futuro Smart al 2030* (p. 4). Parma. Retrieved from https://www.smile-dih.eu/wp-content/uploads/2018/04/Introduzione-SMART-ECONOMY-INNOVATION.pdf

3.2.3. Smart Mobility

Smart Mobility, thanks to the large availability of structural investments and to its low cost of innovation, represents one of the most relevant dimensions. It generally refers to all the attempts at making urban mobility smart through more efficient public transport which is made more innovative and sustainable. This can also be realized by discouraging private transfers or by putting into place info-mobility services to manage citizens' daily commutes. Nowadays, the concept of mobility has extended beyond individual services to also include a complex support system for commercial activities. Indeed, different urban plans for sustainable mobility include innovative forms of e-commerce and delivery logistics favouring speed as a way to add value to commercial activities online and make them more convenient to customers. This so-called disruptive logistics is an upcoming trend which entails quick innovation of e-commerce logistics in a way that impacts all businesses in the space[39].

At the core of the smart mobility concept is an approach favouring services that are virtually tailor made. These include: the improvement of road safety, optimisation of urban and inter-urban mobility, advancement in logistics and development of "smart" roads. This approach requires profiling of users' behaviour while also identifying commercial and entrepreneurial trends through the use of technological platforms able to deliver on-site services. These services include, among others: parkings, tolls, car sharing, bike sharing and carpooling[40]. These platforms are designed in a way that integrates all the mobility options, hence allowing the development of seamless systems that integrate infrastructural and price-related information while users can benefit from instant communication services. Lastly, due to the nature of the issues it tackles, smart mobility is supported by international

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[39] Lierow, M., Janssen, S., & D'Incà, J. (2014). *Disruptive Logistics- The New frontier for E-commerce*. OlIver Wyman. Retrieved 11 May 2021, from
https://www.oliverwyman.com/our-expertise/insights/2014/sep/disruptive-logistics-the-new-frontier-for-ecommerce.html#:~:text=E%2Dtailers%20of%20all%20sizes,throughout%20the%20entire%20shopping%20process.
[40] Lauri, C. (2021). Smart Mobility: Le sfide regolatorie della mobilità urbana. *Rivista Trimestrale Di Scienza Dell'amministrazione*, 6-9. https://doi.org/10.32049/RTSA.2021.1.03

funds and represents, together with the environment, one of the two main axes of smart programs[41]. It is indeed one of the main themes of interest to the European Commission, and a number of policies have been implemented to reduce CO2 emissions of vehicular traffic, considered to be one of the main factors of the increase in pollution.

3.2.4. Smart Governance

A smart administration is one which promotes transparency and fosters sharing of information flows from citizens through the use of open data. It aims at simplifying and digitizing processes in order to reach an electronic government (e-government) system. At the core of this process to achieve smartness must lie the ability to set a long-term strategic vision supported by action guidelines that come from an agreement with active citizens. A crucial element is the definition of the type of structure in charge of coordinating smart projects and initiatives. Most typically, this structure takes the form of a foundation which has a higher degree of financial and organizational autonomy than a public authority[42]. The e-government initiatives which have been undertaken allow for better communication between government agencies and their constituents thanks to online access to government services, information and expertise. Data serves as a building block for gathering information to enhance services, transparency, participation and devise new models of delivering services. Algorithms transform data into information and enable the creation of services such as predictive and preventive policies, personalized feedback and real-time control[43].

Urbanization has been accompanied by social and economic transformations, and cities have become important drivers of development. They indeed attract a large share of the national economic

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[41] OiCE - Associazione delle organizzazioni di ingegneria, architettura e di consulenza tecno-economica. (2021). *Smart City: uno strumento per le città intelligenti* (pages 85-89). Confindustria.
[42] Guenduez, A. A., et al. (2018). Smart Government Success Factors. Swiss Yearbook of Administrative Sciences, 9(1), pp. 96–110. DOI: https://doi.org/10.5334/ssas.124
[43] Guenduez, et. al.

activity, government and facilities, and are a crucial link with rural areas, between cities, and across international borders[44]. The role of city governments, therefore, is increasingly important at a national level too, as it has to take on several initiatives in order to "sustain against complex global challenges (e.g., climate change and economic growth with a reduced spending capacity) at a local level" and against national and international competition[45]. City governments can hence leverage on emerging technologies (e.g. cloud, data sensors) to increase their strength. Ultimately, as Gil-Garcia explains, smart government is "a creative mix of emerging technologies and innovation in the public sector", which can manage uncertainty and complexity through coordination, open data access, continuous engagement and information sharing[46].

3.2.5. Smart Environment

Topics relating to the environment generally translate to energy efficiency and sustainability, waste reduction , recycling and mitigation of the impacts relating to global warming. They also include public lighting, management of green urban spaces and the reduction of CO_2 emissions. They represent a wide range of project areas as the Smart Environment axis is the one most supported by European funding and by many national plans in various countries that have largely experimented with them. Having said that, however, the Smart Environment framework has often been translated into experimentations relative to energy matters, rather than actions regarding the environment in general. Most frequently, initiatives concern the realization of low energy consumption neighbourhoods that are equipped with intelligent networks and are powered by renewable energy and which manage waste disposal effectively. Other times, interventions relate instead to network

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[44] Leonidas G. Anthopoulos, 2017. "Understanding Smart Cities: A Tool for Smart Government or an Industrial Trick?," Public Administration and Information Technology, Springer, number 978-3-319-57015-0, December.

[45] Leonidas Anthopoulos, page 3

[46] Gil-Garcia, J. Ramon & Helbig, Natalie & Ojo, Adegboyega. (2014). Being smart: Emerging technologies and innovation in the public sector. Government Information Quarterly. 31. I1–I8. 10.1016/j.giq.2014.09.001.

systems (water, energy, waste, etc..), to the realisation of more efficient and less costly public illumination systems, or to the improvement of energy performance in public buildings.

As regards to the initiatives pertaining to the theme of environment more generally, three main areas of intervention can be distinguished. These are: air pollution, management urban utilities (urban waste, water services etc.) and mitigation and prevention of natural hazards[47]. Urbanisation is significantly contributing to climate change and it is reported that the 20 largest cities consume 80% of the world's energy and urban areas generate 80% of greenhouse gas emissions worldwide[48]. Therefore, smart environment plans should aim at effective and sustainable development while also adequately managing resources. Creating a low carbon electricity ecosystem should therefore be the essential component of urban planning in order to avoid future origination of greenhouse emissions. In terms of preventing natural disasters, plans should aim at alleviating population pressure on natural habitats and biodiversity[49].

Lastly, smart buildings should be another important segment to optimise energy consumption. Buildings are generally classified as smart if they are equipped with automated systems for routine operation, communication, safety, security and entertainment along with smart configuration of control systems[50]. The smart citizen of a smart city shall live and work in a smart building environment , where citizens would be provided with the right information at the right time by service providers and the city government in order to make better energy switching and scheduling consumption decisions. Ultimately, Moreno-Munoz et al.'s contribution is relevant in this regard as they support the evolution of 'Smart Energy Communities'. These communities would allow the

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[47] Kumar Vinod., T.M. (2020). Smart Environment for Smart Cities. 10.1007/978-981-13-6822-6_1.
[48] Kumar Vinod, pages 4-5
[49] KumarVinod, pag. 5
[50] KumarVinod, pages 6-7

active participation of "prosumers" (individuals both producing and consuming) "in a genuinely open market"[51].

3.2.6. Smart Living

This domain of smart cities concerns all activities relating to the improvement of services to citizens, from healthcare to schooling, tourism and culture. The development of these aspects significantly influences the liveability of an urban area. Initiatives of smart living also include more social aspects not necessarily related to technology, namely social housing. This aspect has been generally considered to be an integral part of smart living as the Smart City should also envisage the availability of sustainable housing with affordable prices for the most vulnerable segments of the population[52]. The concept of smart living overall refers to having a high level of social cohesion and developing the social capital. A smart city is hence an ecosystem that is able to communicate with citizens with the most innovative techniques and applied technology. It is a place where smart components have a pivotal role in the improvement of living, be it domestic life, tourism experiences, security or mobility.

Thanks to the use of simple applications it is possible to be informed about the location and the availability of a diverse set of services useful to everyday life, namely restaurants, bars hotels, news, shops etc. These platforms serve as a real online community, within which information is provided which goes beyond the geographic location of the service that one needs. It indeed includes opinions and comments on the availability, the quality and the usefulness of a service. The possibility to communicate one's own degree of satisfaction or dissatisfaction on the services available within a technological platform provides the citizen with the opportunity to give a personal opinion on the

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[51] Moreno-Munoz, Antonio & Bellido, Francisco & Siano, Pierluigi & Gómez-Nieto, Miguel. (2016). Mobile social media for smart grids customer engagement: Emerging trends and challenges. Renewable and Sustainable Energy Reviews. 53. 1611-1616A. 10.1016/j.rser.2015.09.077.
[52] Ministero del Lavoro e delle Politiche Sociali. (2021). *Smart Living: Green Jobs - Formazione e Orientamento* (pp. 1-12). Retrieved from https://www.cliclavoro.gov.it/Progetti/Green_Jobs/Documents/Smart_City/5_Smart%20Living.pdf

service, hence activating direct participation platforms which can influence their supply and have a real-time impact on the demand side.

In conclusion, smart living relates to a series of intelligent technological solutions which facilitate the daily life of modern citizens living in a smart city, be they applied to housing, art and culture, or in the services and restaurants sector and mobility. Smart living is strictly associated not only with the features mentioned above, but also and especially with the concept of smart people: a citizen will be smart not only with regards to how many smart services are provided, but also to the degree he or she will be able to utilize them in order to make his or her life easier and richer in terms of services and information, with a special attention to waste reduction and energy saving. Within this framework, a smart city is ultimately one that is able to utilize technological tools to provide a vast amount of services, while at the same time making citizens informed in order for them to live the city context in a smart way.

4. The Smart City after the Covid-19 Pandemic: What Future?

4.1. Introduction

In this chapter I will investigate the effects of the Global Covid-19 pandemic of 2020 on our urban life and I will demonstrate how the pandemic acted as an experiment to foresee an evolution scenario towards smart cities. The sanitary crisis of 2020, urging us to rethink our personal, social and working habits, has arguably caused the transition to smart cities to become a priority. Studying the effects of the pandemic on cities will hence enable me to assess the capacity of current smart designs to make cities resilient to this type of changes. Resilience and safety are indeed considered to be two of the pillars of a smart city. Focusing on a radical urban transformation like the one imposed by the sanitary emergency will therefore guide my discussion to understanding whether smart city models work to the benefit of all. The aims of this chapter are ultimately twofold: 1) to reflect on the development of smart urban contexts and on the needs of today's citizens highlighted by the pandemic 2) to test whether technology alone and data-centric visions can effectively and efficiently respond to the needs and challenges of cities and have a significant impact on society.

Within a few months' time, the pandemic caused by the Covid-19 virus, and the measures put in place by governments to counter its diffusion, have deeply affected most urban centers around the world in their operations, management and daily life. The inherent features of urban context represent at the same time the strengths and weaknesses in the management of this emergency. Cities are by nature characterised by high density of population and visitors, and by their capacity to attract an influx of people from surrounding areas due to the services, the commercial, cultural, educational and sanitary activities, along with events of various kinds. These features represent a determining factor in the spread of the virus. Urban density generally renders the implementation of social distancing in most activities difficult. Most cities, moreover, are important international hubs as they represent key points for global interconnections. If on the one hand the critical issues of cities facing this crisis are

many, on the other hand focus should also be on the strengths and resources which can be activated at the urban level in the management of the emergency and the successive recovery phase.

There is evidence that local governments around the world have enacted measures established by national guidelines[53]. At the same time, they have become active promoters of initiatives on multiple fronts, leveraging on policies at the normative, economic and managerial level. These initiatives have also seen the involvement of the stakeholders concerned. Cities indeed constitute the layer of governance that is closest to the citizens, and they are directly involved in the management of territory and most important services which have been affected by the new measures to contain the sanitary emergency. Cities, moreover, and especially the ones that are undertaking a transformation process to become "smart", have equipped themselves with a series of infrastructures and digital resources which now turn out to be fundamental for the activation of smart working both within the public and the private sector[54]. Looking beyond the management of the emergency phase, the complexity of the Covid-19 crisis shows how it is necessary for cities to adopt systemic and long-term responses, thereby rethinking and planning the city and urban services to increase resilience and counter possible future exacerbation of the emergency. These responses must ultimately be supported by a clear governance, which defines coherent and coordinated actions between central areas and peripheries, within a metropolitan optic.

If on the one hand the Covid-19 emergency has sparked a global crisis with serious consequences for the sanitary, social and economic systems of countries, on the other there is the possibility to seize the opportunity to pursue new solutions and adopt innovative measures which have long been postponed. New technologies can contribute to rethinking and innovating city life, for example by introducing systems to book services or the purchase of products in commercial activities, thereby avoiding queues and gatherings. Another development in this sense could be the domestic delivery of

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[53] Costa, D. and Peixoto, J.P. (2020). COVID-19 Pandemic: A Review of Smart Cities Initiatives to Face New Outbreaks. 10.1049/iet-smc.2020.0044.
[54] Costa and Peixoto

products. In terms of design of urban spaces, this will have to take into account the concepts of social distancing, separating people flows and adopting the necessary technology to map the number and the conditions of all people in the space at all times. This would allow having targeted responses which will not limit circulation in emergency situations. These spaces could be equipped with "smart" turnstiles able to count the number, or even the name and health conditions of the people present inside[55].

Through the normative measures established by the various local administrations, the pandemic has caused a radical change in the relationship between public and private life. In an innovation management perspective, this has meant abandoning the traditional idea of urban spaces like squares, streets or parks, where gatherings would normally occur. This is because the new reality has forced cities to adopt social distancing as the only avenue to counter the spread of pandemic diseases. The new rules are giving way to social protocols which have the aim to define in greater detail the ways in which it will be possible to work, rest and spend one's day. The dominant perspective is one emphasising the "new normal" in thinking about life in tomorrow's world, one where new possible pandemic diseases may characterize the new Millennium[56]. These fears of a new normality cannot merely translate themselves into the respect of rules, but also into new spatial designs.

4.2. Redefining the spaces

Architecture is the starting domain where change will need to happen in response to the newfound necessities of today's life. Architecture should arguably provide a framework to view everything as a new opportunity for a radical change in our way of living and caring for the environment and well-being in general. The architecture of smart cities will hence entail a novel way of thinking and building spaces, where sustainability will be centre stage through increased use of raw materials[57]. One case in point in regard to this effort is Google's choice to use wood as the material of the

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[55] Costa and Peixoto, pag. 3
[56] Costa and Peixoto, pag. 4
[57] Delsante, Ioanni. (2006). Innovazione tecnologica e Architettura.

future[58]. The aim is to realize an experimental and forward-looking Smart City which was growing on the Toronto waterfront, a project signed by urban transformation corporation Sidewalk Labs. The innovative public-private space will be developed on more than three million square metres, including public spaces and multi-storey residential towers. According to the Smart City Observatory of Bocconi University, the future will increasingly point to the realization of multi-storey edifices, which will be sustainable, technological and will have low environmental footprint due to the reduction of ground space they will occupy[59]. An example is the Bosco Verticale (literally "vertical forest") designed by architect Stefano Boeri in Milan. It represents a model of low environmental impact residential building which can be replicated on a major scale. Ultimately, it is possible to assert that the standards which have long been set to define the intelligent city in terms of security, efficiency and sustainability will become a real priority to achieve within a short time frame. Innovation will hence need to push towards new Smart City models, where energy efficiency, sustainability, safety and digital transformation represent the real engine of tomorrow's cities.

4.3. Optimizing the Six Dimensions

In parallel to this, it is imperative to optimize the growth of the six dimensions of the smart city previously analysed and to re-elaborate models of safe, sustainable and efficient cities which have as a common denominator the centrality of the citizen[60]. The first dimension, Smart Economy, will need to be centered on technological innovation to allow it to restart. Smart People, thanks to the means of communication already present in the market and to the new ones developed during the forced isolation period of the pandemic, are becoming more and more involved in collective decisions. In terms of Smart Governance, this will have to adapt to the new conditions to establish a direct

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[58] Voci, M. (2019). *Il grattacielo Smart sarà in legno: a scommetterci c'è anche Google*. Il Sole 24 Ore. Retrieved 9 June 2021, from
https://www.ilsole24ore.com/art/il-grattacielo-smart-sara-legno-scommetterci-c-e-anche-google-ABiJJ0hB.
[59] Newsletter di Informazione. (2021), *5*. Retrieved 9 June 2021, from
https://www.green.unibocconi.eu/wps/wcm/connect/5e31426e-fe9e-4853-be44-4f30a8c00768/Newsletter5_Os
servatorioSC.pdf?MOD=AJPERES&CVID=nAifoTv.
[60] Costa and Peixoto

relationship with citizens and hence simplify the provision of remote and digital services. Smart Mobility will need to become more and more intelligent and sustainable, for example by incentivizing electric environmentally friendly mobility and the use of bikes and alternative means of transport. Ultimately, the environment and sustainable development remain the focus of attention (Smart Environment), while Smart Living, namely the level of comfort and well-being, will have to be guaranteed to citizens with new modes of access to health, education, security and culture services.

4.4. Creating flexible energy communities

 The European Union has introduced the concept of energy communities in its legislation through the "Clean Energy for all Europeans" package[61]. The directive highlighted the necessity to develop energy communities for a potential energy exchange between citizens in the future, notably as citizen energy communities and renewable energy communities. These energy communities would organise citizen-driven energy actions that lead the way for clean energy transition. They contribute to increasing public acceptance of renewable energy projects and making it easier to attract private investments in the clean energy transition. During the sanitary emergency, cities have become networks of services, assistance and solidarity. Being forced to stay at home, people have gained increased awareness of the importance of improving the quality of cities, which have arguably re-acquired their features as anthropological and physical spaces where new development ideas can flourish. In the EU Directive on Common Rules for the Internal Electricity Market (2019/944), new rules have been established which enable active consumer involvement, individually or through citizen energy communities, in all markets, either by "generating, consuming, sharing or selling electricity, or by providing flexibility services through demand-response and storage"[62]. Ultimately, thanks to the lessons learnt from the sanitary emergency, adoption of these good practices at the

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[61] European Commission (2020) *Energy communities* - Energy - European Commission. (2020). Retrieved 10 June 2021, from https://ec.europa.eu/energy/topics/markets-and-consumers/energy-communities_en.
[62] European Commission

international level should be part of new smart city scenarios where citizens become active participants.

4.4. Rethinking the city's timetable and the '15-Minute City'

Another important point which has been frequently raised regards rethinking the city's timetable- in terms of work activities, schooling, and public services- in a way that helps avoiding peak time gatherings within public spaces and mobility services. Local transport services have been significantly affected by the limitations on social gatherings, which have caused a drop in demand for public mobility[63]. If on the one hand it will become necessary to adopt specific measures for the use of public transport- such as entry limitations, sanitization- the necessity to favour individual means of transport may provide a significant boost to biking and walking, hence allowing for appropriate distancing while also aiding traffic reduction measures.

In this direction, a very futuristic proposal has been advanced lately by France, that of designing a 15-Minute City. The proposal by Paris mayor Anne Hidalgo was welcomed with enthusiasm, especially by the city of Milan in Italy, which included it in its Milan 2020 document[64]. This proposal aims at enabling citizens to reach the necessary services for work, eating and entertainment within a fifteen-minute time span, either by bike or walk. The 15-Minute city idea derives from the "neighbourhood unit" concept, developed for the first time in 1923 in a national architecture contest in Chicago, as a proposal to build new residential compact zones[65]. The idea is indeed that the proximity between services, public facilities and housing could lead to the creation of communities with a clear social and cultural identity on a local scale, thereby countering the anonymity of big metropolises.

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[63] Newsletter di Informazione. (2021), *5*. Retrieved 9 June 2021, from
https://www.green.unibocconi.eu/wps/wcm/connect/5e31426e-fe9e-4853-be44-4f30a8c00768/Newsletter5_Os servatorioSC.pdf?MOD=AJPERES&CVID=nAifoTv.
[64] Righini, S. *Trasformazioni | Ecco la "città dei 15 minuti", a misura d'uomo e rispettosa dell'ambiente - Linkiesta.it*. Linkiesta.it. (2020). Retrieved 11 June 2021, from
https://www.linkiesta.it/2020/05/citta-15-minuti/.
[65] Righini, pag.2

This project is a very ambitious and it will need time and a radical rethinking of the city in terms of territorial re-planning. Within the current debate, which aims at shortening production chains of globalization and hence favouring local services, there is growing awareness of the need for a stronger presence of national governance in the economy especially[66]. Within a Smart Economy optic, such futuristic proposals will require strengthening territorial planning to reorganize spaces and must rely on innovative metropolitan policies which integrate environment, mobility, collective services and the production system. Ultimately, within such a national.level agenda, local governments will be able to adopt urban planning measures that facilitate a different use of spaces, in a greater flexibility perspective.

4.5. Agile working and the work-life balance

The pandemic has transformed work modalities as most work activities had to turn to smart working. Smart working refers to a new way of managing work performance, based on measurable objectives and on flexible and agile working, namely in terms of location, work schedules and methodologies. The introduction of this agile type of working (or the extension of this existing modality to sectors which did not previously deploy it) has the potential to provide benefits in two domains: Smart Governance and Smart Living. As regards the first, discussions have revolved around the potential of smart working procedures to introduce important tools to measure work performance within public administration. Indeed, smart working can increase results-based management in the public sector, where all actors contribute to achieving a set of development results and hence ensure that their processes, services and products contribute to achieving desired results[67]. As regards Smart Living, smart working facilitates work-life balance, in that it introduces regulations to safeguard most vulnerable workers and it helps re-balance work and private life. Ultimately,

[66] Whittle, N. (2020). *Welcome to the 15-minute city*. Ft.com. Retrieved 11 June 2021, from https://www.ft.com/content/c1a53744-90d5-4560-9e3f-17ce06aba69a.
[67] Pazvakavambwa, A. & Steyn, G.. (2014). Implementing Results-Based Management in the Public Sector of Developing Countries: What Should be Considered?. Mediterranean Journal of Social Sciences. 5. 10.5901/mjss.2014.v5n20p245.

activating smart working does not merely mean providing employees with technological devices, but building an ecosystem of technologies, interactions and services surrounding the activity of working people.

4.6. Scenarios and Challenges after the Sanitary Emergency

In conclusion, the effects of the pandemic disease on cities show that a city's level of smartness determines whether it will be equipped to face the challenges of the future. This chapter has aimed to explore the opportunities and challenges that the Covid-19 emergency has brought about, and the lessons it has provided for future smart city development. The first is that, to innovate in an efficient way, it is necessary to foresee investment strategies and to adopt a clear vision, namely in terms of development plans which consider the concrete usefulness of technology for society. This requires foresight at all levels of governance, where the aim is not to pick the latest innovation on the market, which could have a short life-cycle and provide no benefits. In addition to this, it is fundamental not to adopt a one-sided mindset, namely one that focuses on the improvement of a single dimension within an optimization process. For effective innovation to happen, it is indispensable to rely on technologies while at the same type adopting an holistic approach to problem solving which involves multiple actors.

Therefore, aside from responding to the necessities of the moment, this sanitary emergency must alert us on the urgency to adopt a broad perspective, and to understand that everyone is part of the development process. This vision is especially relevant during the current recovery phase of the crisis. Forward-looking solutions, adopted in concert with actors from different sectors, can be a turning point in the evolution of cities after this difficult period. In this perspective, then, talking about smart cities becomes more and more relevant. Indeed, the need for an innovative ecosystem which we have experimented with in the last year is in conflict with the technical and administrative difficulties that hamper the realization of solutions to benefit the economy and society. In particular,

it is urgent to define clear and novel strategies to support innovation and the requalification of the workplace, hence revising practices which are no longer appropriate for today's technology infrastructures.

Making an urban context smart means implementing strategies able to solve problems and which take account of the real needs of the population, of enterprises and administrations. Installing a camera on a pole, for example, would not be a smart solution. Rather, a smart solution would be to enable the camera installation to detect traffic, or queues at the post office, or even to supervise parkings in an intelligent way. It is evident that coordinated efforts will need to be made at all levels of government and economic and social actors to overcome the emergency and build a better future for cities. This ultimately shows how the smart city takes on a role in this development not as a mere metropolis pursuing sterile technology. Rather it should be viewed in its configuration as a political ideology aimed at favouring the restoration of communities through software engines which are distinct systems which are intelligently integrated for their fruition by people.

5. Toward the Smart Enough City: Case Study Analysis to challenge Technocentric Innovation Models

5.1. Introduction

The following section will provide a thorough understanding of how smart city initiatives have so far been conceived and practiced by city governments, corporations and all the stakeholders involved worldwide. Main reference will be made to Ben Green's original and thought-provoking concept of Smart Enough City, a city ecosystem whose "intelligence" is not solely determined by its data-driven nature, but also by other attributes and dimensions[68]. In line with Green's vision, I will challenge the

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[68] Green, B. (2019). *The Smart Enough City : Putting Technology in Its Place to Reclaim Our Urban Future*. MIT Press.

commonplace idea of a smart city as being the mere byproduct of technological breakthroughs. Indeed, the widespread view of the smart city as the "utopian" city exaggerates the power and importance of technology to the point that cities are mostly seen as technology problems to solve. Conceiving of every issue as a technology problem means limiting solutions to technical ones and dismissing other remedies, ultimately developing narrow conceptions of what a city can and should be. In Green's words, reshaping the foundations of municipal governance and urban life according to this perspective will create cities that are "superficially smart but under the surface are rife with injustice and inequity". This section will therefore explore case studies of initiatives from around the world and will view them through the lens of Green's perspective. This will allow me to question the popular technocentric view of smart cities and thus devise more comprehensive and balanced scenarios for our cities of the future.

To better assess what forms of innovation are needed in cities and how these can be combined to improve urban living, it is imperative to acquire an all-inclusive understanding of a city's needs and features. Technology is most impactful when it is deployed with other forms of innovation which tackle different aspects of a city. To date, technology has been applied in a way that makes existing programs more efficient, but it still appears that most smart city projects lack a clear assessment of how well these processes respond to the needs of urban residents. Green's perspective follows the socio-technical strand of thought seen previously in the literature. In fact, in his words, a truly smart city is one that "recognizes that social problems are rooted in more than just technological limitations and embraces a variety of approaches to ameliorate those problems"[69]. Another important aspect that makes a city smart is its ability to couple the adoption of technology with reforms to operations and institutions.

At the core of such a type of city is an awareness that technology will be fruitless unless it is appropriately incorporated into municipal practices and structures. Smart cities have opened the

[69] Green, pages 25-28

way for collection of so-called "big-data", i.e. "simply, cheaply and efficiently created databases or sensor networks", which gathers information from different sources to test and implement sophisticated simulations on behavioural aspects of citizens and urban processes[70]. Business models based on algorithms, technologies and data are the underlying asset of large ICT (Information and Communication Technology) companies, which creates dependencies for municipalities, politics, administrations and society at large. This is especially true in the case of medium-sized cities, where administrative bodies have limited budget and personnel. Values and politics are therefore always involved when new and more efficient technologies are adopted. Ultimately, the way a smart city technology is developed and deployed always has significant political consequences. By framing urban issues as technology problems, ideologists of the smart city disregard the normative and political aspects of these issues.

The fundamental question of this chapter is not whether to be in favour of innovation and technology or not. It is, rather, how to realize the type of innovation and progress that will be most beneficial to city residents. This question will be addressed through the analysis of different initiatives worldwide in the following four areas: transportation, network infrastructures, civic participation and urban planning. Some case studies will be considered to showcase successful smart city examples. Others will be used as illustrations of smart city initiatives that leave ground for further improvement. Overall, these initiatives have been selected for the purpose of this thesis to show how some innovations can serve as models in a best-practice/worst-practice framework. They represent the varied results from countries worldwide in approaching the smart city agenda in a way that considers innovation in all fields and that allows the citizens to take centre stage in the process.

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[70] Dembski, Fabian & Wössner, Uwe & Letzgus, Mike & Ruddat, Michael & Yamu, Claudia. (2020). Urban Digital Twins for Smart Cities and Citizens: The Case Study of Herrenberg, Germany. Sustainability. 12. 17p. 10.3390/su12062307

5.2. The Smart Columbus case: addressing inequality through transportation. Columbus, Ohio, United States.

In 2013, The Mid Ohio Regional Planning Commission (MORPC) issued a study for the city of Columbus, Ohio, called insight2050. It contained a long-term planning assessment of four potential growth scenarios for the region over the next decades. The vision for Columbus was one of mitigating inequality and improving social welfare, beyond the general purpose to improve mobility and transit. Hence, the Smart Columbus project came about, and it aimed at positioning Columbus as Ohio's epicenter of Smart Mobility. The objectives of this program were to: 1) prepare Columbus for the future of Internet of Things (IoT) by investing in an "upgradeable smart city foundation" 2) to make Columbus a living laboratory for smart mobility by piloting new technologies and finding new mobility solutions 3) inspire the broad adoption of new technologies that improve quality of life in Columbus, hence leading the way for a region-wide culture shift[71].

Smart Columbus's objective to overcome inequality through transportation had a specific focus, namely the neighbourhood of Linden. This neighbourhood is situated between downtown Columbus and Easton and it suffers from an above average unemployment rate[72]. In listening to the needs of Linden's residents, the group understood that the barriers to jobs and healthcare in Linden went beyond the mere lack of convenient transportation. One of the main hurdles was that most Linden residents lack access to data plans, bank accounts or smartphones to unlock and use cost-effective solutions like car-sharing and bike sharing apps. Given these complex and multifaceted issues, the group engaged directly with neighbourhood residents, learning that transportation was one of the factors that contributed to the daily challenges they faced. Transportation challenges included multiple bus route transfers, lengthy commutes and prolonged bus waiting times.

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[71] Braun, B. (2017). *Smart Columbus Overview*. Presentation.
[72] Green, pages 30-32

In response to these issues, Smart Columbus created Pivot, a multi-modal planning and common payment app which allows users to pay for all of the region's means of transport both through their smartphones and through digital kiosks located throughout the neighbourhood[73]. Through this system, users are able to reach smart-city kiosks to plan an end-to-end trip, book and pay for either bus rides, taxis, shared bikes or scooters with a card that can be loaded with cash. Ultimately, the Smart Columbus case is a successful example as it shows two important attributes which a smart city project should have. The first involves setting a clear policy agenda before making use of technology. The other important ingredient is focusing research on people rather than technology. Assessing the city's needs and challenges before developing technological solutions has proven to be essential to the success of this project.

5.3. Network Infrastructures and Brescia's Open Fiber experience: improving literacy on innovation management in Italy

This case study will analyse the development of smart network infrastructures in Brescia and will investigate how well these transformations have been integrated into the knowledge of city administrators. Brescia is a Northern italian city which in recent years has experienced an ever-growing population due to study and work reasons and to the multitude of services it offers. The city has gradually transformed itself into an important pole of attraction for the third sector and has always set itself apart from other italian cities for its focus on innovation. The municipality of Brescia developed the final version of the Urban Digital Agenda back in October 2016. The Agenda gave way to a laboratory of important innovation projects named "Brescia 2030"[74]. The working group focused on four different project areas: Health and Wellbeing, Education, Culture and Tourism, Industry and Enterprises. The aim of these laboratories was to define concrete actions and shared

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[73] Davis, J. (2019). *How Smart Columbus is advancing city transportation tech*. StateScoop. Retrieved 6 June 2021, from https://statescoop.com/city-transportation-technology-smart-columbus/.
[74] Busato, N. (2021). Interview with Nadia Busato: Project Manager of Brescia Smart City [In person]. Rome.

projects for the development of the territory of Brescia, in terms of infrastructure, digital transition and socio-cultural transformation.

The pilot project in this ambitious laboratory of smart city initiatives was the installation of the optical fiber throughout the city of Brescia. In 2019, the city administration invested in an Open Fiber system covering around 70 thousand properties (more than 6 thousand km) allowing increased connectivity speed to the highest performances. The aims of this project were manifold: 1) to improve network and energy efficiency (through the remote controlling of electric meters), 2) to boost the efficiency of video surveillance, 3) to access data and information to monitor and inform administration about security and environment (Brescia Smart Living) 4) to digitalise all of the city's educational institutes, with the "Scuole in Rete" project (namely, "Networked Schools")[75]. Ultimately, within this hyperconnected reality, the aim of Brescia 2030 was to make citizens also "digital" citizens. In other words, it aimed at social inclusion and digital literacy for citizens to actively interact with new technologies and thus increase their participation within the city ecosystem.

The outcomes of this Open Fiber project , however, partially skewed the desired objectives. It was with the outbreak of the Global Covid-19 pandemic of 2020 that the digital transition presented some difficulties. The city's administration responded to the urgency of transitioning to remote work by rapidly virtualizing most public services. However, the sanitary emergency highlighted some gaps in teaching public administration how to switch to digital services. It was only with the outbreak of the sanitary crisis that administrative procedures were simplified for the understanding and adoption by public officials. As Brescia Smart City project manager Nadia Busato contends, the provision of digital services is not merely the online transposition of procedures normally undertaken offline. It rather involves the re-design and simplification of procedures[76]. Within offices, the administration had to rethink by itself the simplification of procedures to access workstations from home. Within

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[75] Busato, N. (2021). Interview with Nadia Busato: Project Manager of Brescia Smart City [In person]. Rome.
[76] Busato.

the broader italian framework, industrial plans, more specifically the Piano di Ripresa e Resilienza, which also include innovation and digitalisation as one of the main pillars, have not been effectively implemented. Despite the city of Brescia being a pioneer of smart city initiatives within Italy, recent phenomena attest to the fact that instruments to make public administration and the population at large literate on the wide variety of IT instruments available to them, are still lacking. This case shows how there still exists groundwork for improvement even in the most innovative city projects, and it ultimately signals that the real transformations begin when citizens and administrations are made knowledgeable and active within the digital revolution.

5.4. Democratic civic engagement: the reality of '311' apps in American cities

Technocentric views of smart cities have generally pointed to direct democracy as the epitome of democratic civic engagement[77]. There indeed exist a number of apps, especially in American cities, that aim at transforming politics and civic engagement processes. Most cities across the U.S. have adopted the digital services apps called 311 as part of their 311 non-emergency hotline programs, typically anchored by a call center where agents locate calls from citizens[78]. The intention behind these is to improve civic engagement in a way that provides more personalized and more efficient public services. Residents can photograph damaged street signs or potholes and notify the municipality without needing to call city hall and ask for services. After reporting, residents receive updates from the government when the issue is solved. Behind development of 311 apps is the belief that service delivery is improved thanks to the public acting as "the government's eyes and ears"[79]. The idea behind it is that this service would in turn increase trust in the government.

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[77] Green, pages 48-50
[78] *Cities Find Big Value in 311 Apps - DATAMARK Insights*. DATAMARK Insights. (2021). Retrieved 8 June 2021, from https://insights.datamark.net/cities-find-big-value-in-311-apps/.
[79] Green, pages 53-54

However, as Green asserts, the effects of these engagement apps on civic participation are limited. These apps indeed drastically simplify civic interactions to the point that this quick and easy design of engagement fails to encourage meaningful citizenship. Political scientist Han's research provides insights into how engaging people in action to solve problems often takes the form of "transactional organizing"[80]. As she explains, when organizations in general think about engaging people in their work, they do so in transactional ways, for example just by "trying to get the right number of people" on board, hence only focusing on supervision, organization and performance[81]. This common ideology also applies to civic groups: they organize opportunities to get involved in an issue while the individual provides time and energy[82]. In contrast to this quick and easy type of organizing, Han suggests that the most effective type of civic participation strategy is that of "transformational organizing", which cultivates people's motivation, skills, and capacities for further activism and leadership[83]. In this type of organizing, the focus is rather on deploying mobilization tactics to increase people's involvement, thus improving civic development rather than transactions. This radical form of organizing requires a mindset shift to encourage people to take on more responsibility and lead future efforts. These engagement apps are ultimately an example of "transactional mobilization": they aim at maximizing the quantity of interactions by minimizing barriers to submitting opinions and requests, but they do not create an active community among users and eventually do not cultivate deeper engagement[84].

In conclusion, as the case of 311 apps shows, engagement is a critical dimension in developing a smart city. In this case, people's smartness is determined by their ability to become active citizens who participate in deliberation. However, innovative strategies to transform democracy fail when they are based on the values of efficiency and simplicity that technocentric views tend to promote.

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[80] McKay, S. (2016). *Organizing for Transformational Change*. Carnegie Foundation for the Advancement of Teaching. Retrieved 8 June 2021, from
https://www.carnegiefoundation.org/blog/organizing-for-transformational-change/.
[81] McKay,
[82] Green,
[83] Green,
[84] Green,

These values, indeed, do not address the fundamental challenges behind engagement and democracy. Democracy, as Green asserts, does not limit itself to a project of aggregating preferences and making logical decisions[85]. At the root of making citizens smart is rather allowing individuals a voice in setting priorities and policies. Addressing political issues, such as how to allocate resources across the population, as coordination issues, such as how to respond to requests efficiently, techno-centric views disregard and exacerbate the inequities that exist in the social fabric.

The experience of 311 apps misinterprets the role of government in a smart city, which seems more akin to a customer service agency which exists to address personal needs. At the core of making citizens "smart" in the sense of fostering civic trust and participation is ultimately reducing the inequalities that discourage people from participating in public life and abolishing practices that systematically marginalize certain communities. In Green's words: "power shifts not when a new technology makes existing processes and interactions more efficient but when those processes and interactions are restructured to give the community greater influence over local governance, whether that is achieved through technology or not"[86].

5.5. A Bottom-up Approach to Urban Planning: People-Centric Digital Twins in Herrenberg, Germany

This case study focuses on an interesting and forward-looking experiment which has been developed to improve urban planning in the city of Harrenberg, Germany. As a premise to this study, it is important to gain an understanding of cities as being complex systems with varying demographic, ecological and economic conditions. Most importantly, cities encompass diverging

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[85] Green, B. (2019). *The Smart Enough City : Putting Technology in Its Place to Reclaim Our Urban Future*. MIT Press.
[86] Green, pag. 36

interests and perceptions of citizens and stakeholders. In this framework, digital technologies and applications gain fundamental importance in putting rational and formal knowledge to the use of a smarter and more sustainable city governance which involves the experience of citizens and makes urban planning more intelligent and democratic[87]. With this rationale in mind, a group of researchers in 2020 developed the prototype of an urban digital twin for the town of Herrenberg in Germany, which has a population of 30,000 inhabitants. Urban digital twins are sophisticated data models which allow for collaborative processes and comprehensive data exchange. They often consist of simulations, models and algorithms which describe their physical counterpart, including its behaviours and features in the real world. They therefore provide digital representations of material or immaterial objects and, to enhance real-life perception, they can be implemented in virtual reality systems[88]. According to the surveys undertaken by the researchers, this method and technology could significantly support collaborative and participatory processes.

Putting urban digital twins to an effective use for the design of a smart city arguably depends on understanding how these tools support urban planners,designers and the general public in improving collaboration to efficiently design the urban landscape[89]. In this context, modeling and visualization have the potential to become valuable tools to analyse crucial complex processes and data such as the participation of marginalized groups. They indeed can become fundamental instruments to address key city challenges. To date, however, digital twins with their modeling and simulation tools have mostly been deployed in the field of engineering, whereas their implementation for urban planning is a recent topic of discussion. The idea of applying digital twins to the town of Herrenberg followed consideration of a number of critical aspects characterizing its urban landscape. Herrenberg is part of the Stuttgart metropolitan region, which features a "fragmented suburban location with a diffuse belt between urban settlements and rural landscapes with low population density"[90].This implies a great

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[87] Dembski et. al., pag. 5
[88] Dembski et. al., pag. 7
[89] Dembski et. al., pag. 5
[90] Dembski et. al., pag 6

dependency on infrastructure and an increase in traffic of individual automobiles. Generally speaking, the Stuttgart hinterland sees high volumes of traffic, mostly caused by a high dependency on commuting, fragmented communities, and a lack of spatial governance[91].

Therefore, by adopting the digital twin technology, researches aimed at addressing the main issue, namely the strong environmental pollution in the city caused by emissions and noise. The prototype hence consists of different techniques to address the issue 1) 3D modeling 2) mathematical street network modeling 3) urban mobility simulation 4) wind flow simulation 5) people's movement patterns 6) stationary activity data, and 7) a number of empirical quantitative and qualitative data using volunteered geographic information (VGI)[92] to understand people's perception[93]. These systems aid collecting data about people's movement routes, social data, and photographic impressions of transit dynamics.

To collect empirical data through volunteered geographic information (VGI), researchers developed the mobile application "Reallabor Tracker" (Real Lab Tracker)[94]. The application, which relies on the Open Street Map (OSM) Tracker[95], allowed users to trace their daily routes, rate the quality of the public spaces, to record imagery and sound samples, and to make comments in the form of notes[96]. Through the application, researchers were able to trace the space and time of movements, daily

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[91] Dembski, et. al. pag 6

[92] Volunteered geographic information (VGI) is the harnessing of tools to create, assemble, and disseminate geographic data provided voluntarily by individuals.
https://en.wikipedia.org/wiki/Volunteered_geographic_information#:~:text=Volunteered%20geographic%20information%20(VGI)%20is,data%20provided%20voluntarily%20by%20individuals.

[93] Dembski et. al. pag 2

[94] Dembski et. al.pag 3

[95] The Open Street Map is a collaborative project to create a free editable map of the world. The geodata from OSM can be used in various ways including production of paper maps and electronic maps (similar to Google Maps, for example), geocoding of address and place names, and route planning.https://en.wikipedia.org/wiki/OpenStreetMap#:~:text=OpenStreetMap%20(OSM)%20is%20a%20collaborative,editable%20map%20of%20the%20world.&text=The%20data%20from%20OSM%20can,place%20names%2C%20and%20route%20planning.

[96] Dembski et. al.

routes, in specific time windows or over certain periods of time[97]. In this regard, there was special attention to data protection. Indeed, visualizations do not show the exact location, the participants were informed accordingly and all personal data of the mobile operators were made anonymous. Moreover, participants could evaluate public spaces on-site, record traffic noise and other sounds and take photos and add further comments as notes[98].

As regards decision making between politicians, experts from different disciplines, administrative staff and citizens, the visualization in Virtual Reality[99] ("virtual twin") which was tested in the experiments has the potential to significantly enhance communication. Indeed, simulations can reduce complexity and spatial and visual representation can aid better understanding. For example, results from simulations are presented in a direct and more easily understandable way in comparison to conventional methods or in specialist language[100]. Thanks to these systems, participation becomes more attractive and inclusive for groups of people which would normally be harder to reach by such formats (e.g. children, teenagers, residents with a low level of education or language barriers). Virtual Reality(VR) projection allows the engagement of up to 15 participants at the same time while on-site VR projections during major events involve hundreds of people[101]. The main takeaway from this experiment is ultimately that various participants with diverging personal and professional backgrounds can be informed at the same time.

In conclusion, the digital twin promises to be a very effective tool for smart urban development due to a number of reasons. Firstly, the digital twin has the potential to support the development of scenarios and testing of urban challenges at all levels. As Dembski et al. assert, "an urban digital twin

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[97] Dembski et. al.
[98] Dembski et. al.
[99] Virtual reality (VR) is a simulated experience that can be similar to or completely different from the real world. Applications of virtual reality include entertainment (e.g. video games), education (e.g. medical or military training) and business (e.g. virtual meetings) https://en.wikipedia.org/wiki/Virtual_reality
[100] Dembski et. al. pages-10-14
[101] Dembski et. al. pages 13-14

is not the exact copy of reality, but a sophisticated abstraction of it"[102]. Secondly, the application of urban digital twins and virtual reality to collaborative planning eases consensus-building among participants from different personal and professional backgrounds. Most importantly, it fosters a common learning process related to such educational aspects as involving youth or other groups of citizens which are not normally involved in such processes[103]. Thirdly, this type of digital twin is the first, among other simulation-based studies in the field of smart cities, to link and combine various urban data from analysis, simulations and models and to apply social data collected from citizens. Lastly, it enables decision-makers to gain an understanding of digital technologies' added value as a solution-oriented holistic approach to solving problems[104]. Urban digital twins have the potential to pave the way for sustainable urban development on every scale. Qualitative studies have ultimately been undertaken to gauge the respondents' perspective on the benefits of these virtual urban models and possible missing information in the presented virtual model. The respondents emphasised the transparency and concreteness of the model, and recognized how it can help improve the interaction processes between citizens on the one hand and official local representatives on the other, thus optimizing urban planning processes which are normally very complex and time-consuming[105].

As promising as the urban digital twin is, consideration must be made of its limitations as an experimental project. As stated by Dembsky et al., the model embraces two crucial competencies required by smart city projects: " 1) an understanding of the impact of implementing digital technologies in the context of urban systems, and 2) integrating solutions that overcome departmental thinking"[106]. However, being a model, the urban digital twin does not encompass all the information from real life and the physical world. The objective of this study is to achieve similarities to the real world accurate enough to tackle complex problems[107]. Furthermore, the sample of people was a small

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[102] Dembski et. al. page 16
[103] Dembski et. al., pag. 16
[104] Dembski et. al., pag 15
[105] Dembski et. al. pag 14
[106] Dembski et. al. pag 15
[107] Dembski et. al.pag 15

and non-representative one. In fact, different people within society may have different perspectives on such new tools. Therefore, realization of the digital twin must be accompanied by social science survey research to analyze the evaluation and perception of virtual urban models. According to Batty, the model strongly needs additional environmental, economic and social data[108]. that there remains a strong need for additional social, economic, and environmental data.

All things considered, with due account of the respective features, the project has a good potential to be applied in a similar way to other small and medium-sized cities facing similar challenges due to digital transformation. The urban digital twin indeed represents a promising avenue in bottom-up, participatory urban planning. With its system of data protection and privacy, it also shows how smart city solutions have the potential to democratize urban data and preserve citizens' data sovereignty. Demonstrating its validity as a transformational tool for democratizing the development of smart cities ultimately rests upon more in-depth social science to reach valid conclusions in a real-life setting.

5.6. A scenario for the Smart Enough City

In this chapter, I have shown how digital tools can support the inclusivity of citizens in multiple domains, to the extent that they are embedded in a comprehensive agenda that is valued by policymakers. Smart cities are truly smart when technical innovations are people-centered and improve people's quality of life, not when they focus on achieving economic efficiency or process optimization. To reach this outcome, there needs to be an improved understanding of the complex problems facing urban systems, an appraisal of the diverging needs and requirements of citizens and the impact of innovations on the social and environmental domains, not only the economic one. The prototype of a digital twin discussed above has the potential to provide a support system to city

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[108] Batty, M. Digital twins. Environ. Plan. B Urban Anal. City Sci. 2018, 45, 817–820

governance. It represents an information system which can be used both in the daily management of cities and for specific purposes.

 It can address urban complexity, where cities need to become experimentation hubs through the active participation of citizens. This is possible thanks to social analyses, questionnaires, together to follow up with data gathering. The difference between classical smart city models and the digital twin is that the former view the many layers of a city (infrastructures, public spaces, mobility, environment etc.) as separate layers. The digital twin, rather, captures the interconnections between these layers and reflects an understanding that interventions on any system produce outcomes for the others. Transforming the city into a truly intelligent and innovative city ultimately rests upon two main conditions. Firstly, capturing the dependencies that exist between urban systems, political, social, economic and environmental dimensions. Secondly, giving sovereignty of data and access to information back to the citizens for them to become active citizens participating in the evolution process.

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Conclusion

This study has aimed to show how designing a smart city is a complex process which requires a holistic understanding of all the aspects involved in making a city intelligent. The theory surrounding the smart city ideology shows that agreement on the interrelation between the six dimensions of a smart city is still missing. From the results of this study, it appears that there needs to be a paradigm shift in the collective understanding of what constitutes a smart city. Governments, policymakers, corporations and all the stakeholders involved, in most cases, do not seem to be acting in concert towards this transformation. This has become especially evident with the outbreak of the Global Covid-19 sanitary emergency: most cities did not have a resilience network to support a rapid recovery from a crisis situation. The slow response to the crisis posed by the pandemic is a testament to the fact that innovation plans were not always adequate to overcome the challenges facing the cities of today.

In providing a summary of the results and understandings reached throughout the course of this thesis, I will outline the aspects that innovation projects for smart cities should take into account. A point of departure should be a thorough understanding of the six dimensions (Smart Governance, Smart People, Smart Economy, Smart Mobility, Smart Environment, and Smart Living) in their individuality but also as constantly interrelated systems. Having a positive impact on cities involves marrying technical skills with careful program design and an empathetic consideration of the complexity of city life. Hence, as learnt from this study, a city becomes smart when 1) it is adaptable 2) it is inclusive 3) it puts technology to the service of people 4) people are literate about technological applications and 5) it tackles digital exclusion.

Firstly, smart city planning should adapt to the needs of the individual city. This implies having an understanding of the challenges and requirements of citizens in all parts of the city, in terms of access

to transportation, facilities, energy efficiency, and inequality. Adaptability means responding to the population's specific needs but also to the changing needs of the population over time. This requires consistent research and dialogue with the population. Secondly, city planning should be inclusive, as it should incorporate civic participation. This implies constant evaluation of smart city initiatives with the involvement of citizens, to assess whether these still respond to the needs of city inhabitants. Inclusivity through citizen participation means undertaking processes of co-creation and transformational organizing which places citizens at the core of the urban revolution. This also entails targeting population groups which are likely to be socially, politically, economically or ethnically excluded from the decision-making process. As seen throughout the case study analysis, it is not the mere provision of government services through technological applications, but an actual empowerment that makes citizens the agents of change.

Innovative technologies can therefore make smart cities inclusive and equitable, but "smart inclusivity" is not an automated process. It depends on the concerted efforts of all community stakeholders, especially those in leadership positions, to make for equitable, sustainable and diverse smart city planning. City stakeholders, including administrators, community leaders, and business people, must recognize that a smart city is not synonymous to an inclusive city. There needs to be concrete action to bridge the gap between these two aspects. and that action is needed to bridge the gap between the two. These stakeholders should therefore focus the efforts of local innovation systems towards devising solutions that ensure inclusive development of smart cities.

As regards the implementation of technologies and the use of data, smart cities should put these to the service of citizens, rather than blindly applying them as the panacea of all city's issues. The advent of data is a very promising phenomenon for this generation. Indeed, data provide unlimited avenues to exploit in order to reshape urban areas and make informed decisions. However, using data to improve the urban fabric is not merely a matter of efficiency and simplicity. Data aids optimization in a wide number of areas from transport to energy production, to environmental sustainability and

the supply of public services. Data can have an immense impact on how cities function in terms of societal structures, governance and physical spaces. With these data available, urban managers and other stakeholders are able to provide real time responses to a broad range of issues, from transport, to security and environment. For data use to be targeted and effective, though, there needs to be a socio-technical understanding of a city's complex issues and it should not solely be in the hands of technology specialists but also of citizens and other stakeholders.

Finally, as regards tackling digital exclusion, smart city strategies need to target digital literacy as a form of inclusivity. They should lay out measures to ensure that everyone benefits from smart initiatives, regardless of their level of digital literacy and background. So, if certain government services transfer online, as happened during the Covid-19 emergency, careful consideration must be made of the digital literacy of those who will need those services. A smart city must be an ecosystem that benefits all layers of society and that favours collective understanding and active participation. Therefore, education on Information and Communication Technologies should be centre stage, along with guidance on services through public institutions.

Ultimately, this study on smart city development was striving towards exploring smart city designs that are not the result of efficiency and simplicity but rather make cities of the future resilient and build strong communities of active citizens. As that of smart cities is a relatively recent phenomenon, devising scenarios on its development presents its limitations. As seen in the last chapter, technological models like that of digital twins represent very promising experiments in making the city an ecosystem of improved quality of life. However, their success as transformational tools for smart city evolution has still a long way to go. There needs to be a thorough and collective understanding of cities as complex ecosystems where different dimensions merge together. Smart ecosystems are the future avenues of urban development, but not with technology alone.

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