Smart Cities in a Smart World

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Abstract Very often the concept of smart city is strongly related to the flourishing of mobile applications, stressing the technological aspects and a top-down approach of high-tech centralized control systems capable of resolving all the urban issues, completely forgetting the essence of a city with its connected problems. The real challenge in future years will be a huge increase in the urban population and the changes this will produce in energy and resource consumption. It is fundamental to manage this phenomenon with clever approaches in order to guarantee a better management of resources and their sustainable access to present and future generations. This chapter develops some considerations on these aspects, trying to insert the technological issues within a framework closer to planning and with attention to the social impact.

Keywords Smart city • Smart communities • Urban planning • Open data • Citizens as sensors • Governance

1 Introduction

Nowadays an approach that narrowly combines the concept of smart city with the sudden spread of electronic devices and with the setting of a technological hard infrastructure is very common. A common and widespread interpretation

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of the concept of smart city has been long related on one side to a centralized control system made of the network infrastructure and sensors, managed by local authorities, while on the other side its implementation is via an exasperated use of applications for smartphones or tablet PCs.

Hence, often the focus is mainly on mobile applications, forgetting that there is also a city. These approaches, despite having a certain degree of usefulness, can produce a waste of resources when completely disconnected from the context, especially from the essence of a city. When complex computer systems are proposed, it is crucial to ask, "Are they really useful to the city?"

This common belief evokes gloomy and distressing urban scenarios as we learned to watch on science fiction movies, as in Ridley Scott's *Blade Runner*. The idea of a city with many vendors should lead to a vision of cities similar to a Pioneer advertisement[1] of the late 1980s, which was very popular in Italy, where each person "wore" one or more cathode tube televisions that acted as a barrier to the outside world, projecting robotic behaviour. This approach to smart cities would lead to a "flood" of electronic devices in our cities, connected to improbable goals to be achieved.

If a city has a structural mobility problem, it is quite impossible to solve it only with a smartphone. The term "smart" is very popular today and has also been adopted in common language and in all kinds of advertisements. In order for us to describe the adoption of this term in everyday language, it could be useful to adopt a parallelism with the Smurfs cartoons.

Everything is "smart" today, and in the Smurf world, we have Smurf-Forest, Smurf-berry, Smurf-strawberries, and so on. It is very common in participation processes, smart participation, to find an interview with the mayor of a city or with the director of a journal called a "smart interview" or to find the term "smart questionnaire" for paper forms distributed to a sample of citizens.

Very often the concept of smart city is strongly related to the wide dissemination of mobile applications, completely forgetting the essence of a city, with its connected problems. In order to bring the smartness concept into the correct approach, it is important to highlight the challenges that cities will face in upcoming years.

2   The Real Challenges of Cities

A study developed by *The Economist* [1] highlights that despite the fact that the United States and the European Union have comparable total populations, in the US 164 million people live in 50 major metropolitan areas, while in Europe there are only 102 million inhabitants of metropolitan areas. These differences are in terms of productivity and incomes. The gross domestic product (GDP) of European metropolitan areas is 72 % of the GDP of the 50 largest American cities.

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[1]Pioneer advertisement for Pioneer Blue: velvet.mpg http://youtu.be/5rMI_aVYtR0

An article in *The Washington Post* [3] emphasizes that in 31 American states, one or two metropolitan areas account for the vast majority of the state's economic production, and in 15 other states, a large metropolitan area alone produces most of the GDP. Seventeen major metropolitan areas generate 50 % of the U.S. GDP. An article in *The Wall Street Journal* [2] explains how U.S. major metropolitan areas produce a higher GDP than the economies of entire nations. Urbanization is also different in terms of city size classes in the two areas. In Europe, 67 % of urban inhabitants live in medium-size urban centres, smaller than 500,000 inhabitants, while just 9.6 % are located in cities having more than five million inhabitants. In the US, one of five urban inhabitants lives in major cities having more than five million people.

From these figures it is very easy to understand that, despite common opinions against the quality of life in big cities, in most cases living in large cities becomes a necessity. Glaeser [4] defines the city as the greatest invention of mankind. Using the advantages of the agglomeration principle, a city emphasizes the strengths of a society. Despite the evolution of modern and contemporary cities having led to disadvantages resulting from congestion, urban poverty, and security, living today in an urban context, even one that is not of high quality, involves more benefits than living in remote areas. Consequently, cities play a central role for humanity, offering the opportunity to learn from each other, face to face. Despite economic contexts and production patterns having been radically changed, a city always represents the most vital element of the economy of a nation. Generally, in every developed country, cities are the economic heart and the most densely populated places, very attractive for people who want to exchange knowledge.

While in the past advantages were closely related to the reduction in transportation and distribution costs, today cities have huge benefits in economic terms due to the exchange of ideas; therefore, there is a transition from the idea of a city founded on the concept of location to that of a city based on interaction [5]. In the next few years, a 2.3 billion increase in the world population will occur, with an average increase in the population of urban areas of 30 % [6].

These scenarios can be inserted in a larger picture, in which cities already hold the majority of the world's urban population. Western and industrialized countries already have an urban population near 80 %, while developing countries to date come in at 47 %. Asia and Africa are expected to surpass an urban population of 50 % 2020 and 2035, respectively. The global urban population is forecasted to increase by 72 % by 2050, changing from 3.6 billion people in 2011 to 6.3 billion in 2050 [9].

By 2020, China's urban population will reach 60 %, and more than 100 million people will migrate to metropolitan areas or contribute to the creation of new urban centres.

This phenomenon is not only limited to countries where rapid economic development is occurring, such as in China [7] and India [8], but it is also taking place in Europe, as highlighted by the "World Urbanization Prospects" United Nations report [9], which projects that in 2050, almost 90 % of the population will live in urban areas.

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Today we are facing the rise and development of several metropolitan areas that merge into a huge urban structure, or megalopolis [18], which in many cases represents the demographic and economic backbone of a national system. Megalopolises are becoming widespread and characterize industrialized areas, such as the United States, Europe, and Japan, as well as emerging economies such as India and China. Also, some authors have forecast the development of urban systems to form a unique continuous conurbation, separated only by oceans, higher mountain chains, and deserts. Without arriving at extreme cases, such as the planet cities hypothesized in science fiction literature and movies, like the Republic/imperial capital Coruscant in *Star Wars* [57], inspired by Asimov's homologous *Trantor* [58]—both planets are completely covered by artificial metal structures and fully urbanized to host several billion people—cities are large consumers of energy and natural resources that very often are not available in cities themselves but need to be transferred from outside. That is a major challenge: Obviously, an "urban" lifestyle implies a lower level of sustainability, more energy consumption, more pollution, more waste production, and so on. In China, 45 airports will be constructed within the next 5 years, cities will produce 80 % of the total carbon emissions, urban areas will consume 75 % of the energy, and 50 % of the water supply losses will take place in cities.

Some alarming predictions highlighted at the 1992 Rio de Janeiro conference are taking place. The planet's resources are used by 20 % of the population mainly living in the Western and most industrialized countries, but given the economic growth of countries such as China, India, Russia, and Brazil, an elevated number of inhabitants could completely blow up the environmental balance of the planet. Therefore, clever approaches to save money and preserve the environment are needed. We cannot reproduce an urban development based on the same model that has governed the process of urbanization that has occurred from the Industrial Revolution until today. It is necessary to move from an approach based on pure physical growth of the city to one founded on the ability to use energy, water, and other resources correctly and efficiently and to provide a good quality of life. In practice, cities should become smarter in programming and planning the management and use of existing resources.

3   A (Smart) City of Networks and Interactions (from Location to Interaction)

Our world is urbanized, and forecasts predict it will be even more urbanized in the future. Cities represent the most visible footprint of humans on the planet; nonetheless, an agreed-upon and unique definition of what is urban and what is not does not exist, and several criteria are used to identify urbanization. Other human-made artificial landscapes have characteristics in common with cities, but

these are generally not sufficient to discriminate between cities and other manmade environments.

Geographers use different principles for identifying cities, such as the demographic principle, where the population and its density in a given area are used. However, there is no general agreement on the quantity of people and the population density needed to differentiate a village from a city in different parts of the world.

A second principle used is based on the quantity, shape, and concentration of buildings, but again, such a principle is not enough for discriminating between a city and a different kind of agglomeration, such as an industrial area.

A functional principle deals with the concentration of activities in cities, recalling the different nature of activities that occur in cities, such as nonagricultural ones and those serving an extra-urban demand.

As a summary point, cities can be identified as places where activities and functions are located and concentrated, so that not just the demographic and infrastructural points of view are considered, but, in addition, the functions that take place in that environment, typically consisting of a concentration of buildings, an infrastructure, and people, are also counted [17, 20]. That is a consequence of the fact that although, as we stated, the world in which we live is urbanized, cities are still quite rare in terms of their occupation of physical space on the Earth's surface and therefore play a role in providing functions over a wider spatial range than their physical boundaries occupy.

The functions played by a city are dedicated both to fulfilling the day-to-day needs of those people who live in the city (e.g., schools, retail stores), or *city serving*, and to realizing those activities that are the essence of the city and make it special, including universities and research centres, specialized medical doctors, and so on, that work for both the strictly defined inhabitants of the city but in particular call people from outside the city to benefit from such activities, defined as *city forming*. A wider surrounding area of the city is therefore served, which implies gravitation towards the city, and an interaction occurs, thought of as a flow, or a movement of people from outside the city towards the city itself.

Thus, a city is not just based on steady, fixed elements like buildings, infrastructure, and localized economic activities, but on movements, too. Typically, commuting identifies metropolitan areas defining the range of a city in terms of its (physical) attractiveness over a certain geographical distance.

A key element in doing that is the distance decay function, which states that the amount of interaction among people and places tends to decrease—with different slopes and speeds—as distance from the place increases.

Interaction and distance decay are applicable at different scales and in different contexts: In the previously mentioned commuting case, the number of people heading to a city for work activities from the surrounding areas tends to decrease as the distance from neighbouring areas decreases. Similarly, in analyses made on telecommunication traffic, interaction decreases with distance. In such a sense, usually cities are seen as nodes in a network system, characterized by linear elements linking nodes and flows on such links [28].

In such a framework, smart cities are strongly related with concepts and metaphors of networks, in terms of both the cities' characteristic of acting as nodes within an interconnected system of relations in space and the urban scale, where (linear) infrastructures connect places and allow flows of people, goods, and data to be interchanged and interact. The network metaphor is not new; Nijkamp [33–36] stated that we are moving towards economies and network societies, or also a "network state," characterized by sharing authority, where all the nodes are interdependent and regions do not disappear but are integrated [29]. Also, Castells [30–32] discusses "spaces of flows" and of a network society, referring to technological and industrial changes intervened in contemporary society. Transport and communication networks contribute to the setting of spatial interaction phenomena and play a relevant role in the location process. Networks are characterized within a scheme of functional relations shaping a territory. Every location process implies the idea of movement in space and across space. Technological innovations in transport and communication influence the relations among networks and space, so as new phenomena of axial and nodal polarization [29].

The importance of scale is paramount, as the interactions intervening among different spatial objects or elements depend on the extension and on the spatial scale considered. A city is a point in a global system of cities, while it is an area if we consider its extension at the local level. In the first case, the city could represent a node within a network system, in which arcs and linkages towards other nodes converge and contribute towards organizing the layout of a territory; in the second one, the city represents a region in space, and therefore an area object, whose boundaries are not well defined and within which are situated network structures of nodes and arcs [60].

On an urban scale, geographers focus their attention on cities in terms of their physical and functional features and on their interaction, while on an extra-urban scale, the focus is on how different cities are organized and linked in comparison with other cities with which they maintain a relationship in terms of commuting, political presence, economic environment, and so forth.

The city itself, as an area object, results from some aspects defined by the network relations occurring inside the same city. The spatial organization of a city can therefore be defined by the urban road network or by "subnetworks" that insist on that, as the subsets of the urban road network where pedestrians or bikers can move, or the network of the public transport system. The network can be seen as an example of trans-scalarity [17], particularly in the urban case. Urban networks in fact can be considered both as single nodal elements with some particular functions and a certain spatial distribution and as networks of cities at different spatial scales. The concept of network as a metaphor is therefore extended from that of "material, physical connections" to that of a "set of relations" that, although based on physical networks, allow urban areas to be represented as networks of nodes. Michael Batty [5, 43] stresses such a concept, suggesting that "to understand cities we must view them not simply as places in space but as systems of networks and flows [5, p. xvii]." The same network metaphor can, however, be moved in the internal part of a city, identifying places where people gather and interact more, such as squares,

shopping malls, and public offices. The same urban area, on a different scale, can be considered as a nodal element of the network [56].

Geographers consider cities and their regions as systems of nodes, connecting lines and flows, organized in a network and/or in a hierarchical system. However, the attention is generally focused on places and on the interaction between people and places. Recently, cities have increasingly been seen as complex systems, needing an even more integrated approach. In particular, then, the huge availability of data, often coming from users of portable devices and ICT social networks, provides suggestions and data sources to delve more in depth on the issue, moving the attention from interactions between people to what's happening in places.

According to Bettencourt [19], a city is a complex system characterized by a twofold soul: It "works like a star, attracting people and accelerating social interaction and social outputs in a way that is analogous to how stars compress matter and burn brighter and faster the bigger they are." He adds, "Cities are massive social networks, made not so much of people but more precisely of their contacts and interactions. These social interactions happen, in turn, inside other networks—social, spatial, and infrastructural—which together allow people, things, and information to meet across urban space."

4 Smart City, Smart Cities

4.1 Smartness or Dumbness

One of the challenges lies in the definition of "smart city," or trying to understand the level of smartness that a city can have. Although a certain agreement on the elements and indicators defining a smart city is set, such optimism cannot be directed towards their meaning and transformation into active practices.

Six axes represent the backbone of a smart city, with smartness translated into economy, society, mobility, people, governance, and environment. In all of them attention is given to the opportunity promised by modern ICT to boost such axes, optimizing and making cities more efficient. The philosophy behind the smart city is strongly related to the sustainable city, in which environmental, social, and economic dimensions are considered as part of the development to be pursued, to allow present and future generations to reach equity in living conditions. The difference lays mainly in the role played by technology, and ICT in particular, in allowing a more efficient management and organization of the different parts of life in cities.

However, how is that translated into the real world? Sustainability in urban contexts involves public participation. Possibly the Local Agenda 21 has been one of the first cases in which a bottom-up approach was suggested into political action at the local level, in such a sense anticipating—and putting the basis for—current public participation in planning, also helped and sped up by social networks and

media. In smart cities, public participation is central and, of course, is boosted by new technologies, social networks, and the media, and it must therefore rely on a consistent network and infrastructure, allowing data and information flowing and sharing. However, the bottom-up approach is possible in the smart city also by means of citizens' and urban users' building and realizing their own services and activities, therefore meeting needs they do know and experience, often better than the final decision and policy makers.

Nevertheless, and as a paradox, the smart city concept is often translated into a "techy" top-down approach and consequent solution, with a single (set of) decision maker(s) preparing supposed valuable solutions for citizens. This is the case with new investments toward smart cities in which high-tech tools are proposed and realized as centralized systems to control several aspects related to energy efficiency, transportation, housing, and more. In such a big infrastructure, projects are implemented that couple hardware network infrastructure and control systems as well as more traditional, although generally technologically advanced, real estate investments.

Rio de Janeiro and Song-Do are among these examples. In the former case, a control system was sold to Rio de Janeiro to monitor traffic in real time, while in the second one, a brand new smart city, or smart suburb, was built from a blueprint in a greenfield area, separate from Seoul and close to the new South Korean international airport, having in mind energy efficiency and saving, quality of life, and a planned environment for business, living, and working. These examples are the offspring of a planned centralized system, often not so flexible at incorporating innovation: As an example, Song-Do was based on RFID technology and not ready to adapt to new communication tools like smartphones and tablets—whose role in locating sensors and devices helping us in automating activities was completely unconsidered or underestimated.

On the other hand, the bottom-up approach is based on how citizens or city-users live and interact with the city and develop their own applications and solutions for the different uses of a city. Similarly to what happened in the past, with new utilities and infrastructure both serving cities' expansion and also shaping it, technology is influencing how we live and set our relations with other people and places. As a trivial example, on the one hand, new devices and tools induce us to cluster close to free Wi-Fi hotspots; on the other hand, people's routine congregation in popular places may induce the authorities or private enterprises to set and reinforce wireless sensors.

Therefore, a similarity with other physical infrastructures (roads, electricity cables, freshwater pipes) arises, but how we now use what flows on such an infrastructure is quite different—and often unexpected—compared with what we used to. So it risks or tends to be for the physical infrastructure of the smart city, or the hardware composing the digital layer superimposed over the city. And that suggests that the bottom-up approach in a very "open" way should be based on the setting of an infrastructure (and a set of rules) and should allow people to "flow," to interact and develop their own activities.

4.2 Smartness in the World

A problem related to "smartness" refers to the differences that different countries and cultures put on "city" and therefore also on "smartness." European cities are different from each other, and the European model of city is different from the North American, Asian, and African ones, for instance. So when we consider a smart city, we must also consider cultural and national differences on how cities are interpreted and intended.

How does that fit with the concept of smart city? If we recall some of the data cited at the beginning of the present chapter, we observed that the mature economies of industrialized countries already have a high percentage of urban population, and the increase in these figures can be translated into an increasing density of existing cities or into urban sprawl with a growth of small and medium-size centres, or in a combination of both factors due to international migrations or, still, in rural–urban dynamics or blurring of the two processes. Europe and the United States possess older urban structures and heritage. In such places, the growth and development of cities happen on a physical infrastructure stratified in several decades (as in the North American case) and centuries (as in the European cases). In such cases, each change will have to face such a heritage, translated in the physical, cultural, and social infrastructure stratified with time.

The case of growing economies and developing countries is quite different. Often the urban growth occurred (and is occurring) at a very fast pace, with different kinds of impacts and consequences. In some cases, urban growth from a demographic point of view is not accompanied by an adequate supply of infrastructure and services. Therefore, a consequence can be that a part of the population is not served by basic services and infrastructure, and informal settlements characterize the urban landscape.

In other cases, cities grow very fast, without a precise model of the city in mind, or by simply creating urban fabric from the blueprint to fulfil a need for housing, industry, retail, and office spaces. Governments in Asia, and particularly Southeast Asia, are working on creating housing and expanding cities and the issue is related to the urban model to be adopted for brand new cities or neighbourhoods. In such cases, brand "new towns" or suburbs are built from scratch, in a similar way as settlements in the Western suburbanization era, but with dimensions comparable to medium-size cities or metropolitan areas in the industrialized world.

A smart city in an urbanizing, developing world means first providing services and infrastructure—starting with water and energy supply and management—and then thinking about optimization through high tech. In the rapidly industrializing world, it means building brand new settlements, from a blueprint and often in greenfield areas. Here a smart city appears as a new town, a planned city in which functions and activities are organized. Often this is also translated into new suburbs or mid-size cities to be realized, in such a sense following a suburbanized scheme already seen in other contexts, with the difference that smartness is put primarily onto energy efficiency and technological devices.

On the other hand, a smart city based on an existing urban fabric, stratified in years of history—as in Europe or even in some US cities—requires optimization and reuse. So, on a more traditional urban fabric, smartness is more related to the challenge of rethinking a city in a smarter way, therefore optimizing it particularly in terms of interactions between citizens or city-users and the "hard," infrastructural component of the city, not just building brand new settlements or suburbs that, in an unsustainable way, would consume soil and space.

5 The Pillars of a Smart City

The risks today lie in focusing on just the technological side of "smartness," maybe without a tight connection neither among techy initiatives, nor—and even worse— with spatial and urban planning activities. We do not deny that ICT is central in setting a technological infrastructure as the backbone of the growing flow of data and information. The role of infrastructure in both serving and boosting urban growth and expansion was already mentioned as having a heritage, since their shape and fabric remain over time and influence different periods and generations. Thus, focused planning is needed, not to be limited to the short term, but to persist.

In such terms, a true smart city acts as an "enabling platform for the activities that citizens are able to develop, linking those inherited from the past to those that can be realized in the future, so it is not focused just on applications but on the possibility that citizens realize them" [10]. Doing so is possible by thinking about it in terms of three main pillars [14]:

1. connections—as networks and technological infrastructures;
2. data—open and public or public interest data to allow the development of innovative solutions and the interaction between users/citizens and the city [22];
3. sensors—including citizens [11–13] able to actively participate in a bottom-up way in city activities (Fig. 1).

Such pillars need to be accompanied by an urban governance able to harmonize them and particularly to represent a set of minimum "driving rules," regulating a smart city in a neutral way, without entering too much into details concerning contents and applications developed by citizens, urban users, private companies, and so forth.

In this sense, a correct approach to smart cities should in some way try to resolve problems typical of urban areas and not just those of niches of users. As an example, our urban areas are often profiled on a category of users: generally male, in his productive age, driving a car, therefore cutting out other important parts of the urban population, such as young and elderly people, as well as the female component [15]. Hence, a purely "techy" smart approach risks reaching just those people actively using ICT (mainly mobile) technologies. Therefore, the technological layer needs to be linked to the spatial context where it is applied, as cities are different from each other. One of the key elements in planning is verifying the compatibility and complementary of a plan with other ones just ended or to be licensed in a short time; another is considering the possible overlap with similar initiatives [16].
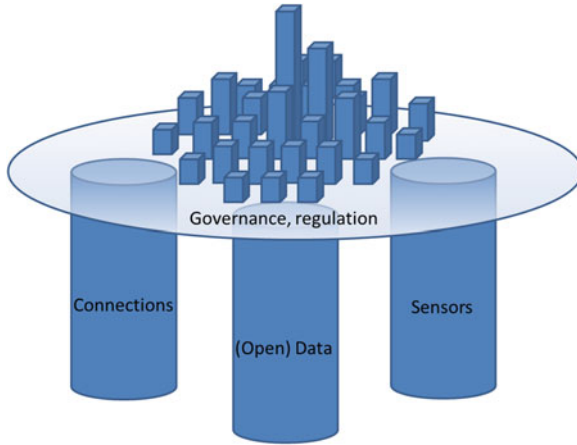
Fig. 1 The three pillars of a smart city and governance (graphical elaboration from [10], in [14, 21])

It is important to use the big impact of technologies on new forms of policy and planning. The six axes of smartness not only need to be connected to technology, but also need to be connected to the added value that innovation can lead to programs and plans already issued.

6 City, Open Data, Big Data

6.1 *The City and the Open Data*

As mentioned earlier, connections, sensors, and open data are the *smart city's* pillars that adopt an approach based on the transition from the concept of *government* to the concept of *governance*. The essence is a background vision of the city able to transform the "impulse" resulting from the pillar activities to be performed into the individual application domains, the six *smart city* axes: *economy*, *governance*, *living*, *people*, *environment,* and *mobility*.

A lot of people talk every day about open data—just as they do about smart cities—without getting into the details on the real meaning and the great opportunities that could arise from their correct use.

In most cases, the concept of open data is based on uploading a file in portable document format (PDF) on a website, allowing the download to everybody. When a public agency shares a PDF file, a monitoring authority should take action and if necessary sanction it, because a public employee spends his or her time to put constraints to data, and in another government agency, another public employee will waste much more time using that data just because of these constraints. The PDF

type was created to allow document or drawing printouts, often in printing services, without using the software that produced these data, by simply employing a PDF file reader.

Tim Berners-Lee proposed an open data classification scheme, associating stars with the level of quality. The lowest level is based on providing an open license, making the data available on a website without defining the specific type of format (usually, the files are of PDF type). The only purpose of this type of data is to inform; it is only possible to read or print them. The second-level aim is to provide data preserving the original structure, allowing also their manipulation. It is a small improvement even if data remain in a proprietary format. Three-star open data allow manipulation and management of data and adopt a nonproprietary format, ensuring better interoperability. The upper level maintains interoperability properties of data and improves availability on the network through the use of semantic web standards (W3C, RDF, OWL, SKOS, SPARQL, etc. [23]). Five-star open data are linked open data.

The limit of this classification is that spatial aspects are not considered at all.

In the introduction to their book *Geocomputation and Urban Planning* [26], Murgante and co-authors cite the famous paper by Franklin [25], who in 1992 quoted that 80 % of all organizational information contains some references to geography. After the publication of the Murgante et al. book, numerous discussions started on social networks and blogs about how was it possible that in 1992, 80 % of information contained a spatial component [24]. The Murgante et al. book was published in 2009 and now, after only a few years, the situation has completely changed: Each mobile phone has a GPS, and Google OpenStreetMap has transformed geographical information from specialist interest into a mass phenomenon and probably 100 % of data have a spatial relation. Consequently, ignoring spatial aspects as an intrinsic component of data is a big mistake.

The spatial component has always been underestimated, sometimes intentionally, sometimes ignorantly. In the first experiences of implementing master plans in a spatial information system, data were deliberately shifted from the original coordinates in many cases and the values of the translation were jealously guarded like the access codes to a bank account. The main aim was to avoid overlapping of planning tools with other layers, allowing the level of subjectivity of some decisions to be discovered. In Italy, for instance, there is a great tradition in creating barriers to the immediate overlapping of information layers: Cartographical maps and cadastral maps have always been produced at different scales to allow some subjectivity for technical bureaus of municipalities.

A comprehensive approach to open data should consider Open Geospatial Consortium (OGC) standards and the INSPIRE directive.

Nowadays, data represent a significant unused economic potential, because if they were available to everybody, the collective imagination could create new companies and produce additional business to existing companies. The great majority of these possible business initiatives should be based on applications for smartphones and tablets, which in 100 % of cases require a spatial component.

Considering the classic application for parking, there is a great difference if the application allows only ticket purchase or if it indicates also where the nearest free parking is located. Consequently, open data for this type of application should be distributed at least as OGC Web Feature Service (WFS) standard.

It is crucial to radically change public authorities' approach: Very often the term "service" is synonymous with "contract."

A municipality does not have to pursue a contract for a parking application, but it has to make open data available in OGC Web Feature Service standard, allowing local startups or to produce an application or to reuse an application produced for other municipalities. The municipality receives a free service and the enterprise benefits with advertisements; if someone does not like the advertisement, he or she can delete it by paying 1€. Local authorities save money and contribute to creating or consolidating enterprises in the field of innovation. To achieve this goal, it is essential that authorities produce and distribute high-quality data.

6.2   The Big Data Challenge

However, the question today is not only on the openness of data but on the dimension data can reach. The term is known as "big data," and it is destined to play a crucial role in the smart city debate. As said, size matters; under the big data label, a wealth of data in different formats and storage systems can be aggregated. In general terms, "big data" encompasses any set of data so complex and large that it becomes difficult to process and analyse using traditional database management systems or processing techniques [44]. All the traditional aspects related to managing data are involved and require new instruments and techniques: acquisition, editing, storage, search, transfer, analysis, visualization, and representation. More than standard procedures and tools, big data requires "massively parallel software running on tens, hundreds, or even thousands of servers" [45].

However, the size of this "bigness" can vary, and so defining big data is not simple, often relying on an organization's ability to handle a certain amount of data [46].

Big data can come from different sources: government, market, private sector, big science, science and research. The widespread use of sensors, particularly mobile, and the capacity to collect wide sets of data in time and space are providing different players with consistent and abundant sources of information.

Furthermore, part of the *big* data could become *open* data, such as those collected by government and public organizations. Also, private organizations could provide open data too, but industrial strategic considerations often heavily limit this option.

The debate is quite vivid, in terms of both the problems connected to the paradigm and the applications. On one side, the critiques focus on the fact that little is known concerning (1) the empirical micro-processes that cause big data characteristics to emerge [47] and (2) the real effectiveness of big data in helping to make good decisions [37], while alerts are posed on the fact that, in any case, data
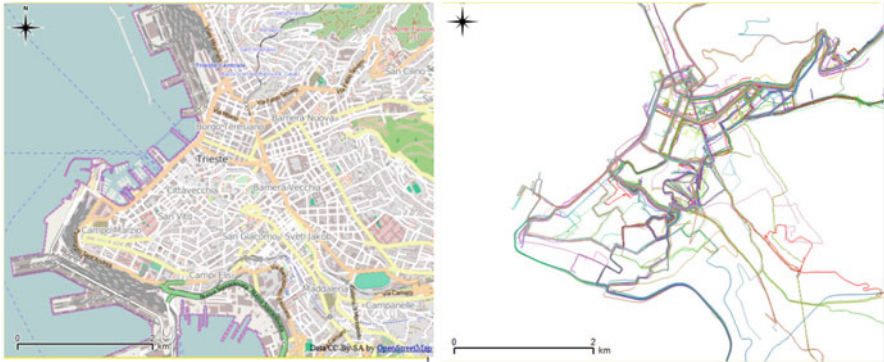
Fig. 2 Personal data as big data: 7 months of car-driven individual paths (*right*) in the city of Trieste (*left*). [*Source*: OpenStreetMap (map); authors' elaboration of individual data]

need to be contextualized into social, economic, and political contexts [48]. On the other side, part of the scientific community expresses concerns about the use of big data in scientific research [50, 52], given the lack of a sound theory behind their use [38, 39], the difficulty in choosing representative samples of data, the management issues, and the difficulty in integrating data from heterogeneous sources [40–42]. However, the challenges posed by these issues are also seen as the promising new frontiers in science [47, 49, 51].

Nonetheless, data collected in space and time, by users and organizations, can provide interesting hints about a city's behaviour and can better orient planning strategies. Well aware of this attribute, Ratti and Townsend propose just connecting people to an urban network and letting them play. Their behaviour, actions, and comments will be more useful than predefined top-down planning policies [53, 54], recalling Adam Smith's assertion that an individual "pursuing his own interest . . . frequently promotes that of the society more effectually than when he really intends to promote it" [55].

As an example, Fig. 2 presents individual movement travel data taken over 7 months, used as a starting point for research on how people "live and drive" in a city. Personal routes can be useful both for an individual in understanding his or her traffic habits and, if aggregated, for urban planners in better understanding their city.

7 Smart Citizens or Devices?

What about portable and mobile devices when talking about smart cities? How smart are we in using smartphones, tablets, and the whole family of portable devices? How we work, navigate, and spend our free time is now mainly based on mobile devices, to date smartphones and tablets, whose diffusion has widely overcome that of more traditional desktop and laptop PCs.

How we use such devices is, however, still very limited to some kinds of uses and applications we, as users, are quite far to exploit their potential. Figures help us here [27], pointing out that at the end of 2013, 91 % of people on Earth had a mobile phone and the number of mobile phones exceeded the number of people [61]. Smartphones cover 56 % of the population. Games consume 32 % of people's time spent on smartphones, followed by social and media networking (24 %), web browsing (18 %), and productivity and utility (10 %). Professional uses have ranked at the top from the beginning, and so email (28.85 % of all emails are still opened on a mobile device), live meetings, and calendars were features differentiating smartphones from more traditional mobile phones. That made the initial fortune of a company like R.I.M., Research In Motion, which created the smartphone concept and the popular BlackBerry platform but is now suffering from—and losing to—the competition of giant ICT players such as Apple and Android. Such a competition is also a symptom of a blurring of personal and professional uses, creating a generation of users whose activities no longer have a marked spatial and temporal separation. So a question arises: Is the use we make of smart devices really smart? When we talk about smart cities and communities, is the use of such devices really helping us in reaching such targets?

We are probably far from reaching a really smart and complete use of such devices, similar to what happened with standard PCs and the software running on them: Spreadsheets or database management systems, for example, are generally designed for a wealth of uses that most users would likely not rely on in their lifetime. This is probably what will happen with smartphones and their apps.

We are facing a very wide and extensive coverage of mobile devices that, however, appear as Formula 1 or NASCAR racing cars driven in a peak-time urban traffic jam, queuing at crossroads.

As Fig. 3 shows, smartphones and portable devices in general can be viewed in different ways and from different perspectives, as tools to connect accounts to social media or to check emails and contacts, but capable of hosting several tools and applications actually enhancing our capacity to act as real mobile sensors [5].

Fig. 3 What is in your smartphone? (Authors' elaboration; also in [28])

We can choose how to use them and view their potentials. On one side, there is their use, as presented in Fig. 3 on the left, as that of social network-media devices, allowing phone calls, email, chatting, weather forecasts, video and picture cameras, among other functions. On the other side, we can exploit their capacity of being real, fully integrated microcomputers, hosting a network broadcasting system, based on both the cellular phone network and Wi-Fi points, a set of software more or less sophisticated, including also GIS and geographical and technical applications, GPS, and other position receivers. Such a combination allows such devices to act as true sensors for collecting a wealth and variety of data as well as to, more or less consciously, participate in the city's choices and decisions. Our smartness as citizens should therefore be that of using the potential of such devices to exploit our interaction with the city to monitor it and highlight both positive and negative aspects and help its better management. Private companies and public bodies already use data that we in a more or less aware way share, such as positional and movement data, which allow the estimations of traffic jams, public transport time, and so on. Also, our preferences for checking in and doing particular activities in certain places is already monitored and allow private companies to target marketing campaigns and products and could—and hopefully will—allow planners and scholars to better understand how cities shape themselves from a social—not only in the ICT way!— point of view. Accepting Ratti and Townsend's suggestion, let's "jack people into the network and get out of the way" [53].

8 Designing a Smart City Is Only an ICT Project, or It Is Also a Planning Activity?

A lot of terms have been adopted in the last few decades to describe different approaches to the city. Hanzl (see Fig. 4) defines a sort of ranking of these terms according to popularity at this moment. Obviously, the term "smart" is most popular in this period and has been adopted in every context concerning the city. The term "smart" has become a sort of telephone prefix to put before each term or concept already defined in the literature. In this way, "participation" becomes "smart participation," "mobility" becomes "smart mobility," and even "sustainability triangle" becomes "smart triangle." The result was the loss of sight of the city, with the decision makers concentrating on mobile applications as a child might with videogames (Fig. 4).

The six axes of the smart city, when considered in an integration perspective, often described as a cultural revolution, are no more than the first lesson of urban planning. Moreover, it is quite obvious that mobility has close relationships with economy, people, governance, environment, and quality of life.

For instance, Masdar City, considered one of the symbols of the smart cities designed by Foster and Partners, is certainly a city designed according to all precautions in term of energy saving and reduction of emissions. The question is: Is a sort of futuristic city realized in the desert sustainable? We are not calling into

Fig. 4 Ten commandments for the city (Hanzl, 2014) (https://www.facebook.com/photo.php?fbid=10204196347015718&set=pb.1438171327.-2207520000.1403434139.&type=3&theater)

question the quality and details of the project, but the basic idea. Also, Ski Dubai has a lot of energy-saving measures, but it is surely not smart to build a ski resort in one of the hottest places in the world.

In the past, more attention was paid to many aspects strongly related to smartness without considering mobile applications.

Figure 5 shows how the oldest part of Sassi in Matera (highlighted in the image) is oriented in order to maximize heating in the winter and cooling in the summer [59].

Also, the cave dwellings were arranged in order to maximize the reuse of rainwater. Rainwater is collected by a system of conduits placed on the roofs; they discharge the water in tanks located inside the dwellings (Figs. 6 and 7).

Additionally, social relationships have been considered in Sassi. The neighbour-hoods (*vicinati*) are the neighbourly relations formed between members of a small agglomeration of dwellings. More precisely, the neighbourhoods are groups of houses placed around the same space with a form of amphitheater with an important role in the organization of domestic and social life. Within the neighbourhoods, life was very intense; there were human solidarity and mutual aid. The neighbourhoods can be considered an urban sphere of relations and mutual assistance, a real cultural exchange, where the private coincides with the public space.

In analyzing technologies applied to the city, it is fundamental to distinguish whether or not the innovations have relationships with the urban environment. The main question is: Are these technologies useful for the city or are they simply solutions looking for a problem? The issue is that it is not easy for everybody to
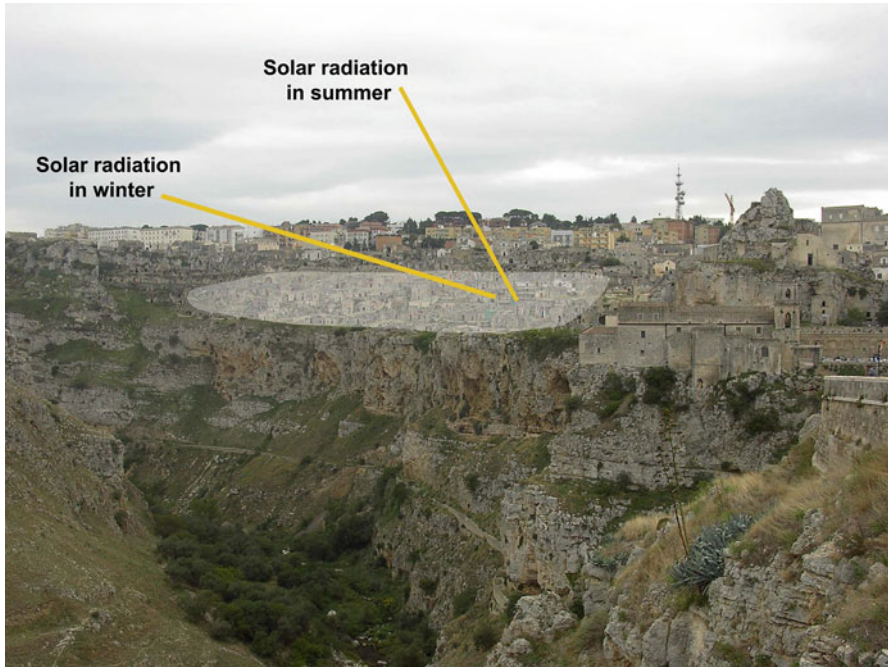
Fig. 5 Orientation of Sassi in Matera

Fig. 6 Reuse of rainwater from Sassi in Matera

Fig. 7 The neighbourhoods (vicinati) of Sassi in Matera

discern clearly these two aspects because of a communication campaign organized by device producers and because of a certain convenience that several applications produce. According to Brandolini, "The amount of energy necessary to refute bullshit is an order of magnitude bigger than to produce it" [63].[2] The main efforts in upcoming years have to be concentrated on distinguishing between what is bullshit and what is useful for cities.

9 Conclusions

The sustainability of cities and quality of life in cities are among the main challenges that current and future communities have to tackle. A "smart" approach to achieving these challenges involves the widespread use of the best technologies available, and particularly the ICT ones, which have experienced unprecedented growth in recent years.

There is a widespread belief that the realization of a smart city is based on an extreme use of applications for smartphones and tablets. Also, there is a belief that smartness in urban terms means building self-contained, gated settlements, realized with eco-friendly materials and a rainfall of ICT devices and advertised as sustainable. Such developments actually result in suburbs, thus continuing to reinforce the unsustainable urban sprawl and land consumption characterizing the last decades particularly in the second half of the Twentieth Century.

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[2]https://twitter.com/briandavidearp/status/481304548305555456/photo/1

Very often the attention has been focused exclusively on device applications, with developers forgetting that there is a city to take care of. Whenever automation through mobile applications is proposed, it is important to consider its effects on the city. When someone proposes a complex technological system, it is important to ask, "Is it really useful for the city?"

In numerous cases, programs that originally declared their objectives to be mainly related to urban aspects have been purely transformed into programs based on ICT improvement. It is evident that in these experiences, the program has lost sight of its main original goal during implementation. In the first lesson of strategic planning courses, it is usually explained that when building a correct program, it is important, as a first step, to identify who are the beneficiaries. In most "technology-driven" programs, often this principle is not taken into account or is forgotten during the implementation.

Cities around the world are very different and in need of different solutions. Technology can play an important role now as it did in the past: Innovations in transport (e.g., tramways), energy (electric lighting), and telecommunications were often at first experiments in cities to contribute to the quality of life of urban people. Similarly, modern information and communication technologies (ICT) can help and be important factors for a city's success.

Technologies can represent a fundamental support in improving the efficiency and effectiveness of a city's planning and management, but it is important to have a clear understanding that technologies are the means and not the target. Given the complexity of the cause–effects relationships of ICT technologies and people, maybe today's challenge is to understand how to put them correctly into planning procedures, just as in the past the challenge was considering a new public transport line or power supply.

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