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Book

Smart cities and clusters

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1 Introduction

The aim of this paper is to provide some insights into the interplay between clusters and smart cities. In recent years, smart cities and clusters have separately been the object of a considerable number of analyses, academic articles and policy reports. Nevertheless, very little attention has so far been paid to the links between them. Consequently, the ideas developed in the following pages constitute an attempt to shed light on the conceptual and empirical links between clusters and smart cities.

The first section is devoted to the origins of the concept of smart cities. The term “smart city” emerged progressively in the 1990s. The concept has become increasingly popular in scientific literature and international policies. Nevertheless, it is easy to detect in the literature a wide variety in the understanding of what a smart city may be. The result is a very heterogeneous corpus of definitions. This paper adopts an EU policy-related perspective in order to provide a working definition.

The next section provides an analysis of the interplay between smart cities and clusters. It seeks to answer the following questions: How can clusters support the development of smart cities? How can smart cities foster clusters? What are the enablers for and obstacles to the convergence between smart cities and clusters?

Empirical observations of national, regional and local examples are provided in section 4 and allow a comparative analysis of how clusters promote the development of smart cities.

Concluding the paper, the final section attempts to pave the way for the formulation of policy recommendations at regional, national and European levels. The main recommendation in this respect is to invest in the field of foresight in order to establish scenarios for the future for designing policies fostering the convergence between smart cities and clusters as a means of supporting and accelerating regional industrial modernisation.

2 Smart cities: concepts and definitions

Origins of the concept

The term 'smart cities' emerged progressively in the 1990s. The concept has become increasingly popular in scientific literature and international policies. According to Albino et al. (2015), the California Institute for Smart Communities was among the first to focus on how communities could become smart and how a city could be designed to implement information technologies. Over the past 20 years, the smart city concept has had many definitions, with smart cities being places where information technology is combined with infrastructure, architecture, everyday objects and our bodies to address social, economic and environmental problems.

Understanding the diversity of definitions

There are several definitions of smart cities in the literature (cf. Chourabi et al., 2012). A **smart city** could be considered to be a city that:

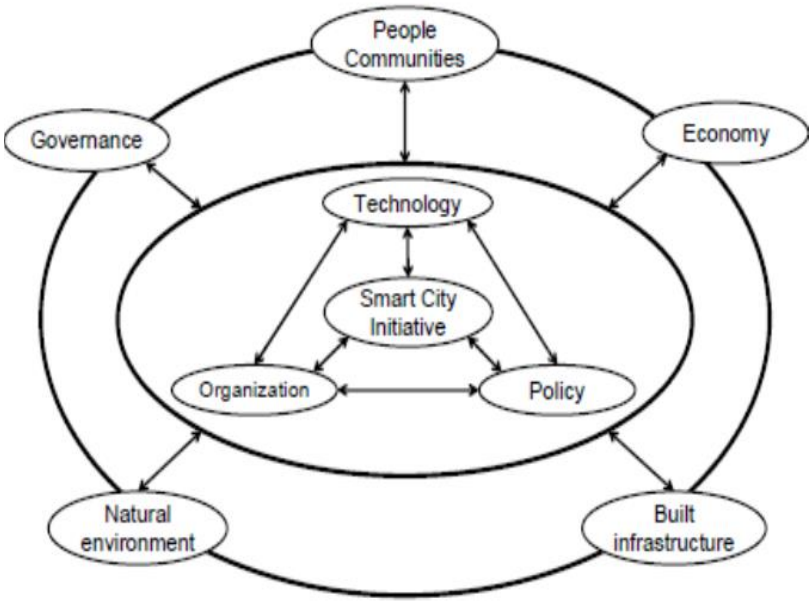
- connects the physical infrastructure and the IT infrastructure with the business infrastructure to leverage the collective intelligence of the city;
- strives to make itself 'smarter' (more efficient, sustainable, equitable, and liveable);
- combines different technologies with (urban) planning efforts and organisational aspects in order to design, dematerialise and speed up administrative processes;
- performs well in a forward-looking way in its economy, people, governance, mobility and environment, built on a smart combination of its endowments and the activities of its citizens;
- monitors and integrates the conditions of all of its critical infrastructures, including roads, bridges, tunnels, railways, underground railways, airports, seaports, communications, water, power, even major buildings, and which can therefore better optimise its resources, plan its maintenance activities and even monitor security aspects in order to maximise its services to citizens.

It is clear that the global rise of cities and megacities generates new kinds of problems: human health concerns, difficulties in water and waste management, air pollution, lack of social inclusion, traffic congestion, etc. Addressing these **challenges linked to societal and environmental sustainability** can be enabled by smart city solutions:

- Smart, green and integrated transport offering inclusive connectivity;
- Secure and clean energy;
- Health, demographic change and the wellbeing of the population;
- Climate action, environment and resource efficiency;
- Safety and security.

At the same time, it is necessary to acknowledge that science and technology can only account for a part of the challenges listed above. In fact, against this background Chourabi et al. (2012) identify **eight critical factors of smart city initiatives** (see following figure).

Figure 1 – A framework for understanding smart city initiatives



Source: Chourabi et al. 2012, p. 2294

Challenges depend heavily on the local context. Therefore, there is not a single smart city model that could act as panacea for different cities. A smart city is not an optimised static construction but a resilient evolutionary system.

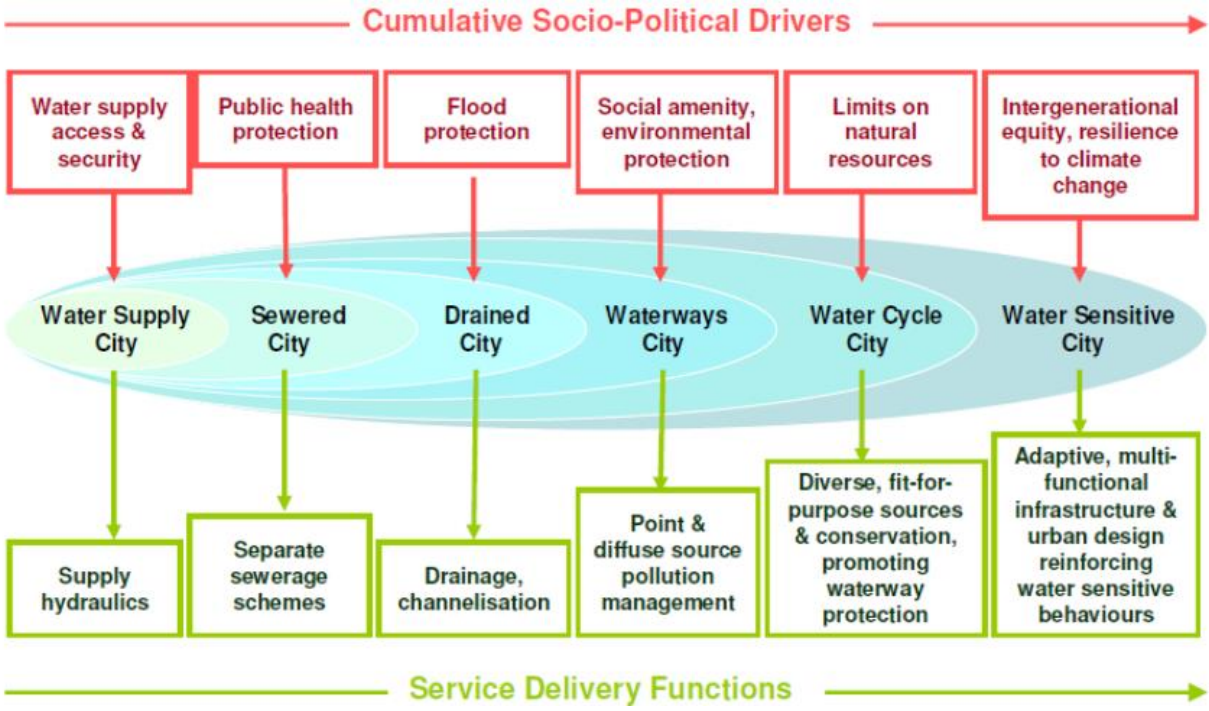
At the same time, smart cities are related to the issue of **urban development**. Nevertheless, according to Caragliu et al. (2009) urban performance depends not only on the city's endowment of hard infrastructure ('physical capital') and the use of ICT to increase its performance but also, and increasingly, on the availability and quality of knowledge communication and social infrastructure ('human and social capital'). These authors identify three specific **smart city characteristics relevant for investigating the potential impact of clusters** to contribute to the performance of smart cities:

- The attention paid to the role of human and social capital in urban development;
- The importance accorded to sustainability as a major strategic component;
- The focus on the aim of achieving social inclusion in public services.

Information and Communication Technologies (ICTs) are at the core of smart city initiatives. In fact, the integration of ICT with development projects can change the urban landscape of a city and offer a number of potential opportunities. In other words, ICT integration is expected to enhance very significantly the management and functioning of cities. As such, ICT solutions can improve the quality of life for citizens, but they can also increase inequalities and promote a digital divide. Furthermore, implementing centrally controlled ICT tools means increased top-down regulation, which is the opposite of creativity and participative democracy.

Cities emerging as smart can result in them tackling environmental challenges better (such as ensuring water supply). Focusing on the specific example issue of water management, Brown et al. (2008) propose a transition framework, presenting a typology of six city states, namely the 'Water Supply City', the 'Sewered City', the 'Drained City', the 'Waterways City', the 'Water Cycle City', and the 'Water Sensitive City'. This framework recognises the temporal and technological contexts of cities' transition to sustainable urban water conditions (see next figure).

Figure 2: Becoming a smart city: The example transition from a water supply city to water sensitive city



Source: Brown and al. 2008, p. 5

A city that is becoming 'smart' may also have more options to facilitate its transition into a digital, green, circular or resilient city. A city can be smart by maximizing its physical infrastructure with the use of ICT, circular by discarding linear thinking and embracing the circular economy, digital by putting technologies at the service of people in order to achieve economic growth, and resilient by developing the ability to absorb, recover and prepare for future shocks. More generally, a smart city is a city which its inhabitants are happy to live in.

In the wake of participative democracy, increasing interest is devoted to enquiries about the wellbeing of the inhabitants. Such an instrument certainly contributes to the development of the smart city. The basic idea is understand which factors strongly impact (positively or negatively) the individual and collective "subjective wellbeing". Is it mainly economic opportunities, quality of life, environmental issues, health, cultural supply, security, equality and inclusion…? What is the ranking of importance/urgence in any additional supply of services or amenities among all these topics? What is presently growing in relative importance?

It is worthwhile noting that we do not aim here at maximizing the "happiness level" of the individuals. *Wellbeing* is a more serious concept than (instant) *happiness* – the latter being a purely psychological issue that cannot be monitored by administrative measures. At best, statistics of happiness can be used as a communication device for territorial marketing. *Long run inclusive wellbeing* is a rather better indicator for the smart city. The result of enquiries in this field help to refine urban policies, for instance in balancing contradictory objectives like: demographic and economic growth versus quality of life; touristic attractiveness versus authenticity; urban sprawling versus housing densification; security and social control versus individual liberty; etc.

Smart cities: a working definition

Numerous initiatives have been undertaken on how to label 'smart cities' (an analytical overview is given by Russo et al., 2014). At the same time, and consistent with the diversity of situations and issues at a global level described above, there is no single "official" definition of 'smart cities' used exclusively by European Institutions. Nevertheless, the definition below, combining two EU sources, [1,2] can be considered generic enough to provide a working definition for this paper:

Box 1: Smart cities – a working definition

A smart city is a city seeking to address public challenges (e.g. regarding transport, water & waste, energy, health, safety & security) via ICT-based solutions on the basis of a multi-stakeholder, municipally based partnership approach, which makes traditional networks and services more efficient for the benefit of its inhabitants and businesses.

Potential results of putting in practice smart cities are better organised urban transport networks, upgraded water supply and waste disposal facilities, and more efficient ways to light and heat buildings. It also usually implies a more interactive and responsive city administration, safer public spaces and meeting the needs of an ageing population. As a consequence, smart cities appear as a vector of product, processes and service innovations.

1 https://ec.europa.eu/info/eu-regional-and-urban-development/topics/cities-and-urban-development/city-initiatives/smart-cities_en

2 European Parliament (2014, p.24)

3 Analysing the links between smart cities and clusters

We address here the relationships between both concepts, smart city and cluster, for better understanding if the development of innovative ecosystems within the perimeter of the city is a necessary and/or sufficient condition for becoming *smart*.

How can clusters support the development of smart cities?

By their very nature, **smart cities need heterogeneous elements for their implementation**, some of them highly specialised and which typically may be produced in clusters, which are regional ecosystems of related industries and competences (see box 2).

Box 2: The concept of cluster

Following the seminal works by Michael Porter (see Porter 1998), different definition of clusters can be found in the literature. Clusters can be defined as groups of specialised enterprises (often SMEs) and other related supporting actors that cooperate in a particular location.
Clusters are commonly concentrated on one or more sectors within a specific region. They also emphasize networking and cooperation between companies and institutions, internal and external to the region. In this respect, clusters can be seen as groups of firms, related economic actors, and institutions that are located near each other and have reached a sufficient scale to develop specialised expertise, services, resources, suppliers and skills.
According to the literature and to empirical observations, clusters are commonly highly innovative, the best historical example being the Silicon Valley.

Expertise and solutions for the 'smart' deployment may not yet be available in the clusters within the area or proximity of a city and thus may need to be acquired from elsewhere. While experts may be drawn from clusters further away, it is also possible to seek demand-led development and build up expertise locally, including through **gathering feed-back and solutions** via intermediaries like cluster organisations. This may correspond more to a challenge-driven approach that fully considers the particularities of the specific location for the challenge to be addressed. Moreover, it offers an opportunity for cluster development and positioning in new industrial niches if the tested solutions are picked up elsewhere.

The core technical challenge for smart cities is to build the foundation for a **favourable environment with information sharing, collaboration and interoperability** for all inhabitants anywhere in the city, meaning that ICT is an enabler of urban welfare (Kraus et all, 2015). In addition, due to the innovative character of the emergence of smart cities, digitalisation is key.

Nam and Pardo (2011, pp. 286-287) highlight the fact that mobile, virtual, and ubiquitous - i.e. ever-present – technologies are not only constitutive elements of smart cities, but that

"*[t]hose technologies offer benefits to city dwellers in mobile lifestyle. Smart city application evolves from smart places to networked inhabitants. While the wireless infrastructure is a key element of digital city infrastructure, it is only a first step. A set of technological requisites for smart city comprises network equipments (fiber optic channels and wi-fi networks), public access points (wireless hotpots, kiosks), and service oriented information systems. A ubiquitous/pervasive computing infrastructure is a key technological component in the build out of a digital city*".

The process of development of a smart city results from the combination of two **different forces** (Angelidou, 2015): (i) a technology push effect and; (ii) a demand-pull effect. The huge technological advances of the two last decades, especially in the field of ICT, have made it feasible to develop a broad spectrum of goods and services which have enabled the development of smart cities. This is the technology push effect. This progress was driven in particular by technology oriented clusters. On the demand-pull effect, Angelidou (2015, p. 100) states that: "*On the whole, governments will have to offer improved and customizable services in order to attract and sustain vital resources. In this given situation, local governments represent the decisive pull for the smart city discourse.*" They are usually also the "owner" of the challenges to be addressed and have the role to balance the interests of vested interests and stakeholders.

Smart cities as cluster boosters

For Richter et al. (2015, p. 222, emphasis added) "[a] Smart City is an agglomerated area affected by a high concentration of learning, entrepreneurship and innovation as a result of creative citizens and institutions as well as the implementation of a digital infrastructure." As such, **smart cities can be seen as seedbeds for clusters**. For instance, and according to Hajduk (2016), the specific character of a smart city consists in creating and consolidating knowledge and innovation. This is the reason why the implementation of smart initiatives increases a city's social and economic attractiveness and competitiveness supported by its technological infrastructure: "(…) a smart city exploits ICT to optimize the performance and effectiveness of serviceable and needful city processes, activities and services typically by joining up diverse components and actors into a more or less seamlessly interactive intelligent system." Hajduk (2016, p. 37).

In a similar way, Khatoun and Zeadally (2016, p. 49) stress that: "By leveraging advanced power systems, networking, and communication technologies, a smart city aims to enhance the lives of its citizens and optimize territorial, economic, and environmental resources." Furthermore, the design and development of smart cities requires **cooperation between experts from multiple fields** (e.g. ICT, engineering, economics, sociology, political sciences). This means to a large extent networks of very heterogeneous companies and further actors (e.g. research organisations).

More generally, according to Kraus et al. (2015, pp. 603-604) an *"important aspect for smart cities is the geographical proximity of like-minded persons, also called* ***a cluster or 'magnet***

for creative people and workers' *(...) Competition can result in innovations delivered at a faster pace, and smart cities are getting even smarter, due to a cluster effect."* (emphasis added).

As a consequence, the hypothesis can be formulated that a **smart city tends 'naturally' to favour the emergence of clusters** through reinforced agglomeration effects, and it thus can be seen as a cluster booster. According to these authors, the opportunities offered by smart cities for entrepreneurship explain this tendency. Among the factors that directly impact entrepreneurship in a well-functioning smart city are:

- the high availability and high quality of ICT infrastructure and usage as well as the availability of databases;
- the demand of urban residents for social inclusion in public services that generates strong business opportunities (e.g. new applications to be used for e-governance); and
- the above average positive image of smart cities, which constitutes: (i) a factor of attractiveness for highly skilled human resources; and (ii) a marketing instrument for entrepreneurs.

Enablers and obstacles for the convergence between smart cities and clusters

The question of the convergence between smart cities and clusters can be put into perspective by considering that the *"(...) most integrated of the current approaches for smart and intelligent cities are based on advancing and realizing both urban futures and the knowledge and innovation economy. In these strategies, 'smart' technologies provide the capability for instrumenting physical spaces with the necessary means, not only for making the physical space itself, but also people and activities within it, more functional. (...) In essence, integrated smart city strategies aim to connect the physical space of cities with the economic and social sphere – a connection that although clearly existing, has always been troublesome for scientists and policy makers."* (Angelidou, 2015, p. 102)

Identifying the main enablers and obstacles of such strategies may reduce the troublesome character of the question. In terms of the *enablers*, a reasonable hypothesis is that three are of primary importance: (i) urban planning; (ii) public-private partnerships; (iii) social sustainability and education.

Urban planning is the first crucial factor for the development of smart cities and their propensity to foster the emergence of clusters and for them to flourish. Effective urban planning in this context requires intellectual resources and proper institutions, in particular, to support the expansion of the infrastructures developed previously. According to Hajduk (2016, p. 44) : "(…) *proper local spatial development plans should be applied in those cities. Crucial parts of the city, places of the highest investors interest such as technology parks, R&D companies, business incubators, technology transfer centers and industrial complexes should definitely be incorporated in these plans*."

A second enabler consists of **public-private partnerships**. According to Kraus et al (2015, p. 602): *"(...) it is very important for public authorities to stimulate the necessary conditions for the private sector, encouraging close links between the two sides, which in some cases leads to a close co-operation as in public-private partnerships"*. Examples of public-private partnerships making the link between smart cities and cluster development can be found for instance in the development of science parks, digitisation hubs or fab labs by local authorities to attract more entrepreneurial individuals and organisations.

Social sustainability and education are the third enabler which is crucial for the wellbeing of the inhabitants of smart cities as well as for cluster development. In this respect, Angelidou (2015, p. 103) recommends notably that "(…) *special attention should be paid to issues of accessibility for all, avoiding digital disparities and spatial polarization*." For Kumar (2017, p. 57) social inclusion may result from "(…) *the development of economic clusters where micro-, small-, and medium-sized enterprises can come together, develop business blueprints and knowledge-based economy plans, and seek government support*." Furthermore, education is a critical magnet that makes a city attractive. According to Nam and Pardo (2011, p. 287): "*Collective intelligence and social learning make a city smarter. The notion of a smart community refers to the locus in which networked intelligence is embedded and continuous learning is nurtured*."

In terms of the *obstacles*, the most noteworthy challenges to be addressed can be grouped in three categories: (i) investments and costs; (ii) willingness of citizens; and (iii) privacy and security.

First, limited financial resources of public authorities and higher operating costs (at least at the beginning of the process of a city becoming 'smart') may lead to **lack of investments**. If the development of smart cities and related clusters may constitute part of the solution in the long run (i.e. represent an investment in the future), this may not be obvious in the short or middle term. The development of physical and intangible infrastructure can be slowed by financial hurdles. This relates also to the perceived high risk of investing in innovative solutions. The return on investment in such clusters may be difficult to estimate in terms of (expected) societal impacts. As Kraus et al. (2015, p. 602) put it: "*To generate urban growth, private capital investments have become a decisive factor for Smart Cities, as public investments are often ineffective, due to their relatively small size*."

The second category of obstacles in the possible **reluctance of citizens**. As underlined previously, since smart cities are not only about technology and data, the social dimension must also be taken into consideration since it is crucial. In other words, a city's 'smartness' depends crucially on citizens' participation in smart city projects.

This includes also how to deal with vested interests (such as taxi drivers' opposition towards new integrated mobility solutions being offered at train stations and airports). Without appropriate communication and 'space' for bottom-up participation, a pure technology-oriented top-down approach is likely to fail or at least to prove sub-optimal in terms of results. The devel-

opment of technology and business-oriented clusters within and around smart cities may not sufficiently integrate citizens' expectations. This in turn can turn out to be strongly counter-productive, both for individual companies and research organisations constituting a given cluster and for this cluster as a whole.

Finally, there are potential hindrances in **privacy and security issues**. Even in situations where citizens and companies display a strong interest and seem to be willing to support the process of their city becoming smart, issues such as individual privacy and business secrecy appear as barriers. In a world where cyberattacks are becoming more and more frequent, smart-city related clusters need to contribute to the constitution of protective walls. This is not one of the missions usually attributed to clusters and in the worst case scenario (i.e. cyberattacks organised by enemy countries or terrorist groups) there is a question as to whether smart cities' networks potentially generate strategic weaknesses.

4 Lessons learnt from a comparative analysis of Smart City Cluster initiatives

An empirical investigation of the links between smart cities and clusters reveals the existence of several types of relationship at different geographical levels (local, regional, national and also European). Cluster initiatives can foster the development of smart cities development and even more frequently smart cities can be cluster boosters. In this perspective, the initiatives analysed in this paper may indeed represent what Alaverdyan et al. (2018) have called ***Smart City Clusters***, defined as *"selected measures to support the widening of the general awareness of the Smart City concept across the EU"* and consisting of the "*co-operation of institutionalized actors through cluster initiatives*".

The geographical dimension of selected Smart City Clusters initiatives

Although smart city is a concept mostly related to the local level by definition and clusters generally evolve on a local or regional scale, the main initiatives identified reveal that the links between the two concepts may take different forms depending on the "functional area" at which they develop. Initiatives of what may be called Smart City Clusters are in fact found at local, regional, national as well as European level. Nevertheless, differences in terms of objective and scope between the initiatives promoted can be identified.

Local initiatives

As concerns the local dimension, the main initiatives identified show that the smart city concept may be promoted by clusters as well as by *Living Labs (LLs)*, two distinct but complementary approaches which, although playing different roles in supporting the information value chain, can contribute to the smart upgrade of cities by advocating the importance of research and having innovation at their core (Cosgrave et al. 2018).

Defined as a "system enabling people, users/consumers of services and product, to take active roles as contributors and co-creators in the research, development, and innovation process" (Arnkil et al., 2010), Living Labs facilitate university-industry-end-user relationships and contribute in developing and testing innovative urban solutions in a real-life context. As a result, like clusters, they foster relationships among stakeholders (Alaverdyan et al., 2018) and thus may be considered supplementary to traditional regional innovation policy (Almirall & Warenham, 2008). This complementarity is also reflected in the different purposes of the two approaches: while Living Labs are more focused on the product development, clusters are generally more oriented towards market development.

An example of cluster showing a strong interrelationship with the smart city concept is the ***Different Angle Cluster in Bucharest***[3], created in 2014 as the first ICT Cluster in Bucharest but announcing, at a later stage, that smart cities would constitute the first domain of common interest promoted by the members of the new cluster organisation. Its main objective is to promote and support research, innovation and education for developing and implementing solutions and projects for smart city areas. In particular, its medium and long-term goals consist in improving the efficiency of the local ICT potential and the knowledge transfer between the academic and the private environment and reducing the shortage of employees with ICT skills in Bucharest.

Examples of Living Labs created to promote the smart development of cities may be found for instance in Amsterdam, Barcelona, Helsinki, (Bifulco et al., 2017), with the main initiatives being (Alaverdyan et al., 2018):

- ***Amsterdam Living Lab*** (ALL)4: launched before the start of the Amsterdam Smart City (ASC) project in 2009, the ALL plays a crucial role in the city's smart development as its aim is to test new products and services for several firms in an innovation playground where consumers, knowledge institutions and companies work in close cooperation;
- ***Finnish Living Lab***: in the city of Helsinki the LL focuses directly on urban innovation, with public organisations, local agencies, and citizens acting together to attain innovative community services through digital instruments;
- ***22@Barcelona***: besides supporting business innovation, the LL in Barcelona enables better usage of public spaces. This has been achieved through support to new initiatives around public services, transport, ecology, and ICTs, with universities playing a fundamental role in promoting a culture of open innovation based on citizens and making the city an open laboratory.

Regional and national initiatives

Initiatives characterized by a strong link between smart cities and clusters can also be identified at regional and national levels. Differently from local examples, which appear to be more focused on specific products or types of market, regional and national initiatives generally

3 See http://differentangle.ro/

4 See https://www.amsterdameconomicboard.com/app/uploads/2016/02/Amsterdam-Living-Lab-brochure.pdf

have a broader scope. Their agenda mainly revolve around technological aspects of the smart city concept, with energy, transport, infrastructure and mobility the most relevant fields of interest across clusters. However, also smart governance and e-government, health, education and training, and cultural heritage play a significant role in their cluster strategies.

Amongst the regional initiatives, the ***Andalucía Smart City cluster***[5] represents an example of an alliance of private companies, institutions from the energy, environment, transport, ICT and mobility sectors, cities and universities, aimed at the creation and development of sustainable, efficient and comfortable smart cities as well as of jobs and wealth in the urban business community. To achieve these goals, a key contribution comes from the sharing of research, development, innovation and know-how among its members and across different sectors, such as energy, environment, infrastructure, information and communication technologies and urban mobility. Similarly, also the Italian initiative in the Lombardy Region ***The Technologies for Smart Cities & Communities***[6] promotes and facilitates research in support of sustainable innovation in the field of smart cities and communities, bringing out the synergies between companies, research centres and universities. The ultimate aim of the cluster is to implement the most advanced technology solutions at an urban and metropolitan scale. This is to be achieved by establishing cooperation with the public administration in the following fields: renewable energy and energy efficiency, security and territorial monitoring, mobility, health, wellness, e-government and justice, education and training, cultural heritage and tourism.

As concerns the national level, the ***Smart City Lab Cluster***[7] in Estonia is one of the most successful examples of national cluster strategy focused on the development of smart cities, also in view of the high importance that Estonia attaches to the concept of the smart city (Oü, 2016). Created first as a joint project between the City of Tartu and ICT companies, the cluster currently brings together businesses, citizens, public authorities, R&D institutes and structures supporting innovation and its core goal is to help co-create, develop and export innovative and smart solutions, especially in the fields of transport, governance and infrastructures.

In this context, other two similar examples but with a different focus with respect to the latter can be mentioned. The ***Czech Smart City Cluster***[8] and the ***Cluster Smart City*** (ViP)[9] in Latvia are other two initiatives promoting the smart city concept but focusing more on the promotion of the smart city technology market position of their cluster's members, namely business and companies, in relation to products or services which may be linked to the smart city concept.

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5 See http://www.andaluciasmartcity.com/en/ and https://www.clustercollaboration.eu/cluster-organisations/cluster-andalucia-smart-city

6 See http://www.clusterscclombardia.it/en/content/cluster and https://www.clustercollaboration.eu/cluster-organisations/fondazione-cluster-tecnologie-le-smart-cities-communities

7 See http://smartcitylab.eu/

8 See http://czechsmartcitycluster.com/

9 See http://smartcity.lv/en/about-us/, http://smartcity.lv/par-mums/vip-klasteris/ and https://www.em.gov.lv/en/sectoral_policy/industrial_policy/clusters/clusters_in_latvia/smart_city_cluster

European initiatives

At European level, the smart city concept is to be found in cluster partnerships across several countries and different entities. The main clusters identified in this respect are the ***Smart Cities Mediterranean Cluster***[10] and the ***Smart City Tech***[11]. While the former consists of a close partnership between research centres, industry, innovative SMEs and civil society from 26 countries aimed at identifying a common approach in specific fields of smart City strategies, the latter can be seen more as an inter-cluster partnership with the final aim of stimulating the cooperation between cities and smart system stakeholders, such as companies, policy makers, academia, investors and citizens.

The nature of the links between smart cities and clusters: evidence on the ground

Overall, the selected examples show that the **connection between clusters and smart cities** is quite significant in relation to the need for promoting and supporting research, innovation and education, and for ultimately developing and implementing solutions and projects for smart city areas. In this respect, the direction of this connection is not univocal: existing clusters may be the main supporter of the development of smart cities as well as smart cities can be seen as cluster boosters. However, a horizontal analysis of the above-mentioned initiatives reveals that in a higher number of cases, the second option is the most likely.

Only a few examples, in fact, support the idea that existing clusters are a favourable condition for the development of the smart city concept. This is the case for instance of the ***Different Angle Custer in Bucharest***, whose initial scope was the promotion and support of research, innovation and education in the ICT sector, with the aim of improving the efficiency of the local ICT potential and the knowledge transfer between the academic and the private environment. The cluster started to pursue the development of the smart city concept only as a secondary objective. Another example in line with this approach is the ***Czech Smart City Cluster***, which has been created with the primary objective to increase the competitiveness and economic growth of their members. Building smart cities by providing infrastructures as well as technological solutions is perceived as being an ultimate goal only.

Conversely, all the other examples appears to be more in line with the idea that smart cities can be the seedbeds for cluster. All of them have in fact been created and promoted with the main idea of developing smart solutions, which in turn contribute to develop the smart city concept.

In this context, Living Labs are ascribable to both approaches: while the ***Amsterdam Living Lab*** was specifically created for the development of the Amsterdam Smart City project in 2009, the ***22@Barcelona*** was firstly created to support business innovation and only at a later stage started supporting smart city initiatives. The hypothesis is that because they are nested

10 See http://www.smartcitiesmed.com/ and https://www.clustercollaboration.eu/cluster-organisations/smart-cities-mediterranean-cluster

11 See http://www.smartcitytech.eu/

within smart cities, they nurture two-way relationships both contributing to and taking advantage of the dynamics of smart city development. In doing this, they more forcefully contribute to enlarge the triple helix mechanisms to a quadruple helix configuration, as briefly argued in the subsequent section.

Key players and interactions for a successful Smart City Cluster: evidence of triple vs quadruple helix approach

The successful implementation of smart cities implies citizens' acceptance and inclusion, as citizens are the main reason for the existence of a city and its policies. Moreover, a smart city is not the result of a top-down vision with government investments being the main promoters but is more an organic system of systems (Harrison and Abbott Donnelly, 2011), that is an ecosystem of products, services, companies, people and society collaborating with the aim to foster innovation ideas within a city (Cosgrave et al., 2017).

Nevertheless, activities to improve the **interaction between cities and citizens**, which are a crucial factor for smart city development according to Wang (2015), Corrigan and Joyce (1997) and Nalbandian et al. (2013), seems not to be a prominent characteristic of most of the selected examples.

When focusing on the **type of stakeholders involved**, in fact, the identified Smart City Clusters are usually represented by science (universities, research centres, science supporting institutions, etc.), industry (enterprises) and government (including regional and local self-governments). Beside the preponderant involvement of industry, science institutions are almost always included in the cluster organisations. Examples are the Cluster Smart City (ViP) in Latvia involving only Latvian entrepreneurs and research organisations or Smart City Tech, which includes cluster partners and the related companies. Similarly, but to a lesser extent, the role of government and public administrations is particularly relevant.

Conversely, a less relevant connection may be detected in the activities improving the interaction between the city and its citizens and, as a result, in the low level of involvement of the users/citizens sphere in the cluster organisations linked to smart cities even if, as reported in the previous chapter, a city's smartness depends also on citizens' participation in the smart city projects.

Overall evidence on the ground indeed shows that the triple helix proposed in the 1990s by Etzkowitz and Leydesdorff (1995) is the main approach used for the development of clusters initiatives connected to smart city. Examples of the complement in a fourth sphere - users/citizens – which is a characteristic of a quadruple helix (Waart et al., 2016; Carayannis & Campbell, 2009) can be found in the Smart Cities Mediterranean Cluster, the Smart City Cluster in Estonia and the Czech Smart City Cluster only. Likewise, on a smaller scale, Living Labs, which are based on the concept of "open innovation", also promotes a quadruple helix vision, by gathering researchers, firms, users, public partners and other stakeholders in an innovative environment.

5 Conclusion

In this attempt to think together smart cities and innovative clusters we arrived to a certain number of conclusions. First, it really makes sense to link the *urban future* and the *knowledge and innovation economy*. From this point of view, thinking the "smart city" is close to a *foresight exercise*: anticipating technological developments and societal changes, preparing for the possible futures, adapting the urbanism and the physical and intellectual infrastructures for all the scenarios under consideration. Implementing numerical solutions is of course part of this project, but certainly not the only aspect to consider.

This approach corresponds to the idea of foresight as a strategic management tool. But foresight also means creating *collectively* a set of representations of the future. The French school of *prospective* has coined the word "futurible" to express the idea of "possible and desirable futures" – the latter being collectively constructed, not imposed by the hierarchy. Therefore, the smart city has to consider also social and political interactions, and procedures for achieving the participation of the inhabitants in the preparation of the future.

Returning to the clusters, another important idea is that such innovative ecosystems definitely help to become smarter – not only because they bring new technological solutions, but because they are a way to organize collective creation among a certain set of actors within the urban system. Furthermore, in order to fully contribute to the "smart city" objective, they must be interrelated. From this point of view, the smart city is a meta-cluster (a cluster of clusters).

The preceding view should be still improved, because it looks a little too "techno-oriented". It correspond the concept of Triple Helix (linking firms, research and education, and local governance structures), but we are looking for a "Quadruple Helix" including the users and citizens.

The fourth dimension raises specific questions like the right balance of vested interests, or the inclusiveness of governance. We have to check if the numerical and technological smart city is also a city where the inhabitants are happy to live in. A step further in the questioning is to define *happiness* – or more precisely well-being, because individual and short-term happiness cannot (or must not) be the aim of the urban policy. Being "happy" to live in town means to benefit from convenient and efficient services, but not only. The real aim of the smart policy should be the full-fledged satisfaction of the citizen: being part of the city, an actor of the system in the long run. In this sense, the concept of smart city must be related to the idea of *sustainable collective well-being*.

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