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Università degli Studi di Napoli Federico II

16

numero 1 anno 2016

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16

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The Inclusive, Resilient, Safe and Sustainable City: Models, Approaches, Tools

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BDC - Bollettino del Centro Calza Bini - Università degli Studi di Napoli Federico II
Registrazione: Cancelleria del Tribunale di Napoli, n. 5144, 06.09.2000
BDC è pubblicato da FedOAPress (Federico II Open Access Press) e realizzato con Open Journal System

Print ISSN 1121-2918, electronic ISSN 2284-4732

SHARING PRACTICES AND DEMATERIALIZED SERVICES IN SMART CITIES

Eleonora Riva Sanseverino, Raffaella Riva Sanseverino, Valentina Vaccaro

Abstract

The "intelligent management" of the areas, in which traditionally cities are lived and urban functions are implemented, summarizes the model of smart city. Through new integrated approaches spreading from the use of Information and Communication Technology (ICT) and of the web, which take the role of enabling tools for change, contemporary cities are strongly changing. The digital age creates, in fact, the conditions for the emergence of new tools and new services for citizens, based on communication and on sharing and participation practices. The article contextualizes these changes by focusing on some examples of what can be defined as "dematerialized services" of contemporary cities, seen as new urban services and new practices of community's living in smart cities.

Keywords: smart city, sharing practices, dematerialized services

PRATICHE DI CONDIVISIONE E SERVIZI DEMATERIALIZZATI NELLE SMART CITIES

Sommario

La "gestione intelligente"dei tradizionali ambiti del vivere le città e delle loro funzioni urbane, sintetizza il modello di smart city. Attraverso nuovi approcci integrati generati dall'utilizzo delle tecnologie (ICT) e del web, che assumono il ruolo di strumenti abilitanti al cambiamento, le città contemporanee stanno fortemente mutando. L'era digitale crea, infatti, i presupposti per il nascere di nuovi strumenti e nuovi servizi per i cittadini, basati sulla comunicazione, sulla condivisione e sulla partecipazione. L'articolo contestualizza tale cambiamento focalizzandosi su alcuni esempi di quelli che si possono definire "servizi dematerializzati" delle città contemporanee, intesi come nuovi servizi urbani e nuove pratiche del vivere in comunità nelle città intelligenti.

Parole chiave: città intelligenti, pratiche di condivisione, servizi dematerializzati

1. Dematerialized economy in the city of services

Already some years ago, referring to *product service systems*, Robin Roy (Roy, 2000), talked of the advent of a new era founded on the "dematerialization" of the economy, highlighting the emergence of a new service economy in which the profitability would be based not on production and consumption of goods, but rather on supplying services to satisfy human needs (i.e. in health and mobility). He argues indeed that cleaner production and energy efficiency by themselves could even not provide, on a global scale, a reduced energy consumption due to the rebound effect of increased use of goods and appliances.

This change towards dematerialization, in full line with current trends, would have led, as the author writes, to lesser usage of resources and lower environmental impact.

In this context, the author distinguishes four types of *product service systems*:

- *result services* (also called on-demand products or services), for which the service provider is responsible of all physical aspects of the system and sells a "result" instead of a product (i.e. a company supplying copiers, can provide printing and delivery services to customers). In this case, the purpose is to reduce the use of material parts of a system, by a rational use of the physical components;
- *shared utilization services* (sometimes called product use services or community products), consisting in sharing products among different users. This type of *product service system* has the purpose of increasing the use of the material parts of a system by sharing the products required (e.g. car sharing);
- *product-life extension services*, aiming to significantly increase the useful life of the products or materials through maintenance, repair, reuse and recycling, thereby reducing the amount of energy and resources to provide a given function;
- *demand side management,* (sometimes called least-cost planning or integrated resource management), which is a term coined in the energy field that includes the possibility to limit or modify consumption habits instead of building new generation capacity.

As an example, in the energy sector, the Energy Service COmpanies (ESCO) provide their customers, typically users with significant energy consumption, with different integrated services for the implementation and subsequent management of measures for energy efficiency. ESCO offer result services, namely electricity. These companies guarantee the maintenance of the energy generation plants and return part of the savings to the customer. In this way, by keeping part of the savings coming from reduced energy consumption, they can both finance the investments and get a remuneration. However, what we might call then "dematerialized service/product" is fundamentally characterized by sharing and communication. Emphasized by the current period of economic crisis, the idea of owning something, whatever it is, is more and more replaced by the idea of sharing something. Another highlight of this change in perspective is the increasing attention to the environmental impact of goods and services, which bring consumers, producers, citizens and administrations to make consumption and planning choices with lower environmental impact. In view of all this, is it reasonable to have goods, if people can use services instead? Starting from the new possibilities offered by the information and communications infrastructures, it is possible, indeed, to rethink the urban context and its services to make them more efficient in different ways. All this leads to develop a new approach to the definition of the urban layers or of the urban infrastructures of contemporary cities. As a matter of fact, behind the services provided for the community there are the urban infrastructures, which are traditionally divided into "urban hard and soft infrastructures".

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The first class relates to urban physical infrastructures, such as the supply energy system (electricity, gas), the water supply system, the waste water discharge system, the waste management system, the public transport system, etc. The second class, to which production service systems belong to, refers to the decision-making field, these are about the ideas that shape the community and that appear in all these regulatory tools and standards defining its very founding principles (Malecki, 2002; Landry, 2012; Derudder *et al.*, 2012).

In the novel concept of *smart city*, traditional infrastructures are largely changing due to the need to offer new services to the community and citizens, maintaining clear objectives such as high efficiency, low environmental impact and high adaptability to external changes (climate changes, urban development, new needs and factors affecting the quality of services offered to citizens) in the long term. In this context, the Information and Communication Technology (ICT) and the digital space (understood in its literal and figurative sense, as the set of data to be collected and processed in the web or through sensors in real world) are enabling technologies devoted to this change, as regards both hard and soft infrastructures. An explanation of this concept can be found in the layers model of Smart Community recently proposed (2014) by the International Organization for Standardization (ISO) in ISO/TR 37150 *Smart community infrastructures - Review of existing activities relevant to metrics* (ISO, 2014).The model shows a hierarchical structure in which the different dimensions of the smart city (Table 1), as defined by the ISO/TR standard, are deployed at different levels.

The model is based on the assumption that, behind the services provided to the community, there are the urban "community infrastructures" (ISO/TR identifies only the hard infrastructures), as fundamental and shared technologies to support the delivery of the other two services layers (facilities and services).

Table 1 – Layers model of a Smart Community in ISO/TR 37150:2014

Layers	Examples of functions
Community Services	Education, healthcare, public safety and security, tourism, etc.
Community Facilities	Residences, commercial buildings, office buildings, factories, hospitals, schools, recreation facilities, etc.
Community Infrastructures	Energy, water, transportation, waste, ICT, etc.

Source: International Organization for Standardization (2014)

Focusing on the importance that services have in structuring Smart Communities and focusing on what we called "hard urban infrastructures", the International Organization for Standardization, in February 2012, has begun working on standardizing "Smart Community Infrastructures" (ISO, 2012), which coincide with the infrastructures at the lowest level of the hierarchical model in table 1.

The definition of smart community infrastructures is based on the integration of the different functions and on the implementation of the technologies supporting the community activities. The standard addresses the technical aspects of the Smart Community, dissecting the concept of smartness in terms of performance and technological

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solutions that can be implemented and integrated to create a multi-service infrastructure. It does not focus on dealing with specific standards for each infrastructure.
The Smart Community Infrastructures, then, are defined as infrastructures to minimize environmental impact, increase economic efficiency (for example, in the management of the provided services) and provide services that improve the quality of life of citizens. These objectives are achieved using ICT like sensors networks and Internet of Things (IoT links smart objects to the Internet, smart objects are equipped with sensors and have bi-directional communication ability, IoT enables secure data exchange from very unaccessible sources and at high rate, Cisco estimates that IoT will consist of 50 billion web connected devices by 2020), data transmission systems, actuators network in order to achieve an integrated and optimized management of the technical infrastructures to which these devices are connected and of the relevant provided services (Riva Sanseverino and Vaccaro, 2015). Examples of measures and actions implementing this concept are becoming more and more common, partly because of the strong pressure from the European policies and European funding current orientation (e.g. Horizon 2020).
For example, traffic light systems can sense and transmit information about congestion mobility. The relevant actuator systems are able to change the timing of the turning on and off of red/green lights for traffic regulation to ensure that cars are always on the go (this brings environmental benefits, in terms of reduction of environmental pollution, and benefits to citizens, in terms of saving in time and costs).
A system like this uses sensors, video devices or electromagnetic coils embedded in the asphalt, to receive monitoring data about the traffic from the roads. These systems allow to detect the intensity of the traffic flow with different precision levels, processing the collected data and send information about the number of cars and their speed in the controlled area. The supplied data allow the local administration to implement policies of traffic management tailored to specific areas of the city (environmental and governance benefits).
Monitoring systems, such as video units, coupled with identification systems (sensors) installed on the private cars, also allow the control of the area, increasing the safety and allowing, for example, the identification of the car plates numbers both for the purpose of fining those who have an incorrect behaviour and in order to identify cars of criminals.
Within the layers of services, as explained until now, the digital infrastructure and ICT takes the role of transversal infrastructure, which enables the transition from the traditional "hard urban infrastructures", to the "smart hard urban infrastructures" (Fig.1).
The new information and communications technology, however, have a value even in what are termed "soft urban infrastructures", which, in the smart city, can be identified with the set of intangible services/products, that arise from social interaction, by the desire to solve a shared problem or develop an idea to provide a service to the city or citizens.
The process of development of these new intangible services (traditionally understood as what concerns the institutions and regulations, now evolving into services offered by citizens and devoted to citizens, such as crowd-sourcing, car sharing, etc.) within an undefined set of persons not previously organized allows the transformation of citizens into agents providing a service by means of connectivity. The encyclopedia Wikipedia is a concrete example of how the sharing of knowledge from different free contributors can provide a service to the community. In the following sections some examples of these services are given.

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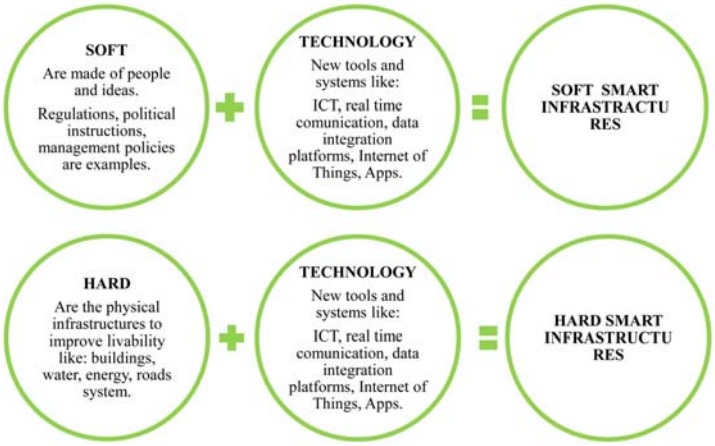
Fig. 1 – How can infrastructures became smart?



Source: Authors (2016)

2. Communication and sharing as *places* of contemporary cities

Communication and sharing have become a *place* of the contemporary city. The experiences of co-working areas are definitely a concrete example of a social innovation *place*. Sharing *means*, namely equipment, information systems, knowledge and skills to make sure that co-working *places* become a multiplier of capital gains.

The tangible productivity and the benefits yielded to the community in terms of employment levels and services offered, is so remarkable that some Italian regions (such as Tuscany) have supported young people who want to create co-working areas. Many *start-ups* are indeed born within co-working areas. Laboratories are often digital innovation Lab, as APPLiCO Digital Lab (APPLiCO, 2015), an infrastructural pole for digital innovation, created by the strategic vision of four Italian ICT companies in the Umbria region. The idea is to aggregate innovative views and professional "digital" profiles to promote the development of synergic projects through sharing workspaces, training proposals and targeted events. Each Applicant or APPLICO co-worker, in addition to the potential offered by a co-working environment with excellent facilities (connectivity) and where all the actors of the growth or transformation of his company are, can rely on dedicated tutoring services supporting the development of their businesses, from obtaining funds to being introduced into relational networks. Sustained by strong innovations within Information and Communications Technology (ICT) and Social Networks, citizens are changing their way of thinking and habits, as reported by field studies. Politicians, businessmen, but also ordinary people evaluate the importance of the communication in everyday activities and rely more and more confidently to the web. Also Pope Francesco (2015) has innovated strategies and ways to communicate with believers, shortening the distances through the use of digital technologies and social applications. Following economic or sociological metrics, the Internet is one of the most important technical infrastructures existing today. A

simple measure of the impact of the Internet and the importance it has within the contemporary community, is to consider the number of users, which is now according to ww.internetlivestats.com more than 3 and half billion. From an economic standpoint, the world 25 largest dot-com companies, defined as companies that do the majority of their business on the Internet with annual revenues exceeding 1 billion USD, expose revenues ranging from 107 billion US dollars to 0.9 billion US dollars in 2015. The wave of political insurrections that hit Egypt in 2011, gave an indication of the impact that the Internet has in sociological terms. Besides it is well known that thanks to Social Networks, citizens have found new channels to get in touch and try to break the power games. The limited use of Internet and of Social Networks (Facebook and Twitter) blocked by authorities in Egypt turned to be totally inefficient to stop the exchange of information among the opponents. It is interesting also to note that the power of the Internet is here measured in a country where Internet penetration in 2011 was limited to 21% (79% was in 2011 in Germany) (Di Liddo *et al*., 2011; Domingue *et al*. 2011). Moreover, an interesting analysis carried out by Cisco IBSG yet in 2011 (Evans, 2011) forecasted that the devices connected to Internet would reach 25 billion in 2015, and 50 billion in 2020: the figures are surprising with reference to the entire world population, much of which actually doesn't have an Internet connection. In Italy, the data provided by Istat on the sample of individuals statistically representative of the Country, tell that in 2014 over the previous year, the share of households with access to the Internet from home and with a broadband connection was increased (respectively from 60.7% to 64% and from 59.7% to 62.7). The Italian scenario shows that families with at least one minor are the most digitally equipped, while the digital gap is stable between the north and south of the country (the families of the center-north, that have a personal computer and access to the Internet from home are about 66%, compared to 57.3% of equipped households in the South). As compared to 2013, the use of personal computers is stable, but increases the daily use of the web (+3.3 percentage points). In fact, the widespread of last generation mobile phones allows citizens to become consciously or unconsciously receptive sensors (Carta, 2014) of a constantly changing and moving city, being able to record situations and compete with their behaviour to a better operation of urban services. It is well known that the concept of "intelligent cities" has attracted considerable attention in the context of urban development policies. Internet, sensors and broadband technologies increasingly take on the role of enablers of services for urban development, as cities are increasingly taking on a key role as drivers of innovation in areas such as health, social inclusion, environment and enterprises (Kroes, 2010). Besides, the advent of the digital era has radically changed our way of living allowing the development of new tools activators of urban welfare through social participation and innovation. The basic role of cities and territories in terms of innovation was mostly focused on the widespread integration of broadband infrastructures as much as possible distributed throughout the territory, today's cities and urban areas are considered not only as the passive subject of innovation, but an innovation ecosystem which allows through the possibility of co-creation among users and citizens, to develop "smart" projects and actions.

3. Mobile Apps and citizens "enabling" dematerialized services for the city

In this frame, more and more novel intangible services are developed in the "management of living" through smartphones and tablets and based on user friendly mobile Applications (Apps) relying on open source data. In this way, citizens become receptive sensors and

providers/users of services, bringing back to the idea of prosumer (producer/consumer) that is already a consolidated issue in the energy sector. An interesting study (Castellano, 2014) addressed the concept of sharing economy reporting the example of some of the most popular apps used in the world. These apps offer what was previously referred to as *shared utilization services*, also creating business alternatives and works. Nowadays, in fact, any good traditionally felt as a "property" can be easily shared: houses (Airbnb app), cars (Uberpop app) or even meals (Gnammo app). The benefits of such a structured economy support owners in recouping the costs of management of the property, while offering added value of the exchange of experiences and knowledge that these services indirectly give. The success of an app or a web platform is measured through the feedback, namely a way to communicate experiences to future customers/users. Reviews (like sharing an experience) become the driver that triggers curiosity and involves the community. Fabio Era (Paparo, 2014), senior researcher at Ipsos, asserts that the innovation, environmental sustainability and ethics which are implied in the sharing of goods and services, are the real factors determining the success of the Apps. Services based on sharing are becoming more and more common and such business model works so well that also public administrations make use of it. In Oregon, USA, the municipal administrations share, through a digital platform, heavy vehicles for road maintenance (Buono, 2015). The advantage of this approach is that the single administration must not necessarily own all the heavy vehicles necessary for the maintenance with the consequent economic benefits. The sharing economy, thus reinvents the concept of ownership coming to what Rachel Botsman (Botsman and Rogers, 2010) called *collaborative consumption*, which is based on trust.

The process, as mentioned, is made possible by tools such as "Open data, Cloud computing, Internet of Thing and Apps". Applications for smartphones (Apps), in fact, are a tool that appeared on the market already fifteen years ago; only in recent years Apps have become a mass phenomenon that involves citizens, young and old, and the local Administrators. Apps development is an area that, to date, has a turnover of several billion dollars and above millions of developers and users. The "smartness" and the benefits of these tools are:

- they can be developed with moderate investments (the average development cost is about 1.000-5.000 euro) (Filippini, 2015; Carter, 2011);
- they can be developed even not having domain-specific skills. One can indeed rely on a freelance, on an agency or on a "do it yourself" services which allow a cross-platform development (it is a software development mode which is independent of the operating system and which allows the production of Apps usable on most systems) without having to know programming languages;
- they offer the possibility of using open source data. Many apps are using open source data provided by the municipal government (e.g. a lot of Apps made by the municipality of Bologna in Italy) or they can interface with the most common free data platforms such as Google Map;
- they provide services to improve the daily citizens quality of life. Apps offer, in fact, innovative response to the real and concrete needs of citizens. The idea of developing an app, in fact, often born by citizens themselves that share a problem and invent a way to have a simple and immediate benefit;
- they are a horizontal tool (data shown above regarding the use of the web and Smartphone in the worldwide population, give an indication of the potential users of such tools);

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– they enable public administrations to shorten the distance with citizens, offering the opportunity to engage them and get them involved in the management of the public goods.

Thanks to all these features, public administrations are increasingly considering Apps as operational instruments with an equal role in the urban development as compared to traditional measures (e.g. local regulations and development of physical infrastructures).

The first experiences concerning the use of the Apps in the management of urban services, date back to a few years ago and refer to the cities known as "precursors" of the concept of smart city (for over a decade, cities that have implemented alternative ways of governance, keeping under constant review the level of greenhouse gas emissions) such as Stockholm, Amsterdam and Singapore.

These were, for example, the first ones that, through the data picked from mobile phones of citizens, have experienced new ways to manage the traffic. If we refer to smart city measures, we can find several projects using Apps in all six areas of the "smart city" (smart economy, smart mobility, smart environment, smart people, smart living, smart governance), a perfect example of this is the case of the city of Bologna, Italy. The city of Bologna, today, is in the second place in the ranking of the smart Italian cities, second only to Milan (ForumPA, 2016).

During the first phases of this work (2011), the city, through the platform Bologna Smart City, has identified seven key areas on which smart measures and partnerships could be created involving public institutions and private companies to implement specific actions. Within the identified key areas, the establishment of "Iperbole 2020 Cloud & Crowd" was one of the most relevant initiatives. This project led to the creation of *Iperbole,* an action aiming to the redesign of the "Civic Network" (London, 1997) (created in 1995, *Iperbole* was among the first civic networks promoted by a European government; it was also the first in Italy among those promoted by municipalities). *Iperbole* was initially focused on free access to Internet for citizens and was later developed for improving public services for citizens. More recently, the Digital Agenda (presented in Europe in May 2010) (Comune di Bologna, 2012), whose precisely defined objectives is to develop the economy and the digital culture in Europe, as part of Europe 2020, constitutes one of the seven flagship initiatives of the strategy.

The Administration goal in the re-design of the *Civic Network Iperbole*, was to create an open communication and information tool, namely a space devoted to providing digital contents, a continuous story about the society, a platform which could aggregate and intercept the stakeholders' needs, harmonizing and representing a continuous dialogue within the city. Between 2011 and 2012, the Municipal Administration initiated a process of reconfiguration of its online presence.

The Public Administration has held steady at a policy of investment in infrastructures, focused on reducing the digital divide and on building a broadband network linking government buildings and schools. At the same time, it was decided to keep active the institutional portal and open new channels of communication, especially dedicated to ideas and events (including the Digital Agenda Iperbole 2020). The Civic Network Iperbole 2020, to date, is a single online platform due to the main domain of the City of Bologna which has a cloud infrastructure. The platform, via which all the municipal open data can be accessed, is the area of digital services to citizens, an institutional communication area, dedicated to the contents generated by users.

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A report of the municipality of Bologna (Comune di Bologna, 2013a) points out that the residents and the city users have shown a strong interest in using the web and related ICT services, increasing demand for services delivered through the City's platform, and going to ask a lot of constantly changing applications. Here there are some of the dematerialized services offered to citizens by the administration of Bologna.

"Smart Governance" App

In Italy, the Bologna's community stands out for its interest in collaborative mapping activities and in active policies for the common good. The city of Bologna has the highest concentration of data mapped by citizens through digital devices, on Open Street Map (Cardelli and Del Luogo, 2014).

Taking into account this support from citizens, the Municipality of Bologna in 2013 invited them to contribute to the mapping of the abandoned buildings in the municipal area ("Impossible Living Project") with the aim of returning them back to the citizens. The buildings were counted in the Municipal Open Data and have been distinguished in:

- unused buildings to be valued, buildings for which the City already has a project awaiting funding;
- business premises, such as shops and warehouses, which are waiting for being rented and purchased to start business activities;
- unused buildings for which there was no planned new use.

Through an open data application also usable by mobile phone, the municipality has opened an online consultation to the intended use of the municipal unused buildings, involving citizens in proposing ideas and projects in order to return these public spaces to the use of the community (Ragno, 2013). The future destinations of the buildings and spaces would respond to meet the real needs of future users, and precisely citizens.

"Smart People" App

The BazzAPP is a digital platform aiming to create new methods of interaction between the Bologna's citizens, the City and its public and private infrastructures, through a system based on two elements:

- theBazzAPP: temporary mobile apps which represent those exciting opportunities that companies, institutions and organizations make available to users, even for limited periods;
- BazaaR: a platform that aims to spread the BazzAPP to users at the time and right place even through the Augmented Reality.

The BazzAPP service, offered by the Municipality of Bologna, by notification on the mobile phone and depending on the position in the city and on the profile of the registered user according to their movements and needs, notifies the apps available in any specific time of the day (Comune di Bologna, 2013b).

The development of this service by the municipality emphasizes the digital policy that is one of the main axes of the development of the smart city of Bologna.

"Smart Mobility" App

A new approach has been adopted for managing passenger transport in Emilia Romagna, the region in which Bologna is located. The development of Apps has been left to free developers, exploiting the available data on service Open Data. This choice has already

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given rise to various Apps. Among the most interesting "Mi Muovo SmartCity" (Comune di Bologna, 2013c). Made within a project funded by the European Commission, the City of Bologna, the Emilia-Romagna region, and a private company, it aims to aggregate different web traffic services for the city of Bologna within a single platform delivering different web traffic services for the city of Bologna. The App allows citizens to find in a single portal, also compatible with smartphones, the information needed to move.
The App exploits the information layers displayed on Google map:

- about the bus stops, in Bologna and its province. The App brings, in real-time for each one, the arrival time, through a GPS tracking of the buses. It also shows the closer shop to the bus stop where to buy tickets;
- about the traffic. Through the monitoring system of vehicular traffic the App displays the status of the traffic on the main streets of Bologna (updated every 5 minutes). Different colors indicate the level of congestion on the roads. The App reports also the main traffic problems such as road work in progress, shrinkage of the roadway and traffic congestion;
- about car parks. It, in real time, displays the main public car parks with details of vacancies, and information about rates and available services. There are also the positions of the parking meters;
- about bicycle paths. The map shows the network of cycle paths, specifying the type of the various pathways (eg. pedestrian path, promiscuous vehicular etc.) and bicycle rentals;
- about security. Map shows the positions of the cameras for access control (Restricted traffic areas, the old town, reserved lanes, etc.);
- about accessibility of the public places. The App provides information on the level of accessibility of public places (e.g. pubs, offices, etc.). Information is provided by the citizens in cooperation with the portal "Liberi di Muoversi ("Free to Move" is the portal of the city dedicated to giving information to people with disabilities);
- about general information. In the portal you can search for days and time of the night cleaning of the streets in the historic center of Bologna. The service is provided by the company "Hera Group".

The development and success of these Apps is the clue that citizens identify the time issue as a main feature for assessing the quality and efficiency of mobility services. So their development is a necessity accompanied by a growing demand for efficient mobility and simplification of the road transport services. It is interesting to note that the system combines the contributions of the various stakeholders (citizens, municipality and private companies) in order to provide a service as complete as possible. The interoperability of the data used in the service offered by the App and the ability to be continuously updated in real time are other advantages of using these instruments for citizens.

"Smart living" App

Social inclusion of disabled people is decidedly an indicator of the liveability of a city. One of the great achievements of the digital age is to allow the overcoming of the many obstacles that disabled people have in the use of some urban infrastructures. In accordance with this principle, and in collaboration with the Municipality, the Uildm (Italian Union for the fight against muscular dystrophy) has developed "Accessibol": App that lets the citizen find the entertainment premises in the city of Bologna that are accessible to wheelchairs.

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Through an interactive map, the App provides information on geo-referenced barriers of the entertainment premises (for example the presence/absence of steps at the entrance, parking suitable for persons with disabilities and their distance to the location where the user is). The platform can be implemented through the reporting of the same users, implementing the collaborative process to the use of a service that is one of the aspects of the new dematerialized services of the smart city.

4. Urban sharing for mobility and energy

Some experimental projects in some European and non-European cities, are based on the new possibilities deriving from the use of ICT to optimize urban functions and services (energy and mobility). Apps and Internet of Things, IoT, technologies are driving this tremendous innovation. The main challenge of IoT technology consists in dealing with billions of devices connected over wireless networks. IoTis now a hot topic in the industry but it is not a new concept. In early year 2000's, Kevin Ashton at MIT was laying the groundwork for what would become the Internet of Things (IoT). He conceived this idea as he searched for ways to improve Procter & Gamble's business by linking RFID information to the Internet. The concept was simple and powerful. If all objects in daily life were equipped with identifiers and wireless connectivity, these objects could communicate with each other and be managed by computers. Most IoT applications are today devoted to the urban community services, facilities and infrastructures management (Fig.2). Mobility, as an example, may use a connected cars environment. Such environment exploits the on-board sensors or the smart phone sensing potential.

Vehicles are more and more embedded with different types of sensors monitoring diverse components as well as the driver's behaviour. As vehicles will be connected over wide-area wireless networks, many of their performance-data along with localization data and user-behaviour information will be open to the automotive Original Equipment Manufacturers, OEMs, and aftermarket vendors. This data already provide a rich source of information about vehicles and drivers behaviour. Once these data are combined with contextual data about environment, location and the driver, they may give many new possibilities also to third parties, such as consumers market, insurance industry, car repair chains and car OEMs. Part of the data analytics can be carried out at local level both using on-board systems or smartphones to optimize the communication. Kargupta said: «Like most other industries, technical and business processes in the automotive and transportation industry have been traditionally analyzed, understood, and modelled based on limited amount of empirical data and the contextual domain knowledge. Availability of massive amount of data is putting the existing understandings in new light, posing new questions, and creating new possibilities that were not possible before. "Big Data" are changing how we make vehicles, how they work, how we use them and how they interact with everything else in this world. From vehicle-manufacturing to warranty management, insurance underwriting to dealer CRM, and traffic modelling to route optimization, Big Data is changing the world of automotive/transportation industry and beyond» (Kargupta, 2015). Mobility and urban transportation, through sensor networks, wireless communication and data analytics potential for managing "Big Data", are in this way reinvented and made more functional and smart. One part of the IoT game in cities are also smart phones, considered as moving monitoring stations that can register data about the process to be studied and the environment and can transmit them through GSM technology.

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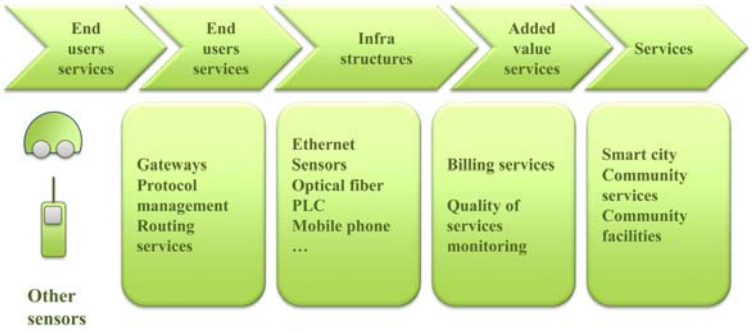
Fig. 2 – Internet of Things in smart city



Source: Authors (2016)

Recently, in July, the Index Ventures company invested 100 million dollars in BlaBlaCar (BlaBlaCar, 2015) the sharing mobility community with more than 8 million subscribers in 12 countries (including Italy). Last year Zipcar – the US car sharing service recently activated in Canada and in Europe – has been acquired by a car rental company, AVIS, for 500 million dollars. The private mobility in most cities is one of the sectors in which the inefficiencies are no more sustainable: 70% of travelling in cities is made with private cars. Car stay under-utilized in parking lots for more than 70% of their lives; when they are used, on the average, no more than 30% of available space is employed (Smart City Exhibition, 2014). Sharing a travelling route through *sharing mobility* is nowadays a possibility provided by citizens through web connected platforms. In Naples, the service offered by Bee (Bee, 2015) allows to take the vehicle in one area of the city and leave it in another place. Bee does not require to travel with other people and cars provided by the company are electric vehicles. To use the service it is required to subscribe to the Bee platform, which allows to get in the Limited Traffic areas of the city of Naples and to park everywhere for free. The car can be booked at a Bee point or directly in the parking areas. The rate is triggered when the car is taken, and it stops when the race ends. This means that only the actual usage of the car is paid. The yearly cost of the subscription is limited and ranges around 30,00 euro. "Shar'ngo" (Sharengo, 2015) is a national platform for electrical and sustainable mobility managed by Car Group, offering floating car sharing services with profiled tariffs in the largest Italian cities. The differentiated tariffs is a particular feature of "Shar'ngo" and they are created based on the lifestyle getting to 50% discounts. For this reason, the cars are called as "fair" cars (*equomobili*), with the ambition of turning car sharing into a mass habit. "Shar'ngo" rents electrical and high performance micro-cars 100%, with autonomy of 100 km and city car equipment: 2 seats, 300 its storage and on-board computer with a navigation system. Produced by Xindayang of the Geely Motor co group, these micro-cars are designed in Italy and CS GROUP has acquired the competences to implement energy and mechanical technologies for their development. In the field of bike sharing (BikeMi, 2015), "BikeMi" offers an efficient service in Milan. Active 365 days per year "BikeMi" is healthy for users and typically operates from 7 to 24. To encourage the use of the bike, "BikeMi" delivers the first 30 minutes of bike rental for free.

Milan is now implementing a pedal assisted bike sharing system, with around 1000 vehicles. It is the first example in the world of integrated bike sharing platform, with a fleet that is rather large. The subscription allow to take both standards bikes and pedal assisted electrical bikes."Io guido" (iOguido, 2015), the Sicilian platform for car sharing has one of the largest Electric vehicles fleet in Italy (24 vehicles) and allows with the same subscription to take cars in many cities in Italy and to take in Palermo, both standard cars, electric vehicles and pedal assisted electric bikes.

By means of GIS tools it is possible to measure the urban health in different areas (mobility, energy, social, etc.) and to create functional maps for the design of strategic choices in the contemporary city.

Since some years MIT and the SENSEable City Lab founded by Carlo Ratti (2015) shows the big cities (such as Singapore and New York) in a different way and not as we have seen them till now. Maps show people movements and habits and give information about people needs. The so-called urban metabolism (Ferrão and Fernández, 2013) is a mutating being with undefined contours and different faces. Monitoring traffic congestion can also be accomplished using smart phones. GPS-enabled cell phones running the Google Maps application continuously pass along each user's location and speed to Google in real time. Using a technique known as "crowd sourcing". Google combines the information provided by thousands of active cell phones to determine how swiftly traffic is moving through a given location. Although this feature can be disabled on cell phones, Google has attempted to discourage users from doing so by making sure all the information it gathers is anonymous. In the city of New York, the traffic congestion and other features are monitored by thousand of taxicab (HubCab, 2015) by "HubCab".

The latter is an interactive visualization that invites to explore the ways in which over 170 million taxi trips connect the City of New York in a given year. This interface provides a unique insight into the inner workings of the city from the previously hidden perspective of the taxi system with a never before seen granularity. This registration allows to understand what are the most common trips in cities (especially for large-medium size cities). These people moving with the cab may make the same job and have same needs. For this reason, through these studies it is possible to put into evidence that the use of cabs could be rationalized and tariffs for individual citizens could be lowered (car pooling/sharing). Another interesting platform concerning mobility in Italy is "Flightcar" (Flightcar, 2015).

It combined the comfort of peer-to-peer car sharing with the possibility of car rental. When going for a medium-long trip, cars can be left at the airport by the owner. "Flightcar" rents the car of the person that leaves to another person that arrives and needs a car for rent at the airport. The subscription to the platform is easy and requires a reliability proof that can be acquired through the ministry of transports. All the services of rental and car release are managed by a very accurate customer care service. Most of the operations are managed on-line. The person owing the car will be compensated economically and will not pay any fee for parking. Besides the research tells us that sharing mobility is a profitable business because car use is changing and the first that must realize this are the car makers. People want to drive, but unlike the pre-crisis period they want to have cheaply the availability of the car that can easily be borrowed or rented to someone else without necessarily having to purchase it. This generates a new type of demand and it is no coincidence that more and more car manufacturers, railway companies and airlines hi-tech companies are entering this market. Take for instance the car-sharing services such as "Car2go" Daimler AG and the

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Italian ENI and Fiat Enjoy by Trenitalia. The sharing mobility is one of the fastest growing areas in terms of users and revenues from sharing economy of a disruptive paradigm, fuelled by the explosion of digital technologies, where access (Rifkin, 2015) takes over possession. A recent study by Roland Berger Strategy Consultants has shown for the four most popular services (car sharing, ride sharing, bike sharing and Shared parking) annual growth rates between 20% and 35% and revenue forecasts between 2 and 6 billion dollars for 2020. All services of sharing mobility are based on the following principles:

- application of mobile solutions: software for mobile devices that enable the user to finalize the rental contract at anytime and anywhere;
- social aspect: sharing of information among users through channels of evaluation that will produce positive or negative feedback and that constitute a kind of assurance on the reliability of the service offered;
- needs and services offerings that can be easily divided: action of suppliers and users in accordance with the logic of the market and of their interest in order to eliminate inefficiencies and waste rather than with acts of pure altruism.

Even in the field of smart energy have been recorded in recent years considerable changes, which often have as common thread, the size of the sharing of new experiences, to reach such a savings target. ADDRESS project started on June 2008 and have contributed to the Smart Grids vision by building on the work already done in other EU projects and by demonstrating how active distribution networks may be based on an active participation of consumers and on an intelligent and distributed control approach (Enel Distribuzione, 2015). The European ADDRESS project can be described into three steps:

1) *Vision and target*: In the smart grids vision, electrical network will be flexible, accessible, reliable and economic. The ADDRESS project, completed in 2013 have played a significant role in turning this vision to reality. ADDRESS has aimed at making demand 'active' by enhancing flexibility and adaptability of consumers. Distributed intelligence have guaranteed reliability, thanks to real time optimization at local and global level, while load flexibility and have helped appropriate solutions proposed to remove commercial and regulatory barriers and to fully integrate distributed generation and renewable energy sources. Global and local savings together have translated into energy bill reduction and supported sustainable growth and energy consumption. The target of ADDRESS was the management of active demand, the active participation of domestic and small commercial consumers in energy markets and provision of services to the various power systems actors. Active demand was created by taking a "demand approach" driven by the specific consumers' motivations and needs. The real innovation consists in the role of the "aggregated system" of individual consumers in order to achieve a significant volume for the efficiency of the electrical system.
2) *Objectives*: ADDRESS has studied, developed and validated solutions to enable active demand and exploited its benefits. Active demand has enabled by new technical solutions, both at the consumers premises and the power system level, while identifying possible barriers against active demand development and producing recommendations and solutions to remove these barriers. Active demand has exploited with the identification of its potential benefits, the development of appropriate markets and contractual mechanisms, and the study and proposal of accompanying measures to deal with social, cultural and behavioural aspects. The proposed solutions has been validated

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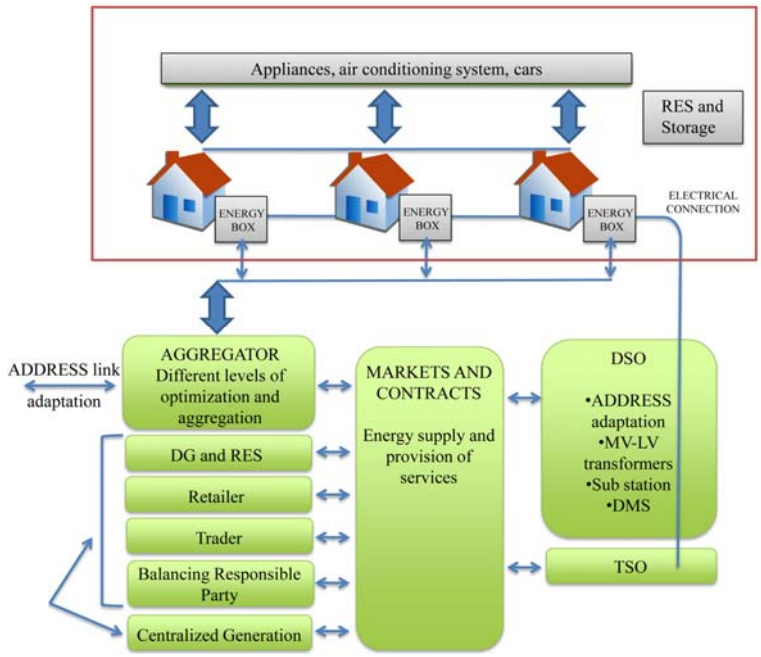
in three complementary test sites in Europe (Spain, Italy, France). The project also has promoted dissemination activities involving different stakeholders promoting the vision and the results of ADDRESS.

3) *Architecture*: At the consumers' (prosumers') premises, electrical appliances, distributed generation and thermal or electrical energy storage systems can be controlled and optimized by the Energy Box, the interface with the external world. The project introduce the new figure of the aggregator, mediator between the consumers (area "Markets and Contract", Fig. 3) and the markets, allowing power system participants to exploit the flexibilities of the aggregated customers model. Distribution System Operators have interacted with the other power systems participants mainly via markets, and also directly with the Transmission System Operators.

Fig. 3 – ADDRESS Project Architecture



Source: Magnani (2010)

In the presence of a peak load, rather than over sizing the infrastructure and production capacity, bringing the generation unit to work in regimes of low efficiency, loads are displaced in time of consumption and peaks can be controlled. The spread of generation sources of renewable and non-programmable type makes the role of the aggregator even more significant to compensate through the flexibility of the load even peak generation. In Europe, interest in the aggregate load is increasing, but in some countries it is already a reality: AV Reserveffekt AB in Sweden and Votalis in France. In the US, the load

aggregation and participation of electricity consumers to limit the construction of new infrastructure is well established. For several years, the national energy planning is carried out through the provision of a participation of the load not only to actions that affect the market, but also concerning the so-called ancillary services, i.e. services to support actions of adjustment to maintain quality electricity supplied by high standards. Examples of sharing part of energy services (Riva Sanseverino and Orlando, 2015) are the groups of energy purchasing, already active in different European contexts and that in Italy have started in 2013. The liberalization of the market energy has opened the possibility to create buying groups able to hold auctions addressed to the suppliers of energy (electricity or gas for domestic use) on the market and therefore to enter into a supply contract with whoever offers the best service according to the needs of members. The main aim is to bring together many customers to negotiate a good price, because the group allows a contracted capacity that is not reachable by the individual company/family, with significant discounts and quality assurance of supply. The estimate of the association "Altroconsumo" in Italy (one of the largest consumers associations in Italy) is to have a saving of about 210 euro a year per family.

Conclusions

Cities are strongly changing, and all these changes do not relate only to the physical world: the immaterial dimension is another way to analyze contemporary cities. The advent of the digital age and the spread of new integrated systems generated from the use of Information and Communication Technology (ICT) and of the web has changed quickly the way we live increasing a lot what we call "dematerializated services" offer. The ICT becomes the bonding agent of the smart city and it goes through the many aspects of contemporary cities summarized in the six smart city dimensions (smart governance, smart energy, smart mobility, smart living, smart people, smart environment) (Giffinger *et al.*, 2007) developed by the Polytechnic of Ljubljana, to measure urban smartness. After a short analysis of the layers model of the Smart Urban Community Infrastructures proposed by recent technical norms, the paper explores news mobile Apps for the city that are today largely used in Europe, in US and also in the Asian world. Some of them are renown, such as Airbnb App, for renting houses all over the world, or Uber App for taxi services. Citizens become receptive sensors and providers/users of services, bringing back to the idea of prosumer (producer/consumer) that is already a consolidated issue in the energy sector as the European ADDRESS project shows in the last part of this contribution. The shared participation approach joint through the ICT dimension and the web power generate also new jobs (i.e. sharing economy), dematerialized services based on networks of people for a better quality of living.

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