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New forms of urban and social sustainability: ICTs in the design of smart cities

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Track: Technology And Smart Improvements For A Better Living (Chair: Luca Pazzi)

ABSTRACT

A new design of the city, that one of the smart city, is evolving implying the frequent involvement of the technological and social field, in order to make urban spaces more sustainable. The development of new information and communication technologies (ICTs), follows the growth and evolution of the city through the monitoring of the multiplicity of sectors that build urban form: economy, education, policy, environment and society. The objective of this research is to identify urban practices that have led to better results in the fields of mobility, environment and social cooperation, highlighting the different methodologies of ICTs' application above all in the existent historical contests.

Keywords: smart city, urban design, ICT, social innovation, historic city.

1. INTRODUCTION

Today, when we talk about sustainability we refer to a multidisciplinary concept, which involves the idea of an urban vision as set of places with their own identity and that will become the scenario of new technological implementations aiming to the safeguard of the environment and to social welfare. The smart urban innovation of the contemporary city acquires a definite shape through the implementation of technological and social strategies, that have allowed us to draw, inside our cities, new forms and virtual dimensions, through the social cooperation and “urban technological sustainability”. The aim of this article is to deep the knowledge about new technological applications of some smart realities that aim to urban sustainability, in accordance with two directions: the first one is set on the environmental and technological field; and the second one in the social and technological field.

2. SMART HISTORIC CITIES AND VIRTUAL DIMENSION

To understand the smart city model within an urban system already established, you have to start from the idea of the historical centre, for example, as an engine place of aggregation and intelligent life. Factors that today build the space of aggregation of the smart city include tangible and intangible elements: civic participation; Living-Labs; co-working; social networks;

virtual networks; cultural identity; historical and digital vision of heritage; technology of network cities; smart buildings and smart safeguard of heritage.

The definition of "smart city" does not have today a unique and shared definition, but it is often modelled according to the function of urban characteristics. One of the most popular lines of thought identifies the smart city along six main principles used as classification criteria. The MIT of Boston, contributes with an another definition, aiming to a concept of smart city in which is included sustainability, liveability, social equity, technological and design innovation through the introduction of digital nervous systems, intelligent responsiveness and optimization at every level of integration system. What is the logic that combines these factors in the design of the established and layered smart historic centre? Identifying a strategy in the representation of smart aggregation places can help in the research of a design which constitutes the compositional axis of the different urban experiences. A civic network, which takes place in the historic centres of smart cities, involves the cooperation and involvement of citizens, as they form a network through the organization of Living-Labs, co-working and ideas aimed at the regeneration of their own city. In the context of the research on smart historic centres, a common platform for smart principles involved a large number of Italian municipalities, in order to bring the contemporary city to face the challenges posed by the social and economic transformation and improve their abilities to organize new subsequent implementations.

This was the interest shown by *Cittalia-Fondazione Anci Ricerche*, the Italian structure dedicated to studies and research on the topics of most interest for the Italian municipalities. The acronym refers to ANCI "National Association of Italian Municipalities", founded in 2008, the Association was responsible for environment, energy and institutions then focused on innovation, welfare and society, social inclusion, participation, management of public spaces and urban policies. The smart cities project falls within the broader European program called "Investing in the development of low carbon technologies". The strategic plan of the energy technologies, of the European Union, aims to establish guidelines and targets of energy policies, with particular attention to the development and circulation of the best sustainable energy technologies among the European countries. According to the European Commission, the activity for smart cities should focus on the renovation of the old buildings and on the construction of new buildings that are able to return energy (Energy Positive Building), on heating and cooling, on electricity (smart grids, smart meters, smart appliances and renewable energy sources) and on transport (electric private mobility, green ports, etc.) (Baker & Steemers, 2000).

2.1 The environmental and technological smartness

The debate on smart cities highlights the role of technologies through which fosters the sale on network of the energy's excess generated by buildings and facilities more efficient. In reality, however, talking about the technology of smart cities, you should refer not only to the more typically linked to the ultra-wideband, to the infrastructure and wiring of buildings, but also to those relating to the transformation and upgrading of buildings and traditional planning in the smart key, as in the case of the redevelopment of city centers in an efficient and sustainable manner. Are summarized below some examples of smart practices linked to the mix between virtual technology and the material one in favor of new urban and social forms of smart cities.

The city of Lisbon, with its 500,000 inhabitants, is investing in digitization and vigilance, but especially in the idea of "estacionamento", the stop, working in terms of policy and technology.

They are digitized payment systems for all transports transmit the information to a central control system, which allows you to monitor traffic flows and anomalies in behaviors.

In addition, interventions in the historic city center have focused on the placement of "mobile bollards" that limit the access of cars and help to safeguard the urban voids that become meeting places in which it is possible to read the stratification of its own urban and cultural identity. The scarcity of resources available today requires a more efficient management of essential services to ensure access to all citizens. Intelligent lighting systems able to vary the intensity depending on traffic or hours of the day and at the same time to provide tourist information using the existing network and waste disposal systems that provide information on the level of coverage and type of waste contained. A more rational use of energy, through the technology of the smart grid, which saves up to 20% in the construction of new urban smart models electric mobility and remote networks. There are several ways that you can decline the paradigm of smart city, in any case it is necessary to consider the identity and human heritage of a territory. These are experiences that follow a logic of reuse, participation and efficiency starting from an analysis that highlights the weaknesses and strengths by investing in international processes, knowledge sharing and enhancement of resources. In this sense the administration of Reggio Emilia has implemented a strategic development model that, from the point of view of a knowledge's economy, enhances the distinctive vocations of the territory. Green Economy, that is Energy and Sustainable building, was the fundamental prerequisite for access to EU funds, as well as a means of strengthening of the institutional framework and local administration.

A notable project in which technology becomes a tool to bring welfare and sustainability, in environmental, social and economic terms has been proposed for Sant Cugat del Vallés, a small Spanish town with a population of about 80,000 inhabitants located in the metropolitan area of Barcelona. The proposed model aims at the creation of a "smart street", which allowed to work simultaneously on several fronts: management of public spaces, energy, mobility and waste. All the technological solutions have been concentrated within the project areas located in proximity to a street in the city center. It is a long path, characterized by networks of sensors and electronic devices, which allow to facilitate and combine together the management of public lighting, irrigation of green areas, mobility and spaces for car parking. All data recovered by the sensors are accumulated and processed in real time by a smart grid. The obtained results demonstrate the effectiveness of the project in reducing of carbon dioxide emissions and waste, focusing on the measurability of the achieved results through the continuous monitoring carried out by smart meters. An intervention related to intelligent mobility through the use of ICT is taking place in

Figure 1. Systems for monitoring traffic in the historic center of Lisbon



Source: <http://www.emel.pt/pt/estacionamento/bairros/bairros.html>

the city of Milan, where the systems of car sharing and bike sharing, with the projects called "GuidaMi" and "BikeMi", are facilitating the definition of areas used as bicycle paths, dedicated lanes and parking. From 2011 to date, the stations have more than doubled and users have

Figure 2. Smart Planning in the city of Sant Cugat, Spain



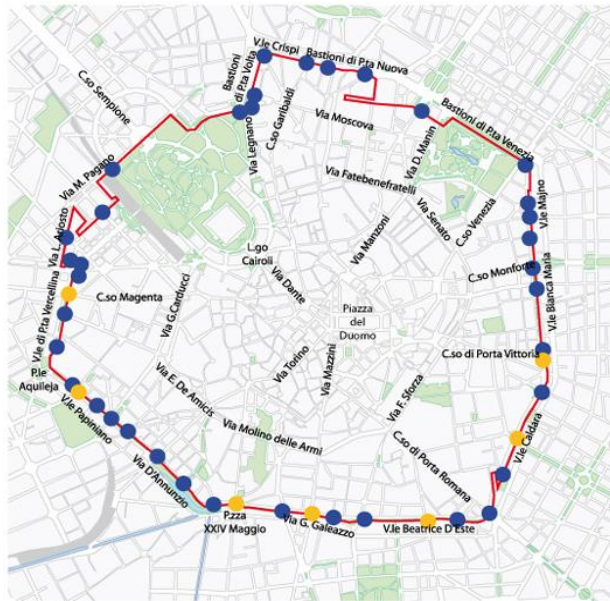
Source: <http://smartcity.santcugat.cat/>

increased by more than 50% in one year, in addition, it was possible to improve links with the areas of the city where it isn't yet activated the subway accesses, so as to increase the commuting allowing a rational use of resources and improving the quality of life. Another example is the city of Ferrara, that has set the planning on accurate, integrated and updated information through the creation of a web portal dedicated to the publication of planning instruments according to the guidelines of transparency and information sharing: a direct solution to optimize the service and increase the direct dialogue between administrations, professionals and citizens, to support a participatory urban planning. This system, born in the early 90s, now has more than 130 informative sources on the territory, mapped automatically, some of which are updated in real time and is today a reference tool for the administration, capable of integrating with respect to the territory, the entire wealth of available data. In the past the publication of map data on the Internet had as its main purpose to inform, later the need became to create a platform that the Administration shares with professionals, to support a process of participatory planning. A range of online tools, a base map to navigate interactively providing support in interactive consultation and dialogue with the Administration, for the production of map scale to export in an open format to encourage dialogue with the institutional actors involved in the government of the territory. It is geodatabase which allows to activate editing actions, both on the graphics side and on the legislation one, both correctly and consistently reported in the database to ensure the consistency of the whole system; subsequently has been put into operation the "WebGIS" solution for interactive publishing of the planning tools in support of the pathways of transparency and participatory planning.

Three Italian cities of Agordo, Riccione and Siracusa are testing methodologies and solutions in the field of energy from renewable sources and ICT for energetic sustainability. The technologies to be tested are based on the transformation of municipal lighting network in a data network that, due to its capillarity, can allow to deliver innovative services across the city: from high-speed internet connection with public wi-fi hot-spots, to the automated management of parking, from the traffic control to the balancing and the rationalization of energy consumption. Agordo (Belluno) integrates renewable energy sources in the area allowing an optimal energy balance in the municipal area; Riccione (Rimini) proposes, as an area of intervention, an area of high tourism impact by providing a fiber optic network that uses the ducts of the public lighting, as well as a detailed plan of ICT services to be delivered with the aim to reduce the current energy consumption; Siracusa sets in the context of its historical center proposing the reduction of current energy consumptions, making available, as an area of experimentation, the island of

Ortigia, heritage of UNESCO. One of the technologies presented during the Smart City Exhibition 2013 in Bologna to allow the reduction of consumption for public lighting, was the

Figure 3. The Area C corresponding to the "ZTL Cerchia dei Bastioni" in which the passage of vehicle is transmitted to the centre of monitoring and recognize the type of transport



Source: http://www.comune.milano.it/portale/wps/portal/CDM?WCM_GLOBAL_CONTEXT=/wps/wcm/connect/contentlibrary/Elenco+Siti+tematici/Elenco+Siti+tematici/Area+C/Ztl+Cerchia+dei+Bastioni/#par01

so-called "SmartEye". It is a cognitive distributed system of optical sensors installed on street lighting lamps, which cooperate synergistically in order to provide innovative and multifunctional services related to energy conservation. Through the analysis of the road section it is able to recognize and classify objects of interest (pedestrians, vehicles, and other), to identify the brightness degree of the scene and the weather conditions, in order to allow the implementation of techniques of adaptive lighting and on-demand, based on the actual needs of light. Those just mentioned are some of the urban realities that have activated energy saving processes and monitoring on the use of available resources, through the use of ICT at the service of the environment. This fact leads to build a new design of cities more sustainable and smart, that of the smart city which incorporates, in its virtual network, traditions of the places, technologies and changing society. In this context of transformation the approach that seems more useful and productive is the one that allows to provide an answer to the city according to the definition of "smart urban structure" in cultural, economic and environmental terms, as well as to identify, in the territorial system, all those resources that are linked to the concept of sustainability and "smart footprint" (Gibson, D. V., Kozmetsky, R. G., Smilor, R. W., 1992). In the contemporary city, in fact, the most important issues are often those relating to urban, cultural and environmental redevelopment of the city and neighbouring areas. It requires, therefore, the contrast between an urban settlement, remained over time and needs, that have changed many times becoming day by day and as a consequence, there is the need to preserve an urban environment that preserves, in its physical size, its own historical memory (Bonfiglioli, S., 1997).

2.2 The social and technological smartness

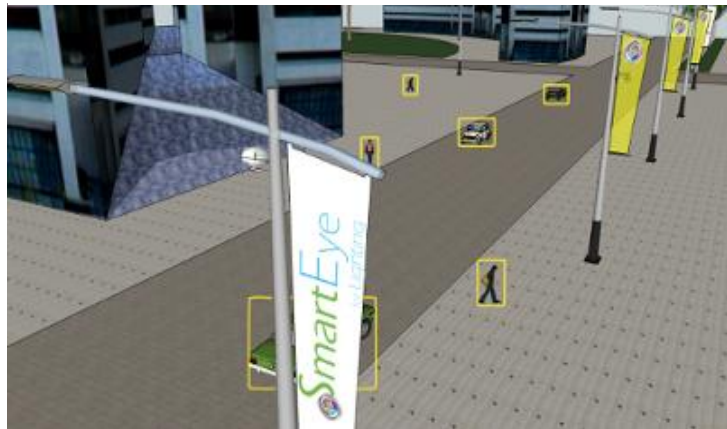
The Smart City is the territory of the digital infrastructure with high capacity of innovation, built on the base of creativity, communication and knowledge management. But how important is the technological matrix into a Smart City? From the "Digital City" model, the intelligent infrastructure allows you to collect the huge amount of data and intangibles information that a city produces in real time and connect them with its urban texture and with the actors who work within it, who can carrying out their activities, using of services and making more efficiently decisions. Through the application of virtual technology, the new models of smart cities have

aimed at solving the problems of contemporary cities; to improve the infrastructure spreading applications in the fields of mobility, energy networks and smart grids; to improve the economy of innovation; to improve the quality of life for the social and environmental innovation; to improve the city government in terms of decision making and citizen participation in public life.

The Smart City may be the field in which the collective intelligence becomes real, within a complex system that can provide different resources with respect to those provided by the traditional city as it not only provides services, but also digital tools that enable people to be active, to confront and work together. The ICOS project, Intelligent Cities Open Source, is a

community of designers, engineers and users working in the field of smart cities, that has as objective the development of smart solutions and open source applications. From the point of view of technology as instrumentation, the project attempts to applications and solutions that have been created, from the point of view of demand, ICOS is targeted to urban authorities, facilities managers and stakeholders of the city in order to increase the cohesion, sustainability and competitiveness of the city. But you can think on amplifying the intelligence of a city? Sensors and infrastructures make it possible to

Figura 4. “SmartEye”, a cognitive distributed system of optical sensors installed on street lighting lamps



Source: <http://www.smart-interaction.com/smarteye.php>

map and monitoring the operation processes of urban life. In this way we can look at the city as an ecosystem and plan intervention to improve it. To understand the process that leads to intelligent city, that embraces virtual and materials tools for the development and management of land, you have to read the city differentiating areas and communities; within the city limits you locate the digital and environmentally smart space (crowdsourcing, social media, mobile app, etc.) looking for new solutions for innovative and sustainable cities. This process is to analyze the three basic components (city, knowledge and digital space) and figuring out how to combine these elements by adopting a system of planning and smart government. The interaction between virtual technologies and urban space takes shape through the establishment of large scale networks, involving a large number of cities, such as the ENoLL (European Network of Living Labs) that defines the Living Labs as environments of open innovation, in real-life situations, in which the active involvement of end-users can create paths of co-creation of new services, products and social infrastructures”. The creativity was seen as an engine of innovation in the “FabLab-digital fabrication laboratory” started in the city of Reggio Emilia. The definition of Fab Lab arises from English expression “laboratory fabrication” and refers to a laboratory equipped with technologies of digital manufacturing, computer-controlled, able to operate on different materials, with the aim of being able to build anything that can be imagined. The project of Reggio Emilia, starts from the international network proposed by the MIT of Boston, is a small-scale laboratory, a public space that uses a series of machines managed with readily available open source software and that moves towards new forms of creativity to be shared on the network, with a significant potential for the industry and the crafts. The companies and even

small and medium-sized enterprises can founding in the FabLab a useful tool to identify low-cost prototyping services and become an incubator of business/innovative start-ups ideas and design support. A virtual platform for social innovation is represented by the “City Protocol”, a community of cities, companies and universities that harnesses the knowledge and experience in cities around the world to accelerate the sustainable transformation. The idea of “City Protocol” was born in Barcelona by municipalities that have worked in the field of Smart City. The reference was the Internet Protocol, which is a protocol for interconnecting networks (Inter-Networking Protocol) that promotes the interconnection between heterogeneous networks for technology, services and management. The City Protocol was developed in the same way, that is, through the construction of a society, such as the Internet society, that works to build the smart city. The proposal is the creation of “digital documents” for the sustainable development of the territory, allowing thus to develop projects ranging from information to standardization; a collaboration among cities, industries and research centers, through an implementation project of applied technology to the city. The company was founded in 2013 in California to give more international legitimacy. The idea of smart city is the base of the City Protocol as it is conceived as an integral part of the “sharing” dimension to get familiar with the city with similar problems that can be addressed in synergy with more reality at the same time and new visions.

The processes of increasing efficiency in order to obtain updated, clear and shared information, aim at creating tools to support the planning and sustainable development of the territory. As part of the planning, the new portal of planning tools of the Liguria Regional Service Center, is an

Figure 5. ENoLL Membership, with the individuation of the Sicilian role



Source: <http://www.openlivinglabs.eu/livinglabs>

Another example of social innovation is the “Living Lab SmartPuglia 2020”, which is following a path to the goal “Digital Puglia 2020”. The project aims to reduce the distance between the subjects of the training, knowledge producers, companies and public authorities, with the goal of creating a network for these three actors and involve them in projects that benefit the community on three lines: “Smart Communities”, “Knowledge and Education”, “Enterprise and manufacturing districts”. In this way more cities can share their common cultural heritage by putting them on the network and providing a platform of services, so as to benefit the tourist industry and promote around the world their cultural heritage.

experience that meets the need of the municipalities, to adopt software application for the management of planning instruments and at the same time of on-line services to simplify the interaction with professionals and citizens. The system, implemented with technologies, data structures and open-standard interfaces, also represents an example of interoperability among agencies at all levels. The greater availability of data interoperable system, added to the rationalization of tools and resources in the centralized activation, resulted in benefits, both economic and efficiency, for the functioning of the portal.

The OR.CH.ESTRA project (Organization of Cultural Heritage for Tourism and Real-time Smart Accessibility) proposed in 2012 by various stakeholders as part of the “Smart Cities and Communities and Social Innovation” aims to develop a set of technological solutions aimed at enhancing of cultural both tangible and intangible heritage, for the use and enjoyment of tourists and citizens, following the principles of environmental sustainability. In this context, the virtual technologies have been implemented for the identification of cultural significance places and the interconnection between tourist/citizen and territory and the development of platforms designed to study the flow of tourists in their size, frequency and distribution. Another objective of the project was to create a system for monitoring the mobility of tourist flows within the urban area together with the generation of info-mobility models for the management and planning of the transport and mobility system. Through the study of these experiences you can associate to technology the role of element that it is not the founding of smart cities, but the instrumental factor through which to develop projects of virtual cities into the physical city. To realize a radical change in the urban historicized structure, the new design of smart city aims to different methodological approaches: the production of energy from renewable energy sources, energy saving, sustainable mobility, organization of a shared network of services by optimizing the use of resources with the ICTs, involvement of citizens towards a cultural and behavioural change. The historic centres of cities can now represent, for history and function, the gravity centre of city life and the scenery of approaches of the above. They are places in which are concentrated commercial, cultural and recreational activities, in short, much of the city’s social activities. Their valorisation is important for the revitalization of the entire urban environment and policies for the discovery and re-launch of the historic centres changes into policies aimed indiscriminately to all the inhabitants. They are also important urban meeting points, rich centres of traditions, changed over time and still today in changing (Villanti, G., 2001).

If you think to the historic centre as the place of balance of two opposite trends, protection of environment and resources and the implementation of innovation technologies, the proposal of a smart urban design within the historic centre, it becomes the reference plane of the cultural vision of a sustainable and intelligent city, depending on the available resources, possibilities and technological potentialities. *«[...] The focus of the project goes to the activation of an osmotic process between society and environment, between the technological culture that this society produces and the environment in which it lives, in a renovated heritage of contents that outlines, in perspective, the human condition as a project in which the technique marries the motivations of the best human and environmental values, reversing the direction of running to the centralization, the encompassing appropriation of natural support, the indiscriminate standardization of places, goods and behaviours»* (Dierna, S., 2000).

In the field of the regeneration of historic centres through a new smart urban design, technology takes also a different role, that of a virtual structure that becomes the prerogative of the intelligent city’s design. The energy issue and the integration of digital nervous systems within cities are in fact becoming some of the key players in the smart vision of city centres. The energy efficiency through the use of innovative materials, the use of distributed and diffuse micro-generation and of renewable energies has triggered a process of environmental sustainability; a process that needs to be supported by ICT applications, leaded and carefully planned especially in those contexts with strong historical cultural and natural values. Processes of integration of such technologies are in rapid evolution, but often applied to study models that consider buildings as self-defined entities neglecting the importance of the phenomenon at the urban scale (Ratti, C., Baker, N., Steemers, K., 2005). We have to support technological innovation in a

more complex system, consisting of the involvement of the heritage, cultural activities and tourism, through the development of ICT technology solutions for diagnostics, restoration, preservation, digitization, use and promotion of cultural heritage of both tangible and intangible heritage. It comes to support innovation in the energy sector through the development of technological and managerial solutions that promote and strengthen recovery, production and integrated management of different renewable energy sources and their distribution systems, taking into account the need to enhance relationship between the urban and rural dimension in energy, environmental and climatic policies of the smart cities (Amirante, I., 1992).

3. CONCLUSION

The issue of smart sustainability inside the historic centres opens the recovery to an environmental dimension in which technology can be considered to play a larger role, that of a science that does not stop to the organization of a single stage of work, placing instead the problem of how to regulate developmental processes for the cities' future, in the definition of a new urban design. A technology that facilitates the creation of knowledge infrastructure becomes an opportunity to recover the environmental knowledge of the places' culture, made of sensitivity and attention, through which now exist the conditions of living, the traditional ones and those of the future. A smart urban design in the recovery of the inherited cities involves the smart city model through the profiling of different parameters (social, economic, political, infrastructural, virtual, etc.), whose sustainability seems to end in identifying the best technologies for a commissioning network of knowledge: a virtual network made of nodes (people) and wires (network for communication) that build a social network of sharing and participation in the production of identifiable and contextualized places. Rethinking the space of the historic centres means looking at the history rediscovering the cultural identity that generated the urban spaces of the city.

The field of application of ICT is polycentric and interests, in a transversal manner, the evolution of the future's city. Create collective attitudes related to improve the quality of life and to a smart configuration of future's city, has meant defining the new virtual spaces for the explanation and description of the smart urban historical-technological face. Identifying urban practices that lead to better results in the fields of mobility, environment and social cooperation, through the different methods of application of ICT allows us to understand how to achieve excellent levels of environmental and social sustainability, addressing the urban multidisciplinary and constituting a reference model that imprints a positive change in the ability of the innovation processes, so as to permanently take root in the new urban realities.

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