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Knowledge and Decision for Smart Cities Initiatives

Cases of Paris and Nice

Pierre-Emmanuel ARDUIN
DRM UMR CNRS 7088
PSL, Paris-Dauphine University
Paris, France

Elsa NEGRE, Camille ROSENTHAL-SABROUX
LAMSADE UMR CNRS 7243
PSL, Paris-Dauphine University
Paris, France

Abstract—Smart City is a concept for which no standard definition has been adopted either in theoretical researches or in empirical projects. Several definitions and classifications, different from each other, have been proposed. However, all definitions agree on the fact that a smart city is an urban space that tends to improve the daily life (work, school, etc.) of its citizens (broadly defined). This is an improvement from different points of view: social, political, economic, governmental, etc. This paper presents a case study by comparing two French cities considered smart by different classifications: Paris and Nice.

Keywords—Smart City; Knowledge; Decision Support System; Digital Knowledge Ecosystem

I. INTRODUCTION

Since the early 90s, the development of Internet and communication technology has facilitated the generation of initiatives to create opportunities for communication and information sharing by local authorities. In our everyday life, we are more and more invaded by data and information. These flows of data and information have given rise to a huge mass of data to treat [20]. The world is becoming increasingly a digital world and people are affected by such changes. Today's world faces two important growths: urbanization and information technologies which mean that digital infrastructure infers an information environment that is "as imperceptible to us as water is to a fish" [18].

As pointed out by [17], "The complexity of connectedness of modern times requires new tools of analysis and exploration, but above all it demands a new way of thinking. It demands a pluralistic understanding of the world that is able to envision the widen structural plan and at the same time examine the intricate mesh of connections among its smallest elements. It ultimately calls for a holistic systems approach; it calls for network thinking." [17, p.45-46]

There exists a kind of parallelism between technology and humans. On one hand, people are hyper-connected by using more and more technology (and information and knowledge flow between different stakeholders, with different uses and backgrounds [16]), and on the other hand (digital) systems are more and more user-centered [29]. Thus, within cities, systems have to adapt to hyper-connected citizens, in a very particular environment, the one of cities in constant evolution where systems and humans are nested. Thus becoming "smart" is a challenge increasingly important for many cities or communities [16].

The definition of a smart city is indispensable to identify its perimeter and to understand which initiatives can be considered smart and which cannot. The definition and the comprehensive smart city framework are the necessary basis on which to build the smart city goals system.

As the definition of a smart city changes depending on the practitioners [2], in this paper we consider that cities are smart: "when investments in human and social capital and traditional and modern communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance" [6].

From our point of view, a smart city can be seen as a Digital Knowledge Ecosystem: (i) a knowledge ecosystem because there is a dynamic evolution of knowledge interactions between stakeholders (citizens, public administrations, etc.) to improve decision-making and innovation through improved evolutionary networks of collaboration [25], and (ii) a digital ecosystem because it is "an open, loosely coupled, domain clustered, demand-driven, self-organizing, and agent based environment which each species is proactive and responsive for its own benefit and profit" [9].

The paper is organized as follows: in the next section, we explain our vision of knowledge and decision. Then we detail some existing approaches concerning smart cities initiatives. We present a comparison of two French (smart) cities: Paris and Nice in Section IV. We conclude in Section V.

II. KNOWLEDGE AND DECISION

This section introduces our vision of knowledge and the underlying knowledge ecosystems; and the ways of regarding decision making processes when considering smart cities.

A. Knowledge

As the authors of this article, we have got tacit knowledge, *i.e.* an individual cognitive construction that we have structured in information during a process of *sense-giving*. As the reader of this paper, you have interpreted this information perceiving forms and colors; you have absorbed words, data, during a process of *sense-reading*, possibly creating new tacit knowledge for you.

Drawing from the concepts of "sense-giving" and "sense-reading" introduced by [23], [28] states that: when datum is sense-given through interpretative framework, it becomes information, and when information is sense-read through

interpretative framework, it becomes knowledge” ([28], p. 88). The concept of “interpretative framework” [28] can be seen as a “mental model”: “Mental models are personal, internal representations of external reality that people use to interact with the world around them. They are constructed by individuals based on their unique life experiences, perceptions and understandings of world. Mental models are used to reason and make decisions and can be the basis of individual behaviors.” [14].

Consequently, knowledge is not an object processed independently of the person who is acting. Formalized and codified knowledge which is independent from individual is no more than information, which may lead to different interpretations, notably due to the existence of meaning variance [3].

Regarding smart cities and their underlying knowledge ecosystems, we consider these three fundamental postulates: (i) Knowledge is not an object – it results of the interpretation by someone of information [28]; (ii) Knowledge is linked to the action – it is necessary to realize processes, which in turn create knowledge [11], and (iii) City’s knowledge includes two main categories of knowledge – tacit and made-explicit knowledge [22].

Nevertheless, when knowledge has been made explicit, is stable, well defined, and recognized by a given specific and homogenous population, it can be considered as an object, and managed as information.

B. Decision

Even if it has been extended since its first description, the classic decision making process of [26] stays the same: intelligence, design and choice. When intelligence and design are carried out by more than one individual, the choice is harder to consensually achieve. In a city, smart city initiatives have to involve citizens in their construction processes. That is the reason why participatory governance is so much important in a smart city: choices are shared choices.

Thereby where decision making could be seen as a constructed model, collaborative decision making, for us, may be regarded as the use of socio-technical media in order to improve the performance and the acceptability of decision making. This is particularly crucial in the case of smart city initiatives. The location of knowledge in the realization of collaborative decision making has to be regarded insofar as, according to [12] (p. 348), knowledge sharing leads to improve collaborative decision making: a “static view” has to be structured and constitutes the “collaborative knowledge”. Knowledge having an important role in individual decision making, we consider that for collaborative decision making, knowledge has to be shared [4].

[24] introduces the “analyst” as the person who makes explicit the problem for the decision maker. The analyst is living the processes, he/she interferes in them, he/she is a “participant observer” [15]. Indeed, [27] notices that neglecting social activity leads to “meaningless conclusions”. This is particularly true in the case of smart city initiatives, where citizens are stakeholders.

III. SMART CITY MODELLING APPROACHES

[10] proposes a ranking of 70 European medium-sized cities by using six characteristics: smart economy (competitiveness), smart people (human and social capital),

smart governance (participation), smart mobility (transport and ICT), smart environment (natural resources), and smart living (quality of life); where a smart city is “a city well performing in a forward-looking way in these six characteristics, built on the ‘smart’ combination of endowments and activities of self-decisive, independent and aware citizens” (p. 11). Each characteristic is defined by a number of factors (33 in total) and each factor is described by a number of indicators. The indicators that “describe the factors of a smart city are derived from public and freely available data” [10]. This classification was followed by some others.

[19] suggests three conceptual dimensions of a smart city: technology (use of ICT to transform life and work within a city), people (human infrastructure, human capital and education), and community (support of government and policy). For [19] “a city is smart when investments in human/social capital and IT infrastructure fuel sustainable growth and enhance a quality of life, through participatory governance” (p. 286).

According to [8], with the EU vision, the concept of smart city is based on four basic elements that composed the city: Land (territorial dimension: not limited to the administrative boundaries of the city), Infrastructures (Buildings, streets, traffic and public transports), People (students, workers, neighbors, friends, tourists, etc.), and Government (local, central, or European level).

Finally, [7] proposes a framework for analyzing smart city projects with eight dimensions that affect the design, implementation, and use of smart cities initiatives: (1) Management and organization: Organizational and managerial factors such as project size, leadership or change management; (2) Technology: Technological challenges such as lack of IT skills; (3) Governance: Factors related to the implementation of processes with constituents who exchange information according to rules and standards in order to achieve goals and objectives; (4) Policy context: Political and institutional components that represent various political elements and external pressures; (5) People and communities: Factors related to the individuals and communities, which are part of the so-called smart city, such as the digital divide or the level of education; (6) Economy: Factors around economic variables such as competitiveness, innovation, entrepreneurship, productivity or flexibility; (7) Built infrastructure: Availability and quality of the ICT infrastructure and (8) Natural environment: Factors related to sustainability and better management of natural resources.

From our point of view, the latter is the most comprehensive and integrative framework for analyzing smart city projects, i.e., it has a sufficient number of analysis dimensions to be implemented on the field while being open enough to manage a lack of field data.

IV. CASES OF PARIS AND NICE

According to the model of [7], in this section, we establish a picture of Smart City initiatives in Paris and Nice [1].

A. Paris

Paris is the capital and most-populous city of France. The Paris region had a GDP of €612 billion in 2012, accounting for 30.1% of the GDP of France, and ranking it as one of the

wealthiest five regions in Europe; it is the banking and financial center of France [31].

1) *Management and organization*: The city of Paris has put in place: (i) a mission “*Smart and Sustainable City*” whose job is to identify transversal topics such as *Smart City* and work with the various departments concerned, (ii) a strategic plan “*Paris: Smart and sustainable city, prospects for 2020*” (since June 2015) [21], as a platform, scalable and participative taking into account the views of citizens, (iii) creation of a Chief Data officer (*during 2015*) to achieve the best of available data, and (iv) *an effective resilience (participation in the group of the 100 most resilient cities, creating a Chief Resilient Officer, etc.)*.

2) *Technology*: From a technological point of view, there exist: (i) some applications for dematerializing public services (the Web site www.paris.fr, for example, helps citizens doing procedures, finding facilities, aids, jobs, parks, etc.), (ii) the extension “.paris” is available for lovers of Paris and for economic operators of the city, (iii) Public numeric spaces with Internet access to better integrate technologies in citizen every-day life, (iv) Open Data portal since 2011 (opendata.paris.fr).

3) *Governance*: The smart city initiative within Paris is mainly directed in a vision of citizen participation and co-production. The concept of Open City is central to this initiative, the human is at the core of the device through continuous interaction on various platforms: (i) “*Paris Petitions*” to launch a petition and to sign on subjects within the town hall (ii) “*Madam the Mayor, I have an idea*” is a platform where citizens propose ideas that will be discussed for possible implementation (*traffic problems, urban development, etc.*), (iii) “*In my street*” to report any anomalies, dirt, clutter, etc. (iv) many websites to propose projects concerning the Paris of tomorrow.

4) *Policy Context*: The urban vision of Paris as a digital and smart city has its roots in the project “*Grand Paris*”, set out in 2007 by the former President of the Republic Nicolas Sarkozy. But it was only in 2012, following the election of the new President Francois Hollande that a concrete vision is presented through the project “*Grand Paris Numérique*”, which aims to be an innovative and progressive project that would fast-tracks Paris to modernity and technology. Finally, in July 2014 (election of the new Mayor), a Mission “*Smart and Sustainable City*” is formally established in the town hall. The creation of this mission organizes the Parisian speech around the “*smart city*” in a specific public action. A major communication is organized around the project “*smart and sustainable city*” to keep all stakeholders informed within the city (citizens, businesses, public administrations, etc.) and also to take advantage of the discussions triggered around the subject.

5) *People and communities*: Citizens are the core of the project “*smart and sustainable city*” of Paris. They are now sought on several topics of discussion to propose, vote and decide on major projects in the city. Paris has chosen to

integrate citizens in the processes of decision and action in a co-production logic that leverages the collective intelligence and creativity. The smart city initiative has the major objective of improving the quality of life of citizens in all areas of daily life. The city of Paris, in conjunction with its economic players, has adopted a policy of communication and information exchange on all aspects of the practical life of its inhabitants, visitors and/or companies (real-time traffic, optimized paths, neighborhood maps, air quality, etc.).

6) *Economy*: The smart city initiative aims to make Paris, one of the start-up capitals through several mechanisms put in place to encourage innovation and creation thanks to aids (i) to finance (“*Paris Finance Plus*”, “*Paris Initiative Amorçage*”, “*Scientipôle Initiative*”), (ii) the installation of foreign entrepreneurs (“*Paris French Tech Ticket*”), (iii) the installation in an incubator (“*Paris Landing Pack*”), (iv) awards for innovative projects, (v) the installation.

7) *Built infrastructures* include: (i) free WIFI and 4G, (ii) “*Autolib*”, rental of self-service electric vehicles, (iii) “*Velib*”, rental of self-service bicycles, (iv) housing construction: 70 000 units per year, (v) “*Grand Paris Express*” to add 4 subway lines and expand 2 existing lines by 2030, (vi) a “*green*” bus network in the next 10 years.

8) *Natural environment*: Paris is experimenting and implementing several innovative practices in energy consumption and resource conservation as part of its commitment to reduce its emissions of greenhouse gas by 75% to 2050 (i) electric vehicles and bicycles, (ii) use of renewable energy (eco-district, smart grid etc.), (iii) circular economy (redistribution of unsold, composting, etc.).

B. Nice

Nice is the fifth most populous city in France, is the capital of the Alpes Maritimes French department and is located on the south east coast of France on the Mediterranean Sea. The Nice metropolitan area had a GDP amounting to \$47.7 billion, and \$34,480 per capita, slightly lower than the French average [30].

1) *Management and organization*: Since 2008, Nice is engaged in a smart city strategy. Its strategy is essentially based on technology and on encouraging innovation to monitor and manage all elements of the city.

2) *Technology*: From a technological point of view, there exist: (i) “*Spot Mairie*” for dematerializing public services since 2013 (Self-service collaborative cubicle that aims to make life easier for citizens by bringing public services closer to citizen life places), (ii) “*Cityzi*” for contactless payments with smartphones (Near Field Communication technology), (iii) “*NICE Park*” for smart parking since 2011 (find a parking place from a smartphone and know the optimized path to get there taking into account the traffic, public transport schedules, weather data, ...), (iv) “*Intelligence operation center*” for real-time collecting and analyzing data concerning citizen mobility, air and water quality, noise, energy, ..., (v) Public numeric spaces with Internet access to better integrate technologies in citizen every-day life, (vi) Open Data portal since 2014 (www.opendata.nicecotedazur.org).

3) *Governance*: Nice wants to be a pioneer for smart city initiatives and builds on innovation and information and communication technology (ICT). Stakeholders are: (i) the metropolitan area of Nice and the various municipalities that constitute it, (ii) *teaching and research* actors, and (iii) many (local and national) industrial and technological partners.

4) *Policy Context*: Since 2008 (*the beginning of the mandate of the current mayor and president of the metropolitan area of Nice*), Nice is engaged in a smart city strategy and has established several partnerships with global ICT players to be more "*connected*" and more open to new technologies. This strategy aims to provide an advanced technological environment to attract investments and contribute to economic growth.

5) *People and Communities*: Citizens and visitors benefit from major urban and technological undertaken projects ("Spot Mairie", "Cityzi", etc.) to facilitate their daily life and ensure the good quality of their environment. In addition, solutions that will facilitate the monitoring of elderly or sick persons are being tested (sensors for monitoring patients at home for example).

6) *Economy*: Several devices are in place to encourage entrepreneurship, *installation of businesses and innovation*: (i) the site "Invest in Cote d'Azur" (www.investincotedazur.com), (ii) the first European science park: "Sophia-Antipolis", competitiveness Pole bringing together businesses, start-ups and scientific research centers, (iii) the urban project "Eco Valley", (iv) lending facilities for the creation of businesses and (v) support structures for business financing.

7) *Built infrastructures* include: (i) free WIFI and 4G, (ii) "Autobleu", rental of electric vehicles, (iii) "Vélobleu", rental of self-service bicycles, (iv) urban monitoring with 2 000 captors (between 2014 and 2016) to collect then analyze environmental data, (v) "Boulevard connecté" (since 2013) where a specific boulevard is equipped with 200 captors to collect the filling level of paper and glass containers in order to adjust the tours of garbage collection trucks, the brightness level to adjust the public lighting to real lighting needs, the real-time traffic, etc., (vi) a new tram line connecting the port to the airport.

8) *Natural environment*: From natural environment, there are: (i) optimizing the collection of waste (level sensors in glass or paper containers to prevent unnecessary tours of trucks, trucks equipped with GPS to optimize tours and better distribute the work, etc.), (ii) provision of electric vehicles and bicycles (self-service), (iii) "REFLEXE" (since 2011), smart grid for production-storage-consumption of energy, (iv) "Nice Grid" for a smart solar quarter (since 2011).

C. Comparison

In this subsection, we compare Paris and Nice (Table I synthesizes some geographic and demographic information of these two French cities).

Paris and Nice are making considerable efforts, through various initiatives, to become more innovative and smarter.

TABLE I. PARIS AND NICE

	Paris	Nice
Region	Ile-de-France	Alpes Maritimes
Mayor	Anne Hidalgo (2014-2020)	Christian Estrosi (2014-2020)
Area	105,4 km ² (40,7 sq. mi)	71.92 km ² (27.77 sq. mi)
Population	2 241 346 (18,2% of France)	343,629
Urban	10 516 110	1,005,230
Density	21 000 / km ² (55 000/sq. mi)	4,800 / km ² (12,000/sq. mi)
Rank	1 st in France	5 th in France
Website	www.paris.fr	http://www.nice.fr http://www.nicecotedazur.org

The geographic, demographic and economic differs depending on the city and this shapes the smart city initiative set up (see Table II).

Paris considers people as being at the core of the device and positions it as a beneficiary but essentially as an important actor in all phases of the initiative from the consultation to decision making. Nice, meanwhile, plans to turn into agglomeration pioneer for innovation and advanced technology.

TABLE II. COMPARISON OF PARIS AND NICE INITIATIVES FOR BECOMING SMART CITIES

	Paris	Nice
Management and organization	The citizen is the core of smart city device	No direct application of citizens as actors or partners of the initiative
Technology	Use of technologies primarily for the dematerialization of services	Opening in several technological experiments in all fields
Governance	Citizens through suggestions, plans, ideas contribute and shape the Smart City initiative	Actors of teaching and research, businesses and ICT contribute
Policy context	Since 2012	Since 2008
People and Communities	People are the central pivot of the project: solicited and involved upstream and beneficiaries downstream.	The main objective of the initiative is the human. The technology is at the service of the welfare of citizens.
Economy	Both cities have implemented several features to attract investments and encourage the holders of ideas and start-ups to settle.	
Built infrastructure	Poorly developed technological infrastructures	Most developed technological infrastructures
Natural environment	Energy consumption and resource conservation	Environmentalist

Smart city projects of Paris and Nice have the same goal which is to ensure the requirements of comfort and well-being of citizens. Nevertheless, the two cities diverge as to the philosophy they have adopted for this purpose. In both cases, municipalities offer several aids and devices that encourage innovation and investments. The technology is used to facilitate the lives of citizens and to collect the maximum of data that will be used to rethink the management methods and the city.

However, the involvement of citizens of Nice in the decision making processes concerning smart city initiatives is very small compared to Paris. However, the latter does not encourage and does not invest as much as Nice in the implementation of technological tools. This difference may be

partly due to the specificities of each of the two populations.

Indeed, Nice is characterized by an aging population, with few strategic jobs, disadvantaged by the low level of qualification of its young, not very attractive demographically [13]. These characteristics are a handicap for the city hampering citizens' involvement in the consultation and proposal phases around the city development topics. Paris meanwhile can benefit from the skills, ideas and actions of its citizens as the city has the largest number of students, companies and managers in France. As Digital Knowledge Ecosystems, smart cities improve their decision making processes by taking into account stakeholders' knowledge.

The divergence between Nice and Paris also lies on the vision of politicians in power on technology and its uses. Paris cautiously envisaged an extensive use of sensors and cameras to monitor the city and its inhabitants; unlike Nice which is related in the media to George Orwell's Big Brother watching citizens by blaming its possible detriment to liberties and privacy.

In both cases, the recovery and the use of data collected in the urban space is not specified. The questions of ethic and direct impacts of the data on urban policies remain open. Both experiences have much to gain by observing the methods and achievements from each other to question their approaches and adopt the relevant ideas.

V. CONCLUSION

Living together within a smart city may be natural for people, but induces investments and governance obligations for municipalities. Cities are becoming smart, relying on digital and social networks.

In this paper, we explained our vision of knowledge and decision. Then we detailed some existing approaches concerning smart cities initiatives. We finally presented a comparison of two French (smart) cities: Paris and Nice.

Within cities, systems have to adapt to hyper-connected citizens, in a very particular environment, the one of cities in constant evolution where systems and humans are nested. The approach used in this paper to study the cases of Paris and Nice lead to formal and quantitative conclusions (see Table II). Nevertheless, we have to warn researchers and municipalities on the fact that such approach, as well as those presented in Section III, neglect one of the major questions in smart cities: the recovery and the use of data collected in the urban space.

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